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**Кафедра иностранных языков**

# АНГЛИЙСКИЙ ЯЗЫК
## для химиков

Учебно-методическое пособие

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Цель учебно-методического пособия – помочь студентам овладеть навыками и умениями английской разговорной речи, реферирования и аннотирования научных статей по специальности. Пособие включает в себя грамматический раздел.

Рекомендации рассчитаны как на аудиторию, так и на самостоятельную работу студентов II-III курсов, изучающих химию. Могут использоваться наряду с действующими учебниками и учебными пособиями.

## СОДЕРЖАНИЕ





## Unit 1. CHEMISTRY: KEY TO PROGRESS AND ABUNDANCE

The science of chemistry includes a study of properties, composition, and structure of matter, the changes in structure and composition which matter undergoes, and the accompanying energy changes.

The Russian chemical industry now holds second place in the world in overall volume of production. Much credit for this is due to our scientists whose research has won worldwide recognition. The classical works by Mendeleyev, Butlerov, Zelinsky, Zaitzev, Lebedev, Favorsky and many others not only served as a theoretical basis for the development of the chemical industry, but enabled our scientists to set up a number of modern branches of the chemical industry as well.

The close links between science and industry enabled the chemical industry to make great progress.

The Soviet Union was the first country to organize large-scale production of synthetic rubber.

Zelinsky's works formed the basis for the synthesizing of a large number of new chemical compounds. These compounds are now counted in thousands, and they are extremely important in the country's economy. Our scientists evolved an original method of extracting phenol and acetone simultaneously from benzene and propylene. Phenol and acetone are needed for the manufacture of plastics, textile fibres, organic glass and other chemical products.

Scientists are making a major contribution to the production of aniline dyes, and many new dyes have been evolved with their help.

The research of our scientists has revealed the physical and physico-chemical conditions necessary for the industrial production and processing of polymeric materials.

The theory of chain reactions is a major discovery of our time. The development of this theory is linked with the name of the Soviet scientist Semyonov, a Nobel Prize winner.

The successes achieved by chemistry and engineering have played an important part in our country's achievements in space.

### VOCABULARY

**chemistry -** химия
**science -** наука
**to include -** включать
**property -** свойство
**composition -** состав
**codas structure -** структура, состояние
**matter -** материя
**to undergo –** подвергаться
**to set up -** основывать
**branch -** отрасль
**close links –** тесная
**large-scale production –** производство в больших масштабах
**synthesizing -** синтез
**compound –** соединение
**to evolve -** разрабатывать
**simultaneously -** одновременно

**accompanying** - сопутствующие
**energy changes** – преобразование энергии
**abundance** - изобилие
**overall volume of production** – общий объем продукции
**much credit for this is due to our scientists** – в этом большая заслуга наших ученых
**research** – исследование
**to win world-wide recognition** – получить всемирное признание
**to serve** – служить
**theoretical basis** – теоретическая основа
**development** – развитие
**manufacture** - производство
**textile fibres** - текстильные волокна
**contribution** – вклад
**aniline dyes** – анилиновые красители
**to reveal** - открывать, показывать
**condition** - условие
**processing** – обработка
**chain reaction** – цепная реакция
**discovery** - открытие
**to achieve** - достигать
**to play an important part** – играть важную роль
**enable** – давать возможность

## FIELDS OF CHEMISTRY

The field of chemistry is now a very large one. There are more than 30 different branches of chemistry. Some of the better known fields are inorganic chemistry, organic chemistry, physical chemistry, analytical chemistry, biological chemistry, pharmaceutical chemistry, nuclear chemistry, industrial chemistry, colloidal chemistry, and electrochemistry.

**Inorganic chemistry.** It eas originally considered that the field of inorganic chemistry consists of the study of materials not derived from living organisms|. However it now includes all substances other than the hydrocarbons and their derivatives.

**Organic chemistry.** At one time it was thought that all substances found in plants and animals could be made only by using part of a living plant or animal. The study of these substances, most of which contain carbon was therefore called organic chemistry. It is now known that this idea is quite wrong, for in 1828 F. Wohler made an "organic" substance using a simple laboratory process.

Organic chemistry now merely means the chemistry of carbon compounds.

**Physical chemistry** is concerned with those parts of chemistry which are closely linked with physics as, for in stance, the behaviour of substances when a current of electricity is passed through them.

**Electrochemistry** is concerned with the relation between electrical energy and chemical change. Electrolysis is the process whereby electrical energy causes a chemical change in the conducting medium, which usually is a solution or a molten substance. The process is generally used as a method of deposition metals from a solution.



**Magnetochemistry** is the study of behaviour of a chemical substance in the presence of a magnetic field. A paramagnetic substance, i.e. one having unpaired electrons is drawn into a magnetic field. Diamagnetic substances, i.e. those having no unpaired electrons, are repelled by a magnetic field.

**Biochemistry.** Just as the physical chemist works on the boundaries between physics and chemistry, so the biochemist works on the boundaries between biology and chemistry. Much of the work of the biochemist is concerned with foodstuffs and, medicines. The medicines known as antibiotics, of which penicillin is an early example, were prepared by biochemists.

### VOCABULARY

**field** – область, отрасль
**nuclear chemistry** – ядерная химия
**It was ... considered (thought)** – предполагали, считали
**to consist** - состоять из
**to derive** – происходить от
**to include** – включать, содержать в себе
**hydrocarbon** – углеводород
**substance** - вещество
**to contain** – содержать
**for instance** - например
**behaviour** - поведение
**current of electricity** – электрический ток
**relation** – соотношение, зависимость
**whereby** – посредством которого
**to cause** – вызывать
**conducting medium** – проводящая среда
**solution** - раствор
**molten** - расплавленный
**method of deposition metals** – метод осаждения металлов
**to draw (drew, drawn)** – тянуть
**to repel** - отталкиваться
**boundary** - граница

## EXERCISES

**I. Give English equivalents for these words.**

| | | | |
|---|---|---|---|
| отрасль | условие | состав | производство |
| развитие | выделение | свойство | одновременно |
| исследование | открытие | наука | достигать |

**II. Answer the questions.**

1) Which branch of chemistry deals with the study of materials not derived from living organisms?
2) Which branch of chemistry studies the behaviour of a chemical substance in the presence of a magnetic field?
3) What is the study of substances containing carbon called?
4) What other branches of chemistry do you know?
5) By whom were antibiotics prepared?

**III. Fill in the gaps with suitable words given below.**

1) Diamagnetic substances are ... by a magnetic field.
2) Much of the work of the biochemist is concerned with . . . and medicines.
3) ... is the process whereby electrical energy causes a chemical change in the conducting medium.
4) Electrolysis is generally used as a method of deposition of metals from ....
5) The theory of ... reactions is a major discovery of our time.
6) The close links between the science and industry ... the chemical industry to make great progress.
7) Zelinsky's works formed the basis for the synthesizing of a large number of new chemical ... .
8) Scientists are making a major contribution to ... of aniline dyes.
9) There are more than 30 different . . . of chemistry.
10) Diamagnetic substances have no ... electrons.

*Production, repelled, unpaired, solution, foodstuffs, compounds, enabled, branches, electrolysis, chain.*

**IV. Make up sentences out of these words.**

1) And, phenol, an original method, acetone, our scientists, simultaneously, benzene, and, evolved, from, extracting, propylene, of.
2) Substance, field, the study, in the presence, behaviour, chemical, magnetochemistry, of, of, is, a, of, a, magnetic.
3) World-wide, this, to, scientists, recognition, much, due, research, credit, our, is, whose, won, has.
4) Other, needed, manufacture, textile fibers, plastics, acetone, and, are, organic glass, for, the, products, of, and, chemical, phenol.
5) Physics, chemistry, parts, linked, which, concerned, are, closely, with, with, physical, chemistry, is, those, of.

**V. Translate into English.**

1) Наши ученые разработали новый метод обработки металлов.
2) Биохимики внесли большой вклад в производство антибиотиков.
3) Электрохимия связана с изучением отношений между электрической энергией и химическими изменениями.
4) Русские ученые основали большое количество современных отраслей химической промышленности.
5) Они не знают состава этого соединения.
6) Советский союз был первым государством, которое организовало крупномасштабное производство синтетического каучука.
7) Этот ученый определил физические и физико-химические условия необходимые для промышленного производства и обработки полимерных материалов.

**VI. Translate the text with the dictionary and reproduce it:**



Analytical chemistry deals with the methods of separation. Synthetic chemistry deals with the methods by which complex bodies can be built from simplier substances. Physical chemiststry deals with changes in state and with the motions of molecule. But at the present time the scientists don't maintain this definition.

The discovery of X-rays, an electron, and radioactivity marked a new era in all sciences in and in chemistry. It was a very important discovery in science. It plays an important part in the development of geology and physiology, in technology and in chemical engineering. Chemistry deals with medicine and agriculture as they are all concerned with the properties and change of chemical substances.

**VII. Read and entitle the text.**

The science of chemistry deals with substances. Chemistry is the investigation and discussion of the properties of substances.

Common examples of substances are: water, sugar, salt, copper, iron and many others.

Chemists study substances in order to learn as much as they can about their properties and about the reactions that change them into other substances. This knowledge is very important as it can make the world a better place to live in, it can make people happier, it can raise their standard of living.

Chemists discovered many laws, investigated many important phenomena in life. They produced many artificial substances which have valuable properties.

Chemistry has two main aspects: descriptive chemistry, the discovery of chemical facts, and theoretical chemistry, the formulation of theories.

The broad field of chemistry may also be divided in other ways. An important division of chemistry is that into the branches of organic chemistry and inorganic chemistry.

**Read the text without the dictionary and retell it in Russian:**

Chemistry is a very large subject. It is the investigation and discussion of the properties of substances. If we ask — why do we study chemistry, the answer can be — it is through chemistry we obtain the knowledge of matter, its changes and transformations.

Everyone understands that science of chemistry plays an important partr in the modern world.

Chemistry plays an important in the development of other sciences such as physics, biochemistry, geology and a lot of other fields of science

## Unit 2. SYMBOLS, FORMULAS AND EQUATIONS

Each of the 105 presently known chemical elements is given a symbol which usually is derived from the name of the element. The symbol of oxygen is O, of hydrogen is H, of helium He, of copper Cu, of sodium Na, of plutonium Pu. Groups of

symbols called formulas are used to designate compounds. The formula for water is $H_2O$, for carbon dioxide $CO_2$, for sulphuric acid $H_2SO4$.These symbols and formulas are used to indicate chemical fractions. For example:

$2H_2O \rightarrow 2H_2 + O_2$ (statement: water decomposes to form hydrogen and oxygen)

## VOCABULARY

1. **symbol -** символ
**equation –** уравнение
**presently -** в настоящее время
**to derive –** происходить
**copper (Cu) -** медь
**sodium (Na) –** натрий
**to designate –** обозначать
**carbon dioxide $C0_2$ –** двуокись углерода
**sulphuric acid $H_2S0_4$ –** серная кислота
**to indicate –** указывать, означать
**statement –** формулировка
**to decompose –** разлагаться (на составные части)

## INORGANIC MOLECULES AND COMPOUNDS

Simple diatomic molecules of a single element are designated by the symbol for the element with a subscript 2, indicating that it contains 2 atoms. Thus the hydrogen molecule is $H_2$; the nitrogen molecule, $N_2$; and the oxygen molecule, $O_2$. Polyatomic molecules of a single element are designated by the symbol for the element with a numerical subscript corresponding to the number of atoms in the molecule. Examples are the phosphorus molecule, $P_4$, and the sulphur molecule, $S_8$.

Diatomic covalent molecules, containing unlike elements are given similar designation. The formula for hydrogen chloride is HCl. The more electropositive element is always designated first in the formula.

For polyatomic covalent molecules containing unlike elements, numerical subscriptions are used to designate number of atoms of each element present in the molecule, for example, water, $H_2O$. Again, as in diatomic molecules, more electropositive element is placed first in the formula.

## VOCABULARY

**molecule -** молекула
**diatomic -** двухатомный
**single –** единичный
**subscript –** подстрочный индекс
**polyatomic -** многоатомный
**numerical –** числовой
**corresponding -** соответствующий
**sulphur –** сера
**covalent -** ковалентный
**unlike –** различный
**similar –** подобный
**hydrogen chloride -** хлористый водопровод
**electropositive -** электроположительный



## PERIODIC LAW

One of the cornerstones of modern chemical theory is the Periodic Law. It can be simply stated as follows: The properties of the elements are a periodic function of the nuclear charges of their atoms.

In 1869 Mendeleyev arrived at the conclusion that by the arrangement of the elements in order of increasing atomic weight the similarity and periodicity of properties of various, valence groups of the elements were clearly delineated.

There were several vacant spaces in Mendeleyev's table which led him to predict the existence of six undiscovered elements, (scandium, gallium, germanium, polonium etc). His confidence in the new classification was clearly expressed in the predictions which he made of the chemical properties of these missing elements. And within fifteen years gallium, scandium and germanium were discovered.

Although this table has been modified hundreds of times, it has withstood the onslaught of all new facts. Isotopes, rare gases, atomic numbers, and electron configurations have only strengthened the idea of the periodicity of the properties of the elements.

## VOCABULARY

**Periodic Law –** периодический закон
**cornerstone –** краеугольный камень
**to state –** формулировать
**as follows –** следующим образом
**nuclear charge –** ядерный заряд
**to arrive at a conclusion –** прийти к заключению
**arrangement –** расположение
**in order of increasing atomic weight –** в порядке возрастания атомного веса
**similarity ['simiylaeriti] exofl-**
**valence group –** валентная группа
**to delineate -** очерчивать
**vacant space –** свободное место
**to predict -** предсказывать
**existence -** существование
**confidence -** уверенность
**to express –** выражать
**prediction -** предсказание
**missing -** отсутствующий
**within –** в течение
**to modify -** видоизменять
**to withstand –** выдерживать
**onslaught –** появление
**isotope –** изотоп
**rare gases –** редкие газы
**electron configuration –** электронная конфигурация
**to strengthen -** укреплять

## EXERCISES

**I. Answer the questions.**

1) How many chemical elements are there now?
2) What is the symbol of Manganese?
3) What is a symbol usually derived from?
4) What does a subscript show?
5) What element is always designated first in the formula?
6) When did Mendeleyev discover the periodic law?
7) How can the Periodic Law be simply stated?
8) What elements were discovered after Mendeleyev modified the table?

9) Give some examples of polyatomic molecules of single elements.
10) What are simple diatomic molecules of a single element designated by?

**II. True or false?**

1) Symbols and formulas are used to indicate chemical reactions.
2) Groups of symbols are called equations.
3) Groups of symbols are called formulas.
4) There are 102 chemical elements now.
5) The more electropositive element is always designated last in the formula.
6) Subscriptions are used to designate the number of atoms of each element present in the molecule.
7) Mendeleyev made his discovery in 1879.
8) There were several vacant spaces in Mendeleyev's table which led him to predict the existence of six undiscovered elements.
9) The table wasn't modified.
10) Properties of the elements are periodic functions of the nuclear charges of their atoms.

**III. Identify the words, each dash stands for one letter only.**

1) d _ _ _ _
2) _ y _ _ _ _
3) _ _ sig _ _ _ _
4) _ _ com _ _ _ _
5) _ _ lya _ _ _ _ _
6) _ _ _ _ _ ar
7) _ t _ t _
8) v _ _ _ _ t
9) ex _ _ _ _ _
10) arr _ _ _ _ _ _ _ _
11) _ _ _ _ _ _ tion
12) m _ss _ _ g
13) var _ _ _ _
14) _ _ _ _ fy
15) f _ _ _ tion

**III. Translate the words from exercise III and make up your own sentences with them.**

**IV. Find special words and terms in the cross-word puzzle.**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **H** | **Y** | **D** | **R** | **0** | **G** | **E** | **N** | **P** | **0** |
| **R** | **E** | **A** | **C** | **P** | **E** | **L** | **E** | **N** | **L** |
| **E** | **M** | **C** | **T** | **E** | **C** | **T** | **G** | **E** | **Y** |
| **L** | **E** | **O** | **I** | **R** | **O** | **R** | **Y** | **M** | **A** |
| **E** | **H** | **P** | **O** | **I** | **H** | **E** | **X** | **U** | **T** |
| **C** | **T** | **P** | **N** | **0** | **Y** | **D** | **O** | **I** | **0** |
| **H** | **Y** | **E** | **R** | **D** | **T** | **I** | **E** | **L** | **M** |
| **E** | **T** | **I** | **C** | **I** | **R** | **X** | **N** | **C** | **I** |
| **M** | **P** | **R** | **O** | **P** | **E** | **O** | **I** | **D** | **E** |
| **I** | **C** | **A** | **L** | **V** | **A** | **L** | **E** | **N** | **C** |



**V. Read and translate the text**

Man at last understood the elements well enough to make his own.
First there were some elements still missing from the Periodic Table. The fact was they were practically missing from nature, too.

Scientists had to make these elements themselves. To make such elements meant first of all to carry on great experimental work. Many scientists worked hard at this problem. In 1919 Ernest Rutherford was the first to change nitrogen to oxygen by bombarding nitrogen atoms with alpha-particles.

To alter an element artificially is to add or subtract particles in its nucleus. The first completely new man-made isotope was created by Rutherford's method, its creators being Irene Curie and her husband Frederic Joliot. To do that they had to bombard aluminium with alpha-particles. This attack transformed some of the aluminium atoms into a highly radioactive substance. This substance was a new kind of phosphorus, its atomic weight being 30, instead of natural phosphorus 31.

It was no wonder that phosphorus 30 did not occur in nature, its half-life being only two and a half minutes. Thus the Joliot-Curies were the first to produce "artificial radioactivity".

The era of artificial transmutation began with the building of the first "atom-smasher", i.e. the cyclotron. By means of cyclotron and energetic particle-accelerators developed later it became possible to open up the nucleus of any atom. It became possible to add particles to it, and even to create new ones.

The first element produced in this way was the missing number 43, it being named "technetium" meaning "artificial". The aim of the scientists was to discover other elements.

In 1939 a new element was found. It behaved like an alkalimetal, therefore it was to be 87 the missing number of the alkali-metal family. It was called "francium". It was detected in nature. Later that element was produced artificially by an accelerator, and only then did chemists obtain enough of it. For that reason francium is to be considered as a manmade element.

Later scientists discovered traces of an element in neutron-bombarded uranium. They called it "neptunium". Radioactive neptunium gave rise to another element — number 94.
In 1955 chemists could produce a few atoms of element 101, which was named "mendelevium" in honour of D. I. Mendeleyev. The isolation of element number 102 occurred in 1963, it being named "nobelium", as part of the work was done at the Nobel Institute in Stockholm.

***a)Entitle the text***
***b)Divide the text into logical parts.***
***c)Make the plan of the text***
***d)Formulate the main idea of each part.***
***f)Give the summary of the text***

## Unit 3. Rules of reading formulas and equations.

**Список наиболлее важных химических элементов ( к таблице Менделеева)**

| | | | |
|---|---|---|---|
| **1. Al** | **aluminium** | | алюминий |
| **2. Ag** | **argentums** | | серебро |
| **3. Ar** | **argon** | | аргон |
| **4. As** | **arsenic** | | мышьяк |
| **5. Au** | **aurum = gold** | | золото |
| **6. B** | **boron** | | бор |
| **7. Ba** | **barium** | | барий |
| **8. Be** | **berillium** | | бериллий |
| **9. Bi** | **bismuth** | | висмут |
| **10.Br** | **bromine** | | бром |
| **11.C** | **carbon** | | углерод |
| **12.Ca** | **calcium** | | кальций |
| **13.Ce** | **cerium** | | церий |
| **14.Cd** | **cadmium** | | кадмий |
| **15.Cl** | **chlorine** | | хлор |
| **16.Co** | **cobalt** | | кобальт |
| **17.Cr** | **chromium** | | хром |
| **18.Cs** | **caesium** | | цезий |
| **19.Cu** | **copper** | | медь |
| **20.F** | **fluorine** | | фтор |
| **21.Fe** | **ferrum = iron** | | железо |
| **22.Ge** | **germanium** | | германий |
| **23.H** | **hydrogen** | | водород |
| **24.He** | **helium** | | гелий |
| **25.Hg** | **hydrargyrum = mercury** | | ртуть |
| **26.J** | **iodine** | | йод |
| **27.Ir** | **iridium** | | иридий |
| **28.K** | **kalium = po-** | | калий |
| **29.Li** | **tassium lithium** | | литий |
| **30.Mg** | **magnesium** | | магний |
| **31.Mn** | **mangnese** | | марганец |
| **32.Mo** | **molybdenum** | | молибден |
| **33.N** | **nitrogen** | | азот |
| **34.Na** | **natrium = sodium** | | натрий |
| **35.Ne** | **neon** | | неон |
| **36.Ni** | **nickel** | | никель |
| **37.O** | **oxygen** | | кислород |
| **38.P** | **phosphorus** | | фосфор |
| **39.Pb** | **plumbum= lead** | | свинец |
| **40.Pt** | **platinum** | | платина |



| | | | |
|---|---|---|---|
| **41.Ra** | **radium** | | радий |
| **42.Rb** | **rubidium** | | рубидий |
| **43.S** | **sulphur** | | сера |
| **44.Sb** | **antimony** | | сурьма |
| **45.Se** | **selenium** | | селен |
| **46.Si** | **silicon** | | кремний |
| **47.Sn** | **stannum = tin** | | олово |
| **48.Sr** | **strontium** | | стронций |
| **49.Te** | **tellurium** | | теллур |
| **50.Th** | **thorium** | | торий |
| **51.Ti** | **titanium** | | титан |
| **52.U** | **uranium** | | уран |
| **53.W** | **wolfram = tung-** | | вольфрам |
| **54.Zn** | **sten zinc** | | цинк |
| **55.Zr** | **zirconium** | | цирконий |

### Правила чтения химических формул

Буквы латинского алфавита, обозначающие название элементов, читаются согласно английским названиям букв алфавита.

- Знак + читается plus, and, together, with, react with.
- Знак — обозначает одну связь или единицу родства и не читается.
- Знак = читается give, form или produce.
- Знак → читается give, pass over to lead to.
- Знак ↔ читается forms and is formed from.

Цифра перед названием элемента обозначает число молекул.

### Примеры:

• **$C + O_2 \rightarrow CO_2$**

1 atom of carbon reacts with 1 two-atom molecule of oxygen and produces 1 molecule of carbon dioxide.

• **$2H_2 + O_2 \rightarrow 2H_2O$**

a) Two molecules of H two plus O two give two molecules of H two O.

b) Two two-atom molecules of hydrogen react with 1 two-atom molecule of oxygen and produce two molecules of water.

• **$N_2 + 3H_2 \leftrightarrow 2NH_3$**

a) N two plus three molecules of H two form and are formed from two molecules of NH three

b) 1 two-atom molecule of nitrogen plus three two-atom molecules of hydrogen form and are formed from two molecules of ammonia.

• **$Na_2CO_3 + CaSO_4 \rightarrow Na_2SO_4 + CaCO_3$**

a) Na two CO three plus CaSO four form Na two SO four plus CaCO three

b) The sodium (Na) and the calcium (Ca) switch

c) The sodium combines with the sulphate radical ($SO_4$), forming sodium sulphate ($Na_2SO_4$) which dissolves in water.

d) The calcium combines with the carbonate radical ($CO_3$), forming calcium carbonate ($CaCO_3$).

e) Calcium carbonate does not dissolve in water, and so settles to the bottom of the solution.

Знаки + или - стоящие в левом верхнем углу, обозначают положительную и отрицательную валентность иона.

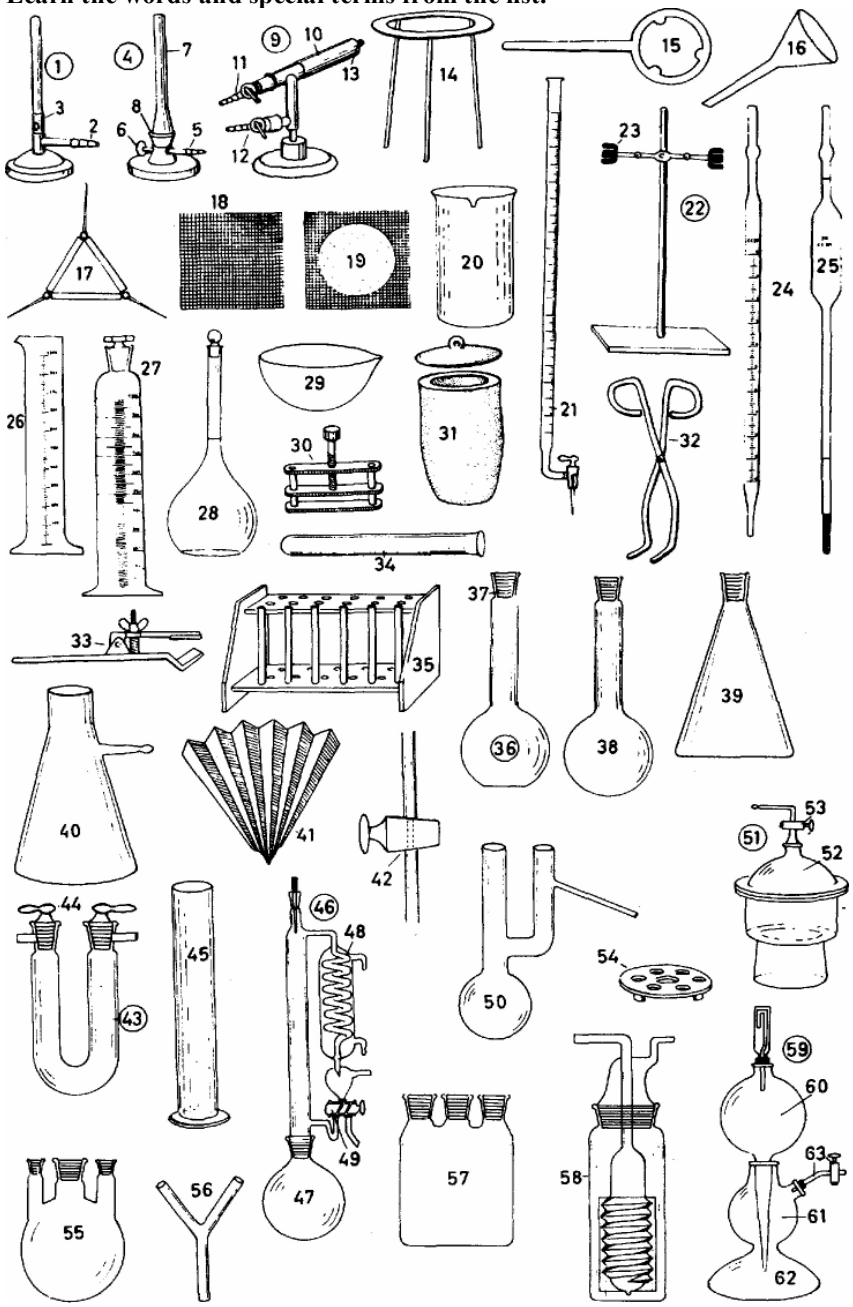
**Пример:** H+ — a) hydrogen ion
b) univalent positive hydrogen ion
Cu ++ — divalent positive cuprum ion
Al +++ — trivalent positive cuprum ion
Cl - — a) negative chlorine ion
b) negative univalent chlorine ion

**Task: - write any 20 formulas and read them**
**- write any 5 equations and read them**

## Unit 4. Laboratory equipment.

1) **1-63 laboratory apparatus (laboratory equipment)** лабораторное оборудование
2) **Bunsen burner** горелка Бунзена
3) **gas inlet (gas inlet pipe)** подвод газа (газовая подводящая труба)
4) **air regulator** регулятор подвода воздуха
5) **Teclu burner** горелка Теклю
6) **pipe union** присоединение газовой трубы
7) **gas regulator** регулятор поступления газа
8) **stem** трубка горелки
9) **air regulator** регулятор поступления воздуха
10) **bench torch** настольная горелка
11) **oxygen inlet** подвод кислорода
12) **hydrogen inlet** подвод водорода
13) **oxygen jet** струя кислорода
14) **tripod** треножник, тренога
15) **ring (retort ring)** кольцо для реторты
16) **funnel** воронка
17) **pipe clay triangle** трубчатый глиняный треугольник
18) **wire gauze** проволочная сетка
19) **wire gauze with asbestos centre (Am. center)** проволочная сетка с асбестовым центром
20) **beaker** стакан
21) **burette (for delivering measured quanti ties of liquid)** бюретка (для выпуска измеренных объемов жидкости)
22) **burette stand** штатив для бюреток
23) **burette clamp** зажим для бюреток
24) **graduated pipette** градуированная пипетка
25) **pipette** пипетка
26) **measuring cylinder (measuring glass)** мерный цилиндр (измерительный стакан)
27) **measuring flask** мерная колба
28) **volumetric flask** мерная колба
29) **evaporating dish (evaporating basin), made of porcelain** выпарная чашка, выполненная из форфора
30) **tube clamp (tube clip, pinchcock)** зажим для трубок
31) **clay crucible with lid** глиняный тигель с крышкой
32) **crucible tongs** тигельные щипцы
33) **clamp** струбцина
34) **test tube** пробирка
35) **test tube rack** штатив для пробирок
36) **flat-bottomed flask** плоскодонная колба
37) **ground glass neck** горлышко с притертой стеклянной пробкой
38) **long-necked round-bottomed flask** длинногорлая круглодонная колба
39) **Erlenmeyer flask (conical flask)** колба Эрленмайера (коническая колба)
40) **filter flask** колба для фильтрования под вакуумом
41) **fluted filter** гофрированный фильтр
42) **one-way tap** одноходовый кран
**43) calcium chloride tube** трубка с хлоридом кальция
44) **stopper with tap** пробка с краном
45) **cylinder** цилиндр
46) **distillation apparatus (distilling apparatus)** перегонный аппарат
47) **distillation flask (distilling flask)** перегонная колба
48) **condenser** конденсатор
49) **return tap, a two-way tap** возвратный кран, двухходовой кран
50) **distillation flask (distilling flask, Claisen flask)** перегонная колба (вакуум-перегонная колба, колба Кляйзена)
51) **desiccator** эксикатор (сушилка)
52) **lid with fitted tube** крышка с вставленной трубкой
53) **tap** кран
54) **desiccator insert made of porcelain** фарфоровый вкладыш в эксикаторе
55) **three-necked flask** трехгорлая колба
56) **connecting piece (Y-tube)** соединительная (Y-образная) трубка
57) **three-necked bottle** трехгорлая склянка
58) **gas-washing bottle** склянка
59) **gas generator (Kipp's apparatus, Am. Kipp generator)** генератор газа 9аппарат Кипа, генератор Кипа)
60) **overflow container** переточный сосуд
61) **container for the solid** сосуд для засыпки реагента
62) **acid container** сосуд для кислоты
63) **gas outlet** трубка для выпуска газа

**II. Learn the words and special terms from the list.**






**I. Match the word with its definition.**

1) funnel
2) beaker
3) microscope
4) slides
5) electric balance
6) tongs
7) mortar
8) pestle
9) tripod
10) rubber tubing
ll) gas tap
12) matches
13) measuring cylinder
14) test tube
15) test tube rack
16) pipette
17) conical flask
18 ) bung/stopper
19) 1ab coat
20) chemical
21) chemical reaction
22) chemist
23) chemistry

a) a tool that consists of two movable bars joined at one end, used to pick up an object
b) a scientific instrument that makes extremely small things look larger
c) a short stick with a heavy round end
d) the science that is concerned with studying the structure of substances and the way they change
e) a round piece of rubber or wood used to close the top of a container
f) a round pipe made of rubber for liquids to go through
g) a substance used in chemistry or produced by chemistry
h) a tube used for pouring liquids or powders into a container with a narrow opening
i) an electric instrument for weighing things
j) a natural process in which the atoms of chemicals mix and arrange themselves differently to form new substances
k) a glass container used for measuring liquid
l) a thing glass tube for sucking up exact amounts of liquid, used especially in chemistry
m) a small glass container that is shaped like a tube and is used in chemistry
n) a piece of clothing that is worn over your clothes in laboratory to protect them
o) a scientist who has a special knowledge in chemistry
p) a glass cup with straight sides that is used in hemistry for measuring and heating liquids
q) small pieces of thing glass used for holding something when you look at it under a microscope
r) a hard bowl in which substances are crushed into powder or very small pieces with a pestle
s) a special type of bottle mat you use to keep liquids
t) a special shelf for tubes
u) a support with three legs, used for a camera, telescope etc.
v) small wooden sticks, used, to light a tire
w) a piece of equipment for controlling the flow of gas from a pipe or container

**V. Describe the functions of each piece of equipment.**
**VI. Read and translate the text**

## LABORATORY

A) All the laboratories of inorganic chemistry are almost alike. These are large rooms where both students and research-workers carry out their experimental work. Modern laboratories of inorganic as well as organic and analytical chemistry are provided with gas and running water. Every laboratory is to be provided with a ventilating hood for the escape of both harmful and unpleasant vapours and odours. Every laboratory has to be lit up very well.

There are many laboratory benches with a great number of drawers in every laboratory. Different apparatus devices as well as materials are to be kept in them. Besides we can see many shelves and cases for containers with chemicals.

On every laboratory bench one can see test-tubes, flasks, beakers, funnels, evaporating
dishes, weighing bottles. All this glassware should be kept in good order.

Various burners serve for producing flames. Bunsen burner is to be mentioned among them. Different crucibles are to be employed when heating of solution and igniting of materials are to be carried out. Crucibles are usually made of quartz, porcelain and iron. In addition to these crucibles, there are platinum crucibles in some laboratories, but they are used very seldom.

B) Every laboratory should be equipped with different kinds of apparatus. Everything in the laboratory is to have its definite place.

Experiments in the Laboratory Many experiments can be carried out in the laboratory of inorganic chemistry. Thus, if we want to obtain hydrogen chloride (HCL) which is often referred to as a hydrochloric acid gas, it is necessary to pour some sulphuric acid through a tube over the crystal of sodium chloride, in a flask. The fiask is to be heated. On warming the fiask, the hydrogen chloride is expelled as a colourless gas with a suffocating odour. It produces heavy clouds of white fumes when it comes in contact with the moist air of the room.

It is soluble and it cannot be collected over water as are oxygen and hydrogen. It is much heavier than the air and may be passed through a glass tube to the bottle. If we dissolve some of the gas in water, the solution has a sour taste, reddens blue litmus, reacts with zinc, etc.: it is hydrochloric acid. When all the sodium chloride originally present in the flask has been transformed, the reaction is complete. The flask then contains a salt called sodium acid sulphate (NaHSO4) together, with unchanged excess of sulphuric acid.

Nitric acid may be prepared by the reaction of concentrated sulphuric acid with sodium nitrate. In the laboratory method, a mixture of sodium nitrate and concentrated sulphuric acid is heated in a glass retort. Nitric acid is boiled out of the mixture and is condensed: NaNO3 + H2SO4 = HNO3+ NaHSO4



**Answer the following questions:**

1. What do we call a laboratory'?
2. In what laboratories can the students carry out their experiments?
3. What is every laboratory provided with?
4. Why is every laboratory provided with a ventilating hood?
5. What can you see on the shelves'?
6. What glassware is there on every laboratory' bench?
7. What are burners used for'?
8. What are crucibles used for'?
9. What are crucibles made of?
10. What is it necessary to do if we want to obtain hydrogen chloride'? (describe the experiment)
11. How can nitric acid be prepared in the laboratory?

## Unit 5. Description of chemical elements.

## CHLORINE

Chlorine is an element with atomic number 17, atomic weight 35.5 (thirty-five point five). It is a gas at ordinary temperatures and is never found free in nature. It is found in nature combined with other elements. At normal temperatures, chlorine is a diatomic gas ($C1_2$), greenish-yellow in colour and about 2 1/2 (two and a half) times as heavy as air. It liquefies at atmospheric pressure at —34. 1° C (minus thirty-four point one degrees Centigrade) to a yellowish liquid approximately 11/2 (one and a half) times as heavy as water. The liquid freezes at —100.98° C (minus one hundred point nine eight degrees Centigrade). Chlorine is soluble in water and indirectly exerts bleaching and bactericidal action by reacting with water to form hypochlorous acid.

$$Cl_2 + H_2O \leftrightarrow HCl + HClO \rightarrow HCl + (O)$$

| Chlorine | Water | Hydrochloric acid | Hypochloric acid |
|---|---|---|---|

The hypochlorous acid is unstable, giving up oxygen to form more HC1. The oxygen attacks and destroys bacteria; it also oxidizes coloured organic substances, forming colourless or less-coloured components.

As one of the most active elements, chlorine ranks in reactivity about with oxygen. It combines directly and readily with hydrogen and most non-metals except nitrogen, carbon and oxygen; it also unites with all the familiar metals except gold and platinum.

Participating in a number of important organic reactions, in some cases chlorine appears in the final product, as in insecticides (DDT) or in the plastic, polyvinil chloride.

Chlorine is generally produced by electrolysis of water solutions of sodium chloride in electrolytic cells. When sodium chloride or potassium chloride solutions are subjected to electrolysis, there are three products; caustic soda or caustic potash, chlorine and hydrogen. If fused sodium chloride is used, there are two products: chlorine, and metallic sodium.

## VOCABULARY

1. **is never found free in nature** не встречается в свободном состоянии в природе
2. **2 1/2 times as heavy as air** в 2 ½ раза тяжелее воздуха
3. **to liquefy** переходить в жидкое состояние
4. **approximately** приблизительно
5. **to freeze (froze, frozen)** замерзать, затвердевать
6. **soluble** растворимый
7. **to exert** оказывать
8. **bleaching and bactericidal action** отбеливающее и бактерицидное действие
9. **hypochlorous acid** хлорноватистая кислота
10. **unstable** неустойчивый
11. **to destroy** разрушать
12. **to oxidize** окислять, оксидировать
13. **component** составная часть
14. **ranks in reactivity about with oxygen** по своей реактивности почти не уступает кислороду
15. **to combine** соединяться
16. **familiar** известный
17. **to participate** учавствовать
18. **to appear** появляться
19. **insecticide** средство для истребления насекомых
20. **sodium chloride** поваренная соль, хлористый натрий
21. **electrolytic cell** электролитическая ванна
22. **potassium chloride** хлористый калий
23. **to subject** подвергать
24. **caustic soda** едкий натр
25. **caustic potash** едкое кали
26. **fused=molten** расплавленный

## EXERCISES

**I. Answer the questions.**

1) In what state is chlorine found in nature?
2) At what temperature does chlorine liquefy?
3) Is chlorine easily soluble in water?
4) What action does chlorine exert in water?
5) What is the reactivity of chlorine?
6) What products are obtained when sodium chloride or potassium chloride solutions are subjected to electrolysis?
7) By what method is chlorine generally produced?
8) What products are produced if fused sodium chloride is used ?

**II. Make up a description of any element you like.**



# Unit 6. ANALYTICAL CHEMISTRY

## METHODS OF ANALYSIS

The analysis of a complex material usually involves four steps, sampling, dissolving the sample, separating mutually interfering substances, and determining the constituents of interest. The first step, sampling can be a significant problem, particularly in industrial applications.

Sampling is complete when the subdivision is small enough to permit analysis.

The second step is the dissolving of a sample. If we know the nature of the sample we use a suitable reagent.

I/Gravimetric methods involve a weighing operation as the final measurement.

Gravimetric analysis have been developed for almost everything from A(luminium) to Z(irconium).

Gravimetric procedures may be done in various ways: by precipitating, by dissolving, by removing as a volatile compound.

Volumetric methods involve measurement of that volume of a solution of known concentration which reacts with a known amount of the sample. Such a solution is called a standard solution.

Volumetric techniques are now applicable to most of the elements and to many specific inorganic and organic compounds. They are widely used in all phases of chemistry, in medicine, and in many allied sciences.

Physico-chemical methods depend upon the measurement of physical properties other than mass and volume. Such methods are important when the simpler methods of analysis are inadequate.

## METHODS OF SEPARATION

Methods of separating a solid and a liquid are built around two processes, filtration and centrifugation.

Filtration is the process of passing the suspension of solid and liquified through a porous barrier which will trap the solid. The barrier may be filter paper, sintered glass, asbestos matting, glass wool and others.

Centrifugation is mechanized setting (or floating) and depends upon the difference between the densities of the solid and the solution. Gravitational setting is usually inadequate. A centrifuge can be used to enhance the gravitational force moving the particles. Most centrifuges operate at hundreds of revolutions per minute. Extremely difficult separations require speeds of tens of thousands of revolutions per minute.

## NOTES AND COMMENTARY

**are built around two processes** – базируются на двух процессах

**mechanized setting** - механическое осаждение

**the process of passing … through** – прцесс пропускания … через

**depends upon** – зависит

**revolutions per minute** – обороты в минуту

## ION EXCHANGE METHODS IN ANALYTICAL CHEMISTRY

Ion exchange is now one of the recognized processes of chemical engineering. It has been applied to the separation processes of quantitative analysis.

General Principles. By **ion exchange we** mean the exchange of ions of like sign between a solution and a solid insoluble body in contact with it. For such an exchange to be possible, the solid must contain ions of its own. The solid (called the **ion exchanger)** must have an open, permeable molecular structure, so that ions and solvent molecules can move freely in and out. Many substances, both natural and artificial, have ion exchanging properties.

In analytical work we are primarily interested in the synthetic organic exchangers. These have a high capacity for holding ions and they are not broken down by acids or alkalies, they have a relatively simple composition.

### NOTES AND COMMENTARY

1. **by "ion exchange" we mean -** под ионным обменом мы подразумеваем
2. **of like sign -** одноименные по знаку
3. **for such exchange to be possible** – чтобы осуществить этот обмен
4. **of it own -** свои собственные
5. **can move freely in and out -** могут свободно входить и выходить

## CHROMATOGRAPHY AND ION EXCHANGE TECHNIQUE

Chromatography is a method of chemical analysis based upon the selective absorption and partial fractionation of various substances by certain suitable materials. The method is simple and requires a minimum of special equipment. The technique consists of pouring a solution through a column containing a suitable adsorbing material. A selective developing agent is then passed through the column and the different substances in the solution are spread down the column into layers visibly separated from one another, provided the substances are colored. In the case of colorless substances, the layers of the different substances may be located by the use of ultra-violet light or by chemical tests.

This method was first described by the Russian botanist Tswett, in 1906. Tswett was engaged in the extraction and purifictaion of plant pigments.

Methods of chromatography have been applied to the separation of the rare earths and a number of procedures, based on chromatography techniques, have been developed for the separation of the inorganic cations and anions.



### NOTES AND COMMENTARY

1. **are spread down … into layers -** оседают пластами
2. **provided -** при условии, что
3. **was engaged in -** занимался

## CHROMATOGRAPHY TECHNIQUES

The techniques of carrying out a chromatographic investigation are very simple. The basic apparatus is the adsorption column. The adsorption column may be constructed of soft glass or in special cases of quartz. The diameter and length of the column are determined by the quantity of material to be absorbed.

No universal adsorbent has been found. A good adsorbent should satisfy the following criteria: it should hold relatively large quantities of the materials to be resolved; the resolved materials must be eluted from the adsorbent by polar solvents; the size of the particles of adsorbent should be such as will allow rapid and uniform percolation; the adsorbents must not react with either the materials to be resolved nor the materials to be used as solvent or color developer; the adsorbent should not be porous and should, if possible, be colorless.

The chromatograph is made as follows: a solution of the material to be adsorbed is poured into the adsorption column and allowed to percolate through the adsorbent. The column is washed with additional portions of the original solvent from which *the* compound was adsorbed. The sides of the column are washed with small portions of the solvent and then larger quantities are added to the column. The passage of the solvent through the column causes the adsorbed materials to move at different rates and thus produce the chromatogram.

### NOTES AND COMMENTARY

**should be such as will allow -** должен бы быть таким, чтобы позволить

**rapid and uniform percolation -** быстрое и равномерное просачивание

## PAPER CHROMATOGRAPHY, APPLICATIONS AND PROCEDURE

In paper chromatography-the absorption column is replaced by strips of paper. The absorbent or ion exchanger is precipitated into the pores of the paper. One end of the prepared paper is dipped into distilled water and allowed to stand until the water has climbed about a centimeter along the paper. It is then removed and dipped into a solution of the materials to be separated. After the unknown solution has climbed about 2 cm, the paper is removed from the unknown solution and returned to the distilled water. After the water has climbed to about 12 to 16 cm, the strip is removed and dried between filter paper. Brushing the dried paper strip with the proper developing agent will produce bands similar to those produced in the adsorption column.

Numerous studies have been made of the paper-strip method for separating cations, anions and metal complexes. The procedure is similar to that of column chromatography.

The paper-strip method has the advantage that the developing reagent does not pass through the adsorbent as it is required in column chromatography. The strip method requires a minimum of test solution, about 0.1 mm, several developers may be applied to the same strip.

The paper-strip method has been applied to quantitative determination of the inorganic cations and to many organic materials.

## GAS ANALYSIS

Special techniques are usually employed in the analysis of the gases. Since the analysis of a gas, or gas mixture usually involves the measurement of a volume and only very rarely the weighing of a sample, the results are most frequently reported in per cent by volume rather than per cent by weight.

It must be remembered that the volume of a gas is greatly dependent upon both the temperature and the pressure and it is necessary to adjust each measurement to standard conditions of temperature and pressure. It is obvious then that these conditions must remain constant over the course of the analysis.

**Notes to the text**

1. **the results are ... reported in per cent by volume rather than per cent by weight** - результаты даются в процентах относительно объема, а не относительно веса
2. **over the course of the analysis** - в течение всего процесса анализа

## SOME PHYSICAL METHODS USED IN GAS ANALYSIS

The relative proportions of various components of gas mixtures can be determined by merely measuring some physical constants of the mixture: the density, the viscosity, the thermal conductivity, heat of combustion, ionization potential.

Condensation methods are often applicable in the separation of complex mixtures of gases. This method has been applied to the gases of the argon group and of natural gas mixtures.

The application of the methods of mass spectrometry to gas analysis has been extensive. The use of a mass spectrometer in analysis enables one to determine the components of mixtures of hydrocarbons, fuel gases, rare gases, etc.

Thermal conductivity applied to gas analysis is rapid, simple to carry out and adaptable to continuous operation .and process control.

Some attempts to apply the methods of emission and absorption spectroscopy to gas analysis have been made.



Other miscellaneous methods include magnetic susceptibility, micro-wave analysis, acoustical method based on the principle that the velocity of sound in a gas is a function of the molecular weight of the gas, inferometric methods, diffusion methods and others.

**Notes to the text**

1. **enables one** - обеспечивает
2. **simple to carry out** - прост в производстве
3. **based on** - основан на

## ANALYSIS OF MIXTURES

Many problems of quantitative chemistry are more complex than determining the amount of a pure substance or the composition of an aqueous solution of a pure compound. Often the problem arises simply because the compound or solution has an unknown or complex composition.

There are three fundamental schemes than can be used in the problem at hand.

1. Phase separation: The metal ion, A, can be determinedwithout interference front B if we separate A from B. We do this by preparing a two-phase system such that all of A is in one phase and all of B is in the other phase.
2. Selective determination: The metal ion, A, can be determined in the presence of B if we can find a determination which is selective toward A, ignoring B.
3. Combined determination: The two metal ions, A and B, can be determined together. This type of measurement combined with another independent measurement gives the amount of each ion.

**Notes to the text**

1. **the problem at hand** - рассматриваемая проблема
2. **are more complex than** - более сложны чем

## EXTRACTION

Liquid-liquid phase separations are possible when a metal forms a compound soluble in two immiscible liquids. The distribution of the compound between the two liquids can be considered to be a solubility contest. Practical considerations dictate that one of the liquids must be water. Among the liquids other contestants are: carbon tetrachloride, chloroform, carbon disulfide, ethers, paraffin hydrocarbons, and aromatic hydrocarbons. Alcohols cannot be added to this list.

Most inorganic compounds just are not interested in the organic solvents which are immiscible with water. Sometimes, however, a complexing agent can be found which will coach an inorganic substance into an organic solution. Cupric, lead, zinc, silver, mercuric, and cadmium salts, for example, will dissolve, in either chloroform or carbon tetrachloride if it contains some dithizone.

## PRECIPITATION

The most generally useful technique for accomplishing a phase separation is the solid-liquid separation, obtained in a precipitation.

To have wide applicability a precipitant should form compounds with many metal ions, and these compounds should have a wide range of solubility. To obtain proper conditions, the concentration of the precipitant should be controlled easilly.

What sort of precipitant is most desirable depends upon many variables: how many samples must be determined, what constituents are present, what reagents are at hand, what time is available, what accuracy is desired, etc.

## ELECTROLYSIS

Another type of solid-liquid phase separation is furnished by electrolytic techniques. Two electrodes are placed in the solution of interest, and a current is passed through the solution at a voltage sufficient to reduce some but not all of the metals present. If the current and concentrations are adjusted properly, the metals which are reduced will plate out on the electrode in a pure metallic deposit which can be dried and weighed directly.

**Notes to the text**

**the solution of interest** - исследуемый раствор
**will plate out** - отлагается
**to reduce some but not all** - для частичного удаления

## ION EXCHANGE

Another procedure utilizing the elution technique is the ion exchange separation. This time the solid (which is called the substrate) is a salt or compound with salt-forming capacity, something like a sulfonic acid group. When a solution containing metal ions is passed through such an acid substrate, the ions can replace the protons, forming salts. Further elution repeats many times the cycle of ion exchange, replacement of a proton by a salt ion, followed by replacement of the metal ion by proton. As in chromatography, the repetitious procedure magnifies small differences in saltforming capacity and permits separations which are extremely difficult by any other method.

Ion exchange substrates fall into two groups: cation exchangers and anion exchangers. Acidic functional groups areeffective as cation exchangers. These groups include sulfonic acids,— $SO_3H$; carboxylic acid,— COOH; phenols or alcohols,— OH; and mercaptans,— SH. These interact only with cations and by an exchange reaction of the following sort:

$$— SO_3H + M^+ = — SO_2M + H^+.$$



Most anion exchangers are amines, depending upon one of the functional groups — $NH_2$,— NHR, and $NR_2$. These groups form ammonium type salts, and the anion can be displaced:

$$— NH_2 • HC1 + X = — NH_2 • HX + Cl.$$

1. **saltforming capacity** - способность солеобразования
2. **something like** - нечто вроде
3. **by any other method** - любым другим методом
4. **fall into two groups** - разделяются на две разные группы

## Unit 7. ORGANIC CHEMISTRY. CARBON AND COMPOUNDS OF CARBON

Organic chemistry is an extremely interesting field of natural science and of great technological significance. The overwhelming majority of chemists prove to be engaged in producing organic compounds; several millions being known so far.

In view of their obvious success in the manufacture of synthetic compounds, the chemists are greatly interested in this field of science.

The name organic chemistry, which was originally used to refer to the chemistry of substances that occur in living organisms, is now used for the chemistry of the compounds of carbon. The chemistry of carbon was greatly advanced about a century ago through the development of a general structure theory, this theory being a chemical theory, induced from chemical facts.

In recent years it has received added verification through the determination of exact structures of molecules and crystals by physical methods, especially X-ray diffraction, electron diffraction, and the analysis of the spectra of substances.

During the first half of the 19th century many organic compounds were found to have been obtained from plants and animals and also to have been made in the laboratory. The were analyzed for their constituent elements, an their properties were carefully studied. Efforts were made to find some correlation between the chemical composition and the properties of the substances.

**Elementary Carbon.** Carbon occurs in nature in its elementary state in two allotropic forms namely diamond, this being the hardest substance known, and graphite, a soft, black crystalline substance used as a lubricant. Having investigated all the substances thoroughly the scientists found charcoal, coke, and carbon black; to be microcrystalline or amorphous (noncrystalline) forms of carbon.

Carbon burns to form gases: carbon monoxide CO, and carbon dioxide CO2, the former being produced when there is a deficiency of oxygen or the flame temperature is very high.

This investigation followed by others resulted in new discoveries in the field of carbon. It has been found out that carbon monoxide is a colourless, odourless gas with small solubility in water. It is poisonous, because of its ability to combine with the hemoglobin in the blood in the same way that oxygen does, and thus to prevent

the hemolobin from combining with oxygen in the lungs and carrying it to the tissues. It should be noted that the exhaust as from automobile engines contains some carbon. Nevertheless carbon monoxide is a valuable industrial gas, for use as a fuel and as a reducing agent.

**Carbon Dioxide.** Carbon dioxide is a colourless, odourless gas with a weakly acid taste, due to the formation of some carbonic acid when it is dissolved in water. It appears to be about 50'/o heavier than air. It is easily soluble in water, one liter of water at O'C dissolving 1,713 ml of the gas under 1 atm pressure. When crystalline carbon dioxide is heated from a very low temperature its vapour pressure reaches 1 atm at 79' at which temperature it vaporizes without melting. If pressure were increased to 2.5 atm the crystalline substance would melt to a liquid at 56.6'. Under ordinary pressure, then, the solid substance could be changed directly to a gas.

Carbon dioxide is known to combine with water to form carbonic acid H2CO3 , it being a weak acid.

If you studied all the properties more thoroughly you would see that carbon dioxide is used for the manufacture of sodium carbonate, sodium hydrogen carbonate, and carbonated water and for many other uses.

From this short review it's clear that chemistry of carbon and its compounds is a very important field of chemistry and should be studied carefully.

## II

**Carbon Pollutants** Carbon monoxide and carbon dioxide are both very important atmospheric contaminants. Human activities are responsible for the introduction of increasing quantities of these gases to the atmosphere. Carbon monoxide is particularly important because of its potent mammalian toxicity, while carbon dioxide is most significant because of its ability to regulate global temperature. Neither gas is tought to causedirect damage to vegetation at ambient concentrations presently monitored.

Carbon monoxide has not been shown to produce acute effects on plants at concentrations below 100 p.p.m. for exposures from one to three weeks. The threshold of carbon dioxide toxicity to plants is in such excess of ambient conditions as to be completely unimportant. The hypothesis that the increasing concentration of carbon dioxide in the atmosphere might result in elevated global temperatures, however, has enormous implications for the health of forest ecosystems.

**Notes to the text:**

1. overwhelming
2. majority
3. to be engaged
4. so far
6. in view of
7. recent
8. verification
9. correlation
10. lubricant
11. carbon
12. poisonous
13. exhaust gas
14. valuable
15. to reduce
16. to damage
17. to prevent
18. to be responsible for



**I. Answer the following questions:**

1. What is organic chemistry. 2. Why are the scientists interested in the field of organic chemistry. 3. What does the name organic chemistry refer to? 4. When was the chemistry of carbon advanced'? 5. What phenomenon was found during the first half of the 19th century. 6. Where does carbon occur? 7. In that form does carbon occur in nature? 8. What gases does carbon form during its burning? 9. What properties of ca-bon monoxide do you know? 10. What properties of carbon dioxide do you know'? l l. What does carbon dioxide form combining with water? 12. What are very important atmospheric contaminants?

**II. Retell the text according to the following plan:**

1. Organic chemistry.
2. The chemistry of carbon.
3. Elementary carbon,
4. The properties of carbon.
5. Carbon monoxide.
6. Carbon dioxide.
7. Carbon pollutants.

## Unit 8. Famous chemists.

D. I. Mendeleyev, the great Russian chemist, was born in Siberia on February 8, 1834. When seven years old he went to gymnasium in Tobolsk. He studied very hard, he especially liked mathematics, physics and history. At the age of 16 he entered the Pedagogical Institute in St. Petersburg, physicomathematical department. He graduated from the Ins-.itute in 1855 and began to teach chemistry at the Technological Institute and then at the University In 1865 Mendeleyev was granted the Doctor of Science degree for the thesis on the combination of alcohol with water. This work was both *of* great theoretical and practical significance. Soon after that D.I.Mendeleyev was appointed Professor of General Chemistry of St. Petersburg Jniversity. Despite lectures and supervision of the laboratory, D. I. Mendeleyev carried on great research work.

Mendeleyev's greatest discovery was the Period c Law. The Periodic Law suggested by Mendeleyev stated that the properties of the elements were a periodic function of their atomic masses. He presented this work to the Russian Chernical Society. Mendeleyev's Periodic Law *opened* a new era in the history of chemistry.

Mendeleyev was interested in many branches of science, indeed there is hardly any field *of* science that was not enriched by his contribution. His numerous *works* dealt with many subjects: properties of liquids, theories of solutions, the development of the gas law, the use *of* oil and many others,

D. I. Mendeleyev was a great patriot. He did everything for the development and progress of his country.

D. I. Mendeleyev continued his research *work to* the very last day of his life. He died in 1907.

The world is thankful to Mendeleyev for his great contribution to the world science. At present there is hardly anybody who doesn't know this Russian scientist and his Periodic Law. D I Mendeleyev did very much for his country, for the development of the world science.

**Notes to the text:**

1. great
2. hard
3. especially
4. to enter the Institute
5. society
6. significance
7. to be appointed
8. despite
9. to die
10. to be interested in
11. hardly
12. contribution
13. to suggest liquid
14. degree
15. thesis

**I. Answer the following questions:**

1. When was D. I. Mendeleyev born? 2. Where was he born'? 3. When did he go to gymnasium'? 4. What subjects did he like'? 5. What Institute did he enter? 6. Where did he work after the graduation from the Institute. 7. When was he granted the Doctor of Science degree? 8. What was he granted this degree for? 9. What was Mendeleyev's greatest discovery'? 10. What did he present to the Russian Chemical Society? ll. What other problems was Mendeleyev interested in? 12. What subjects did his numerous works deal with? 13. When did he die?

**II. Retell the text according to the following plan:**

1. D. I. Mendeleyev's childhood.
2. The gymnasium and the Pedagogical Institute.
3. D. I. Mendeleyev's work at the Technological Institute and at the Uniiversity.
4. His research work.
5. D. I. Mendeleyev's greatest discovery.
6. D. I. Mendeleyev's greatest contribution in science.



7. D. I. Mendeleyev is a great chemist and patriot.

**III. Task: 1) read the texts**
**2) answer the questions**
**3) make up a report about any famous chemist you like**

**Antoine Lavoisier.**

Antoine Laurent Lavoisier is a French chemist, was the founder of modern chemistry.

Lavoisier carefully measured the weights of substances involved in chemical reactions. In 1772 he began a series of experiments that demonstrated the nature of combustion. He concluded that combustion results from the union of a flammable material with a newly discovered gas, which he called oxygen. Lavoisier published his findings in his Elementary Treatise on Chemistry (1789).

With French astronomer and mathematician Pierre Simon Laplace, Lavoisier conducted experiments on respiration in animals. Their studies demonstrated a similarity between common chemical reactions and the processes that occur in living organisms. These experiments provided the foundation for the science now known as biochemistry. Lavoisier also helped to develop a system for naming chemical substances based on their composition. This system is still in use.

Lavoisier was born in Paris. He received an excellent education and developed an interest in all branches of science, especially chemistry. He was elected to the French Academy of Sciences in 1768.

Lavoisier was arrested in 1793 by the leaders of the French Revolution. Many years earlier, he had become a partner in a firm that collected a number of taxes for the government. In spite of his achievements, Lavoisier was found guilty of conspiracy with the enemies of France because of his involvement in tax collection. He was executed by guillotine.

**Questions**

**1)** What famous scientist did Lavoisier work with?
**2)** What experiments did they conduct?
**3)** The foundation of what science did their experiments provide?
**4)** Why was he arrested?
**5)** What series of experiments did Lavoisier begin in 1772?

**Alfred Nobel.**

Alfred Bernard Nobel, a Swedish chemist, invented dynamite and founded the Nobel Prizes. As a young man, Nobel experimented with nitroglycerin in his father's factory. He hoped to make this dangerous substance into a safe and useful explosive. He prepared a nitroglycerin explosive, but so many accidents occurred when it was put on the market that for a number of years many people considered Nobel almost a public enemy.

Finally in 1867 Nobel combined niter with an absorbent substance. This explosive could be handled and shipped safely. Nobel named it dynamite. Within a few years he became one of the world's richest men. He set up factories throughout the world and bought the large Bofors armament plant in Sweden. He worked on synthetic rubber, artificial silk and many other products.

Nobel was never in good health. In later years he became increasingly ill and nervous. He suffered from a feeling of guilt at having created a substance that caused so much death and injury. He hated the thought that dynamite could be used in war when he had invented it for peace. Nobel set up a fund of about 9 million U.S. dollars. The interest from the fund was to be used to award annual prizes, one of which was for the most effective work in promoting international peace.

Alfred Nobel was born on October, 21, 1833 in Stockholm. He was the son of an inventor. He was educated in St. Petersburg, Russia, and later studied engineering in the United States.

**Questions**

1) Who was Nobel's father?
2) What was Nobel's chief invention?
3) Why did people consider him a public enemy for a number of years?
4) What kind of Prizes did he set up?
5) What was the interest from these fund?



## GRAMMAR

## СОГЛАСОВАНИЕ ВРЕМЕН, КОСВЕННАЯ РЕЧЬ

**Упр. 1 Переведите на русский язык, обращая внимание на употребление времен в русском и английском языках.**

1. I knew that you were ill. 2. I knew that you had been ill. 3. We found that she left home at eight o'clock every morning. 4. We found that she had left home at eight o'clock that morning. 5. When he learnt that his son always received excellent marks in all the subjects at school, ho was very pleased. 6. When he learnt that his son had received an excellent mark at school, he was very pleased. 7. We did not know where our friends went every evening. 8. We did not know where our friends had gone. 9. She said that her best friend was a doctor. 10. She said that her best friend had been a doctor. 11. I didn't know that you worked at the Hermitage. 12. I didn't know that you had worked at the Hermitage.

**Упр. 2 Перепишите следующие предложения в прошедшем времени. Обратите внимание на зависимость времени придаточного дополнительного предложения от времени главного.**

1. My uncle says he has just come back from the Caucasus. 2. He says he has spent a fortnight in the Caucasus. 3. He says it did him a lot of good. 4. He says he feels better now. 5. He says his wife and he spent most of their time on the beach. 6. He says they did a lot of sightseeing. 7. He says he has a good camera. 8. He says he took many photographs while travelling in the Caucasus. 9. He says he will come to see us next Sunday. 10. He says he will bring and show us the photographs he took during his stay in the Caucasus.

**Упр. 3. Раскройте скобки, выбирая требующееся время глагола.**

1. He said he (is staying, was staying) at the «Ritz» Hotel. 2. They realized that they (lost, had lost) their way in the dark. 3. He asked me where I (study, studied). 4. I thought that I (shall finish, should finish) my work at that time. 5 He says he (works, worked) at school two years ago. 6. Victor said he (is, was) very busy. 8. My friend asked me who (is playing, was playing) the piano in the sitting-room. 9. He said he (will come, would come) to the station to see me off. 10. I was sure he (posted, had posted) the letter. 11. I think the weather (will be, would be) fine next week. I hope it (will not change, would not change) for the worse. 12. I knew that he (is, was) a very clever man. 13.1 want to know what he (has bought, had bought) for her birthday. 14. I asked my sister to tell me what she (has seen, had seen) at the museum.

**Упр.4. Переведите на английский язык, соблюдая правило согласования времен.**

1. Сестра сказала, что хочет приехать к нам сама. 2. Я знала, что она очень занята. 3. Никто не знал, что вы ждете здесь. Пойдемте в дом. 4. Гид предупредил нас, что в этой части города движение довольно сильное. 5. Секретарь не заметил, что директор с кем-то разговаривает. 6. Все мы знали, что ее семья опять в Санкт-Петербурге. 7. Лена сказала, что она дарит нам эту картину. 8. Я знала, что она работает на заводе, что у нее есть муж и двое детей, что семья у нее очень дружная и она счастлива. 9. Она сказала, что ее коллеги всегда дают ей прекрасные советы. 10. Он сказал, что любит эту пьесу. 11. В прошлом году они думали, что никогда не будут хорошо читать по-английски, но вчера они увидели, что читают тексты довольно хорошо.12. Он сказал мне вчера, что его отец — профессор и живет в Москве. 13. Он сказал мне вчера, что раньше он учился в университете. 14. Мы решили на прошлой неделе, что будущим летом мы все поедем в Крым.

**Упр. 5. Передайте следующие повелительные предложения в косвенной речи.**

1. «Go home,» said the teacher to us. 2. «Buy some meat in the shop,» said my mother to me. 3. «Sit down at the table and do your homework,» said my mother to me. 4. «Don't forget to clean your teeth,» said granny to Helen. 5. «Don't sit up late,» said the doctor to Mary. 6. The doctor said to Pete: «Don't go for a walk today.» 7. «Don't eat too much ice-cream,» said Nick's mother to him. 8. «Explain to me how to solve this problem,» said my friend to me. 9. The doctor said to Nick: «Open your mouth and show me your tongue.» 10. «Don't be afraid of my dog,» said the man to Kate. 11. «Take this book and read it,» said the librarian to the boy.

**Упр. 6. Передайте следующие повелительные предложения в косвенной речи.**

1. «Go home,» said the teacher to us. 2. «Buy some meat in the shop,» said my mother to me. 3. «Sit down at the table and do your homework,» said my mother to me. 4. «Don't forget to clean your teeth,» said granny to Helen. 5. «Don't sit up late,» said the doctor to Mary. 6. The doctor said to Pete: «Don't go for a walk today.» 7. «Don't eat too much ice-cream,» said Nick's mother to him. 8. «Explain to me how to solve this problem,» said my friend to me. 9. The doctor said to Nick: «Open your mouth and show me your tongue.» 10. «Don't be afraid of my dog,» said the man to Kate. 11. «Take this book and read it,» said the librarian to the boy.

**Упр. 7. Восстановите прямую речь в следующих предложениях.**

1. Hesaid that while crossing the English Channel they had stayed on deck all the time. 2. The woman said she had felt sick while crossing the Channel. 3. She said she was feeling bad that day. 4. Tom said he would go to see the doctor the next day. 5. He told me he was ill. 6. He told me he had fallen ill. 7. They told me that Tom had not come to school the day before. 8. I told my sister that she might catch cold. 9. She



told me she had caught cold. 10. The old man told the doctor that he had pain in his right side. 11. He said he had just been examined by a good doctor. 12. He said he would not come to school until Monday. 13. The man said he had spent a month at a health-resort. 14. He said that his health had greatly improved since then.

**Упр. 8. Передайте следующие специальные вопросы в косвенной речи.**

1. I said to Nick: «Where are you going?» 2. I ! said to him: «How long are you going to stay there?» 3. I said to him: «How long will it take you to get.there?» 4. Pete said to his friends: «When are you Cleaving St. Petersburg?» 5. He said to them: «Who will you see before you leave here?» 6. They said to him: «What time does the train start?» 7. Ann said to Mike: «When did you leave London?» 8. She said to Boris: «When Will you be back home?»

9. Boris said to them: «How can I get to the railway station?» 10. Mary asked Tom: «What time will you come here tomorrow?» 11, She asked me: «Why didn't you come here yesterday?» 12. She asked me: «What will you do tomorrow if you are not busy at your office?» 13.1 asked Mike: «What will you do after dinner?» 14. I asked my uncle: «How long did you stay in the Crimea?» 15. Ada said to me: «Where did you see such trees?» 16. I said to Becky: «What kind of book has your friend brought you?» 17. Mother said to me: «Who has brought this parcel?» 18. He said to her: «Where do you usually spend your summer holidays?»

**Упр. 9. Передайте следующие специальные вопросы в косвенной речи, начиная каждое предложение со слов, данных в скобках.**

1. Where is he going? (He didn't tell anybody...) 2. Where has he gone? (Did you know...) 3. Where is he? (Did you know...) 4. When is he leaving school? (I wanted to know...) 5. Where does he live? (Nobody knew...) 6. When will he come back? (She asked them...) 7. Where did she buy this hat? (He wanted to know...) 8. How much'did she pay for it? (I had no idea...) 9. Where did I put the book? (I forgot...) 10. Who has given you this nice kitten? (She wanted to know...) 11. Where can I buy an English-Russian dictionary? (He asked me...) 12. How long will it take your brother to get to Madrid? (He wondered...)

**Упр. 10. Передайте следующие общие вопросы в косвенной речи.**

1. I said to Boris: «Does your friend live in London?» 2. I said to the man: «Are you living in a hotel?» 3. Nick said to his friend: «Will you stay at the 'Hilton'?» 4. He said to me: «Do you often go to see your friends?» 5. He said to me «Will you see your friends before you leave St. Petersburg?» 6. Mike said to Jane: «Will you come to the railway station to see me off?» 7. She said to me: «Have you sent them a telegram?» 8. She said to me: «Did you send them a telegram yesterday?» 9. I said to Mike: «Have you packed your suitcase?» 10. I said to Kate: «Did anybody meet you at the station?» 11. I said to her: «Can you give me their address?» 12. I asked Tom: «Have you had breakfast?» 13. I asked my sister: «Will you stay at home or go for a walk after dinner?» 14. I said to my mother: «Did anybody come to see me?» 15. I asked my sister: «Will Nick call for you on the way to school?» 16. She said to the

young man: «Can you call a taxi for me?» 17. Mary said to Peter: «Have you shown your photo to Dick?» 18. Oleg said to me: «Will you come here tomorrow?» 19. He said to us: «Did you go to the museum this morning?»

**Упр. 11. Передайте следующие вопросительные предложения в косвенной речи.**

1. The teacher said to Mike: «Does your father work at a factory?» 2. Mother said to us: «What are you doing here?» 3. Father said to Nick: «Have you done your homework?» 4. Tom said: «Ann, where are your friends?» 5. Kate said: «Mike, do you like my dress?» 6. Grandfather said to Mary: «What mark did you get at school?» 7. My sister said to me: «Will you take me to the theatre with you tomorrow?» 8. Mother asked me: «Did you play with your friends yesterday?» 9. «Why don't you play with your friends, Kate?» said her mother. 10. «Do you like chocolates?» said my little sister to me. 11. «Did you see your granny yesterday, Lena?» asked Mr. Brown. 12. The doctor asked Nick: «Do you wash your face and hands every morning?»

**Упр. 12. Восстановите прямую речь в следующих предложениях.**

1. I asked if they had taken the sick man to hospital. 2. I asked my friend if he had a headache. 3. I wanted to know when he had fallen ill. 4. I wondered if he had taken his temperature. 5. I asked him if the doctor had given him some medicine. I asked him if he was feeling better now. 6. I asked the man how long he had been in St. Petersburg. 7. I asked him if he was going to a health-resort. 8. We asked the girl if her father was still in Moscow. 9. I asked the girl what sort of work her father did.

**Упр. 13. Переведите на английский язык. Сравните конструкцию повествовательных и повелительных предложений в прямой и косвенной речи.**

1. Мой друг сказал: «Все ученики нашего класса любят уроки истории.» 2. Я сказал ему: «Мы любим уроки английского языка.» 3. Учительница сказала: «Скоро вы будете хорошо говорить по по-английски, так как вы много работаете.» 4. Мама сказала: «Не шумите! Дедушка спит.» 5. Катя сказала: «Папа в комнате. Он читает.» 6. Учитель сказал: «Я уже проверил вашу контрольную работу.» 7. Аня сказала: «Мы нашли в лесу много грибов.»

1. Мой друг сказал, что все ученики их класса любят уроки истории. 2. Я сказал ему, что мы любим уроки английского языка. 3. Учительница сказала, что скоро мы бу дем хорошо говорить английски, так как мы много работаем. 4. Мама сказала нам, чтобы мы не шуме ли, так как дедушка спит. 5. Катя сказала, что папа в комнате и что он читает. 6. Учитель сказал, что он уже проверил нашу контрольную работу. 7. Аня сказала, что они нашли в лесу много грибов.

**Упр. 14. Замените придаточные предложения инфинитивными оборотами.**

E.g. He is so old that he cannot skate. He is too old to skate.

1. The problem is so difficult that it is impossible to solve it. 2. The box is so heavy that nobody can carry it. 3. The baby is so little that it cannot walk. 4. He is so weak that he cannot lift this weight. 5. She is so busy that she cannot talk with you. 6. She



was so inattentive that she did not notice the mistake. 7. The rule was so difficult that they did not understand it. 8. He was so stupid that he did not see the joke. 9. She has got so fat that she cannot wear this dress now. 10. The accident was so terrible that I don't want to talk about it. 11. They were so empty-headed that they could not learn a single thing. 12. The window was so dirty that they could not see through it. 13. She was so foolish that she could not understand my explanation. 14. I have very little wool: it won't make a sweater.

*Запомните следующие застывшие словосочетания с инфинитивом:*

- to cut a long story short — короче говоря
- to tell (you) the truth — сказать(вам) по правде
- to say nothing of — не говоря уже о
- to put it mildly — мягко выражаясь
- to say the least of it — по меньшей мере
- to begin with — начнем с того что

*Запомните следующие предложения:*

- The book leaves much to be desired. — Книга оставляет желать лучшего.
- He is difficult to deal with. — С ним трудно иметь дело.
- He is hard to please. — Ему трудно угодить .
- She is pleasant to look at. — На нее приятно смотреть.

**Упр.15. Переведите на английский язык, употребляя застывшие словосочетания с инфинитивом**.

1. Мягко выражаясь, она была невежлива. 2. Ваша работа оставляет желать лучшего. 3. Сказать по правде, я не люблю бокс. 4. Вашей сестре трудно угодить. 5. Начнем с того, что я занят, б. На него было приятно смотреть. 7. Короче говоря, он не сдал экзамен. 8. Мы все были рады, не говоря уже о маме: она сказала, что это самый счастливый день в ее жизни. 9. Твое сочинение оставляет желать лучшего. 10. Это очень странно, по меньшей мере. 11. Для начала, она открыла все окна. 12. С моим соседом трудно иметь дело. 13. По правде говоря, я очень устал. 14. Его поведение оставляет желать лучшего. 15. Мягко выражаясь, вы меня удивили. 16. На этих детей приятно посмотреть. 17. Короче говоря, они поженились. 18. Самая известная книга Джерома — «Трое в лодке, не считая собаки.» 19. Вам трудно угодить. 20. По меньшей мере, мы были удивлелы.

**Упр. 16. Переведите на русский язык, обращая внимание на Active Infinitive и Passive Infinitive.**

1. Nature has many secrets to be discovered yet. 2. To improve your phonetics you should record yourself and analyze your speech. 3. This is the book to be read during

the summer holidays. 4. To be instructed by such a good specialist was a great advantage. 5. To play chess was his greatest pleasure. 6. The child did not like to be washed. 7. Isn't it natural that we like to be praised and don't like to be scolded? 8. Which is more pleasant: to give or to be given presents? He is very forgetful, but he doesn't like to be reminded of his duties.

**Упр. 17. Раскройте скобки, употребляя требующуюся форму инфинитива.**

1. I hate (to bother) you, but the students are still waiting (to give) books for their work. 2. He seized every opportunity (to appear) in public: he was so anxious (to talk) about. 3. Is there anything else (to tell) her? I believe she deserves (to know) the state of her sick brother. 4. He began writing books not because he wanted (to earn) a living. He wanted (to read) and not (to forget). 5. I consider myself lucky (to be) to that famous exhibition and (to see) so many wonderful paintings. 6. He seems (to know) French very well: he is said (to spend) his youth in Paris. 7. The enemy army was reported (to overthrow) the defence lines and (to advance) towards the suburbs of the city. 8. The woman pretended (to read) and (not to hear) the bell. 9. You seem (to look) for trouble. 10. It seemed (to snow) heavily since early morning: the ground was covered with a deep layer of snow. 11. They seemed (to quarrel): I could hear angry voices from behind the door. 12. Perhaps it would upset her (to tell) the truth of the matter. 13. They are supposed (to work) at the problem for the last two months. 14. The only sound (to hear) was the snoring of grandfather in the bedroom. 15. Her ring was believed (to lose) until she happened (to find) it during the general cleaning. It turned out (to drop) between the sofa and the wall. 16. They seemed (to wait) for ages.

**Упр. 18. Переведите на английский язык, употребляя требующуюся форму инфинитива.**

1. Я рад, что рассказал вам эту историю. 2. Я рад, что мне рассказали эту историю. 3. Я хочл познакомить вас с этой артисткой. 4. Я хочу, чтобы меня познакомили с этой артисткой. 5. Я рад, что встретил ее на станции. 6. Я рад, что меня встретили на станции. 7. Мы очень счастливы, что пригласили его на вечер. 8. Мы очень счастливы, что нас пригласили на вечер. 9 Дети любят, когда им рассказывают сказки. 10. Я не предполагал останавливаться на этой станции. 11. Я не ожидал, что меня остановят. 12. Я сожалею, что причинил вам столько беспокойства. 13. Он будет счастлив посетить эту знаменитую картинную галерею. 14 Он был счастлив, что посетил эту знаменитую картинную галерею. 15. Он не выносит1, когда ему лгут. 16. Я вспомнил, что уже встречал это слово в какой-то книге.



## Причастие

**Упр. 19. Переведите на русский язык, обращая внимание на причастия.**

1. Everybody looked at the dancing girl. 2. The little plump woman standing at the window is my grandmother. 3. The man playing the piano is Kate's uncle. 4. Entering the room, she turned on the light. 5. Coming to the theatre, she saw that the performance had already begun. 6. Looking out of the window, he saw his mother watering the flowers. 7. Hearing the sounds of music we stopped talking8. She went into the room, leaving the door open.

**Упр. 20. Замените придаточные определительные предложения причастными оборотами.**

1. All the people who live in this house are stu dents. 2. The woman who is speaking now is oui secretary. 3. The apparatus that stands on the table in the- corner of the laboratory is quite new. 4. The young man who helps the professor in his experiments studies at an evening school for la bo ratory workers. 5. People who take books from the library must return them in time. 6. There are rnany pupils in our class who take part in all kinds of extra-curricular activities.

**Упр. 21. Замените придаточные предложения причины причастными оборотами.**

1. As he now felt more at ease, the man spoke in a louder voice. 2. Since he knew who the man was, Robert was very pleased to have the chance of talking to him. 3. As he thought that it was his brother at the window, Steve decided to open it. 4. As the people were afraid of falling into a ditch in the darkness at any moment, they felt their way about very carefully. 5. Since he needed a shelter for the night, Peter decided to go to the neighbours' house.

**Упр. 22. Замените придаточные предложения времени причастными оборотами (не опускайте союз when).**

1. When you speak English, pay attention to the order of words. 2. Be careful when you are crossing a street. 3. When you are leaving the room, don't forget to switch off the light. 4. When you begin to work with the dictionary, don't forget my instructions. 5. When they were travelling in Central Africa, the explorers met many wild animals. 6. When you are copying English texts, pay attention to the articles. 7. You must have much practice when you are learning to speak a foreign language. Упр. 360. Переведите следующие русские причастия и деепричастия на английский язык.

Упр. 360. Приносящий, принесенный, принося, принеся, переводящий, переведенный, переводя, переведя, давая, написав, читающий, берущий, данный, прочитав, сделанный, пьющий, сказанный, будучи потерянным, нарисовав, написавший, делая, взятый, взяв, рисуя, выпитый, сделав, идя, пишущий, прочитанный, дав, рисующий, делающий, нарисованный, выпив, говорящий, беря, написанный, читая, идущий, дающий, сказав, сидевший, посмотрев, будучи забыт, строящий, строящийся, играя, поиграв, рассказанный, рассказавший, видя, принесший, будучи принесенным, построенный, продав.

**Упр. 23. Переведите на русский язык, обращая внимание на Past Participle.**

1. My sister likes boiled eggs. 2. We stopped before a shut door. 3. Tied to the tree, the goat could not run away. 4. They saw overturned tables and chairs and pieces of broken glass all over the room. 5. This is a church built many years ago. 6. The books written by Dickens give us a realistic picture of the 19th century England. 7. She put a plate of fried fish in front of me. 8. The coat bought last year is too small for me now. 9. Nobody saw the things kept in that box.

**Упр. 24. Переведите на русский язык, обращая внимание на Participle 1 и ParticipleII.**

1. a) A fish taken out of the water cannot live.

b) A person taking a sun-bath must be very careful.

c) Taking a dictionary, he began to translate

the text.

a) A line seen through this crystal looks double.

b) A teacher seeing a mistake in a student's dictation always corrects it.

c) Seeing clouds of smoke over the house, the girl cried: «Fire! Fire!»

a) The word said by the student was not correct.

b) The man standing at the door of the train carriage and saying goodbye to his friends is a well-known musician.

c) Standing at the window, she was waving her hand.

a) A letter sent from St. Petersburg today will be in Moscow tomorrow.

b) He saw some people in the post-office send-

ing telegrams. When sending the telegram she forgot to write her name.

a) Some of the questions put to the lecturer yesterday were very important.

b) The girl putting the book on the shelf is the new librarian.

c) While putting the eggs into the basket she broke one of them.

a) A word spoken in time may have very important results.

b) The students speaking good English must help their classmates.

c) The speaking doll interested the child very much.

d) While speaking to Nick some days ago I forgot to ask him about his sister.

**Упр. 25. Выберите из скобок требующуюся форму причастия.**

1. a) The girl (writing, written) on the blackboard is our best pupil.

b) Everything (writing, written) here is quite right.

2. a) The house (surrounding, surrounded) by tall trees is very beautiful.



b) The wall (surrounding, surrounded) the house was very high.

3. a) Who is that boy (doing, done) his homework at that table?

b) The exercises (doing, done) by the pupils were easy.

4. a) The girl (washing, washed) the floor is my sister.

b) The floor (washing, washed) by Helen looked very clean.

5. a) We listened to the girls (singing, sung) Russian folk songs.

b) We listened to the Russian folk songs (singing, sung) by the girls.

6. Do you know the girl (playing, played) in the garden?

7. The book (writing, written) by this scientist is very interesting.

8. Translate the words (writing, written) on the blackboard.

9. We could not see the sun (covering, covered) by dark clouds.

10. The (losing, lost) book was found at last.

11 (Going, gone) along the street, I met Mary and Ann.

12. Read the (translating, translated) sentences once more.

13. Name some places (visiting, visited) by you last year.

14.1 picked up the pencil (lying, lain) on the floor.

15. She was reading the book (buying, bought) the day before.

16. Yesterday we were at a conference (organizing, organized) by the pupils of the 10th form.

17. (Taking, taken) the girl by the hand, she led her across the street.

18. It was not easy to find the (losing, lost) stamp.

19.1 shall show you a picture (painting, painted)by Hogarth.

20. Here is the letter (receiving, received) by me yesterday.

21. Look at the beautiful flowers (gathering, gathered) by the children.

22. His hat (blowing, blown) off by the wind was lying m the middle of the street.

23. How do you like the film?" he asked, (turning, turned) towards me.

24. When we came nearer, we saw two boys (coming, come) towards us.

25.1 think that the boy (standing, stood) there is his brother.

## Герундий

**Упр. 26. Переведите на русский язык, обращая внимание на герундий.**

1. Have you finished writing? 2. Taking a cold shower in the morning is very useful. 3. I like skiing, but my sister prefers skating. 4. She likes sitting in the sun. 5. It looks like raining. 6. My watch wants repairing. 7. Thank you for coming. 8. I had no hope of getting an answer before the end of the month. 9.1 had the pleasure of dancing with her the whole evening. 10. Let's go boating. 11. He talked without stopping. 12. Some people can walk all day without feeling tired. 13. Living in little stuffy rooms means breathing poisonous air. 14. Iron is found by digging in the earth. 15. There are two ways of getting sugar: one from beet and the other from sugar-cane. 16. Jane Eyre was fond of reading. 17. Miss Trotwood was in the habit of asking Mr. Dick his opinion.

**Упр. 27. В следующих предложениях замените придаточные дополнительные герундием с предлогом of.**

E.g. She thought she would go to the country

for the week-end.

She thought of going to the country for

the week-end

1. I thought I would come and see you tomorrow. 2. I am thinking that I shall go out to the country tomorrow to see my mother. 3. What do you think you will do tomorrow? 4.1 don't know now; I thought

l would go to the zoo, but the weather is so bad that probably I shan't go. 5. I hear there are some English books at our institute book-stall now. - So you are thinking that you will buy some, aren't you? 6.1 thought I would work in the library this evening, but as you have come, I won't go to the library.

**Упр. 28. Переведите на русский язык, обращая внимание на разные формы герундия.**

1. Watching football matches may be exciting enough, but of course it is more exciting playing football. 2. She stopped coming to see us, and I wondered what had happened to her. 3. Can you remember having seen the man before? 4. She was terrified of having to speak to anybody, and even more, of being spoken to. 5. He was on the point of leaving the club, as the porter stopped him. 6. After being corrected by the teacher, the students' papers were returned to them. 7. I wondered at my mother's having allowed the journey. 8.1 understand perfectly your wishing to start the work at once. 9. Everybody will discuss the event, there is no preventing it. 10. At last he broke the silence by inviting everybody to walk into the dining-room. 11. On being told the news she turned pale. 12. The place is worth visiting.



*Запомните следующие глаголы и выражения, требующие после себя герундия*

to avoid to burst out cannot help to deny to enjoy

to excuse to finish to forgive to give up to go on

to keep (on) to mind1 to postpone to put off to stop

**Упр. 29. В следующих предложениях замените придаточные времени герундием с предлогом after.**

**E.g. When she had bought everything she needed, she went home. After buying everything she needed, she went home**

1. After I had hesitated some minutes whether to buy the hat or not, I finally decided that I might find one I liked better in another shop. 2. When she had graduated from the university, she left St. Petersburg and went to teach in her home town.

3. When he had proved that his theory was correct, he started studying ways and means of improving the conditions of work in very deep coalmines.

4. After she took the child to the kindergarten, she went to the library to study for her examination.

5. When he had made a thorough study of the subject, he found that it was a great deal more important than he had thought at first.

**Упр. 30. Переведите на английский язык, употребляя герундий.**

1. Наконец они перестали смеяться. 2. Она отрицала, что украла деньги. 3. Давайте отложим поездку на дачу до следующей субботы. 4. Простите, что я потерял вашу ручку. 5. Когда она кончит писать сочинение? 6. Я не возражаю против того, чтобы остаться дома и поработать над моим переводом. 7. Перестаньте дрожать. Избегайте показывать этим людям, что вы их боитесь. 8. Я не могу не беспокоиться о них: они перестали писать. 9. Я не отрицаю, что видел их в тот вечер. 10. Он не возражал против того, чтобы его осмотрели: он перестал притворяться, что здоров. 11. Он не может меня простить за то, что я порвал его сумку. 12. Перестаньте разговаривать. 13. Мы закончили работу над этой проблемой. 14. Продолжайте петь. 15. Вы не против того, чтобы открыть окно? 16. Он отрицал свое участие в преступлении. 17. Я очень люблю рисовать. 18. Мы получили удовольствие от плавания. 19. Я не могла не согласиться с ним. 20. Он рассмеялся. 21. Она бросила курить. 22. Она избегала встречи с ним. 23. Мы отложим обсуждение доклада.

**Упр. 31. Раскройте скобки, употребляя герундий в активной или пассивной форме.**

1. Why do you avoid (to speak) to me? 2. She tried to avoid (to speak) to. 3. The doctor insisted on (to send) the sick man to hospital. 4. The child insisted on (to send) home at once. 5. Do you mind ;him (to examine) by a heart specialist? 6. He showed • no sign of (to recognize) me. 7. She showed no sign of (to surprise). 8. He had a strange habit of (to interfere) in other people's business. 9. I was angry at (to inter-

rupt) every other moment. 10. He was always ready for (to help) people. 11. He was very glad of (to help) in his difficulty. 12. On (to allow) to leave the room the children immediately ran out into the yard and began (to play). 13. In(to make) this experiment they came across some very interesting phenomena. 14. The results of the experiment must be checked and re-checked before (to publish). 15. David was tired of (to scold) all the time. 16. The watch requires (to repair).1 17. The problem is not worth (to discuss).118. Jane Eyre remembered (to lock) up in the red room for (to contradict) Mrs. Reed.

## СЛОЖНОЕ ДОПОЛНЕНИЕ (COMPLEX OBJECT)

**Упр. 32. Закончите предложения, употребляя сложное дополнение.**

E.g. «Bring me a book,» said my brother to me. My brother wanted me to bring him a book,

1. «Wait for me after school,» said Ann to me. — Ann wanted___2. «Fix the shelf in the kitchen,» my father said to me. — My father wanted___3. «It will be very good if you study English,» said my mother to me. — My mother wanted___4. «Bring me some water from the river, children,» said our grandmother. — Our grandmother wanted___

5. «Come to my birthday party,» said Kate to her classmates — Kate wanted___6. The biology teacher said to us: «Collect some insects in summer.» — The biology teacher wanted___7. «Don't eat ice-cream before dinner,» said our mother to us. Our mother did not want___8. The teacher said to the pupils: «Learn the rule.» — The teacher wanted___9. «Be careful, or else you will spill the milk,» said my mother to me. — My mother did not want___10. «My daughter will go to a ballet school,» said the woman. — The woman wanted___11. The man said: «My son will study mathematics.» — The man wanted___12. «Oh, father, buy me this toy, please,» said the little boy. — The little boy wanted___

**Упр. 33. Переведите на английский язык, употребляя сложное дополнение.**

1. Я хочу, чтобы вы прочли эту книгу. 2. Мне бы хотелось, чтобы вы приехали к нам. 3. Она хотела, чтобы ее сын хорошо окончил школу. 4. Им бы хотелось, чтобы мы проиграли игру. 5. Она не хотела, чтобы я уехал в Москву. 6. Я бы не хотел, чтобы вы потеряли мою книгу. 7. Папа хочет, чтобы я была пианисткой. 8. Мы хотим, чтобы этот артист приехал к нам в школу. 9. Вам бы хотелось, чтобы я рассказал вам эту историю? 10. Хотите, я дам вам мой словарь? 11. Я не хочу, чтобы ты получил плохую оценку. 12. Мне бы не хотелось, чтобы они опоздали. 13. Я не хотела, чтобы вы меня ждали. 14. Она бы хотела, чтобы ее брат получил первый приз. 15. Я хочу, чтобы все дети смеялись. 16. Я хочу, чтобы все это прочитали. 17. Мне хотелось бы, чтобы доктор посмотрел его. 18. Дети хотели, чтобы я рассказал им сказку. 19. Я не хочу, чтобы она знала об этом. 20. Он хотел, чтобы его друг пошел с ним. 21. Мой брат хочет, чтобы я



изучала испанский Язык. 22. Я бы хотел, чтобы мои ученики хорошо знали английский язык.

I expect him to come.

I know him to be a good pupil.

**Упр. 34. Перепишите следующие предложения, употребляя сложное дополнение вместо придаточных дополнительных предложений.**

E.g. I expect that she will send me a letter. I expect her to send me a letter. I know that he is a great scientist. I know him to be a great scientist. 1.1 did not expect that my brother would forget to send her flowers. 2. He knows that my mother is a very kind woman. 3. She expected that her brother would bring her the book. 4. I know that your uncle is an excellent mathematician. 5. People expect that the 21st century will bring peace on the earth. 6. I know that my friend is a just man. 7.1 expect that he will understand your problem and help you to solve it. 8. I expected that she would behave quite differently.

**Упр. 35. Переведите на английский язык, употребляя сложное дополнение.**

1. Я рассчитываю, что письмо придет завтра. 2. Он рассчитывал, что учитель похвалит его.3. Она не рассчитывала, что они вернутся так поздно. 4. Я знаю, что она талантливая певица 5. Я знала, что он великий ученый. 6. Мы не рас считывали, что вы так много сделаете. 7. Учитель рассчитывал, что ученики поймут правило 8. Я не ожидал, что он напишет такие прекрасные стихи. 9. Она знала, что он очень добрый человек. 10. Все знали, что она прогрессивны!" ученый. 11. Я знаю, что твоя сестра очень способная студентка. 12. Все знают, что Байрон великий поэт. 13. Я не ожидал, что это случится так скоро. 14. Мы рассчитываем, что вы нам поможете. 15. Он ожидал, что министр ответит сразу. 16. Мы рассчитывали, что погода изменится.

I like her to sing. I hate her to cry.

**Упр. 36. Переведите на английский язык, употребляя сложное дополнение.**

1. Я люблю, когда дети смеются. 2. Она не любит, когда я с ней спорю. 3. Она не любила, чтобы мы приходили поздно. 4. Он терпеть не может, когда я опаздываю. 5. Наш учитель любит, когда мы задаем вопросы. 6. Я ненавижу, когда ты забываешь свои обязанности. 7. Бабушка любит, когда Лена играет на рояле. 3. Папа любит, когда я говорю по-английски. 9. Мой дедушка не любил, когда дети разговаривали за столом. 10. Он терпеть не мог, когда мы ломали игрушки. 11. Он любил, когда мы играли в тихие игры.

## СЛОЖНОЕ ПОДЛЕЖАЩЕЕ (COMPLEX SUBJECT)

Обратите внимание, что сказуемое выражено глаголом в PassiveVoice.

Eg. He was said to work a lot. — Говорили, что он много работает

Следующая таблица поможет вам переводить предложения, содержащие Complex Subject.

| | |
|---|---|
| 1. ...was said to | 1. Говорили, что |
| 2. ...was seen to... | 2. Видели, что |
| 3. …was heard to | 3. Слышали, что |
| 4. …was supposed to | 4. Предполагали, что |
| 5. ...was believed to | 5. Полагали, что |
| 6. ...was expected to | 6. Ожидали, что |
| 7. ...was reported to | 7. Сообщали, что |
| 8. ...was considered to | 8. Считали, что |
| 9. ...was thought to | 9. Думали, что.., |
| 10....was found to | 10.Обнаружили, что |
| 11....was announced to | 11.Объявили, что |
| 12....was known to | 12.Было известно, что |

**Упр. 37. Переведите на русский язык, обращая внимание на сложное подлежащее.**

1. He was said to be one of the most promising nuclear physicists. 2. He is said to be a good translator. 3. Roberta was known to be an honest and hard-working girl. 4. Clyde was expected to arrive at the week-end. 5. Becky and Tom were supposed to have stayed at the widow Douglas'. 6. The number of the unemployed is reported to be increasing with every year. 7. Many new textbooks are expected to be published soon. 8. The Moscow Underground is said to be the finest in the world. 9. Chernyshevsky is known to have spoken several foreign languages. 10. Ahare is known to run very fast. 11. The man was seen to take off his coat. 12. The diamond content of the mines in Western Yakutia is said to be in no way inferior to that of the world-famous South African mines. 13. That power station is known to be situated on the Angara River. 14. These devices are considered to be very effective. 15. Many books are known to be published in our country every year. 16. You are supposed to graduate in four years. 17. Radium is said to be very radioactive. 18. This device was known to have been designed in that laboratory. 19. His invention is considered to be of great importance. 20. The sun is known to represent a mass of compressed gases. 21. The new rocket is reported to go into operation next year. 22. This type of rocket is supposed to have many advantages. 23. For a longtime the atom was thought to be indivisible. 24. The helium atom was found to have two electrons. 25. I did not know what I was expected to say to that, so I said nothing.



**Упр. 38. Перефразируйте следующие предложения, употребляя сложное подлежащее.**

E.g. *We heard that a car stopped outside the door. — A car was heard to stop outside the door. It is believed that the poem was written by Byron. —The poem is believed to have been written by Byron.*

1. We know Bernard Shaw to have been a very witty man. 2. People consider the climate there to be very healthful. 3. It was announced that the Chinese dancers were arriving next week. 4. It is expected that the performance will be a success. 5, It is said that the book is popular with both old and young. 6. It is believed that the poem was written by an unknown soldier. 7. It is supposed that the playwright is working at a new comedy. 8. It is reported that the flood has caused much damage to the crops. 9. It was supposed that the crops would be rich that year. 10. It has been found that this mineral water is very good for the liver. 11. Scientists consider that electricity exists throughout space. 12. It is said that the weather in Europe was exceedingly hot last summer. 13. It is said that this man was very handsome in his youth. 14. It was reported that five ships were missing after the battle.

**Упр. 39. Переведите на русский язык, обращая внимание на сложное подлежащее.**

1. Irving turned out to be a long, pale-faced fellow. 2. His office turned out to be in one of the back streets. 3. He appeared to be an ideal man. 4, She doesn't seem to want to do anything I suggest. 5. He turned out to have no feeling whatever for his nephew. 6. This appeared to amuse the policeman. 7. You can easily get in through the window if the door happens to be locked. 8. The peasants did not seem to see her. 9. The Gadfly seemed to have taken a dislike to Signora Grassini from the time of their first meeting. 10. You don't seem to have done any great thing to yourself by going away. 11. «Jim,» he said at last, in a voice that did not seem to belong to him. 12. Money just doesn't happen to interest me. 13. Inthe middle of the lecture Dr. Sommerville happened to pause and look out of the window. 14. From the very first men. turn of Long John, I was afraid that he might turn out to be the very one-legged sailor whom I had watched for so long at the inn. 15. Clyde seemed to have been thinking of no one else but Sondra since their last meeting. 16. Clyde appeared to have forgotten of his promise to spend his spare eve. mugs with Roberta. 17. She appeared to be an excellent actress. 18. One day a Hare happened to moot a Tortoise. 19. The Tortoise seemed to be moving very slowly. 20. The Hare turned out to be the loser of the race. 21. The apparatus seemed to be in excellent condition. 22. You appear to have found in him something that I have missed. 23. This work seems to take much time. 24. The operation seemed to be a complicated one. 25. The new methods of work appear to be very effective. 26, The percentage of carbon in this steel turned out to be low.

**Упр. 40. Переведите на английский язык, употребляя сложное подлежащее.**

1. Известно, что марсианские каналы были открыты в 1877 году. 2. Предполагают, что заседание закончится в десять часов. 3. Полагают, что они знают об

этом больше, чем хотят показать. 4. Джим оказался храбрым мальчиком. 5. Рочестер случайно встретил Джейн по дороге домой. 6. Говорят, что он работает над своим изобретением уже несколько лет. 7. Говорят, что эта статья переведена на все языки мира. 8. Вы, кажется, много читали до поступления в университет. 9. Как известно, Жукове кий был прекрасным педагогом и лектором. 10. Никак не ожидали, что холодная погода наступит так рано. 11. Оказалось, что мы уже когда-то встречались. 12. Вы, кажется, устали. 13. Условия работы оказались более трудными, чем предполагалось. 14. Вы случайно не знаете этого человека? 15. Книга, которую вы мне дали, оказалась скучной. 16. Новые автобусы оказались очень удобными. 17. Из трех сестер Брон-те Шарлотта считается наиболее талантливой. 18. Как известно, английская писательница Войнич жила в течение нескольких лет в Петербурге и изучала русскую литературу. Считают, что русская литература оказала влияние на ее творчество. 19. Ваш приятель, кажется, очень интересуется древней историей. 20. Известно, что римляне построили на Британских островах хорошие дороги. 21. Полагают, что поэма «Беовульф» была написана в VIIIвеке. 22. Вальтер Скотт считается создателем исторического романа. 23. Сообщают, что экспедиция достигла места назначения. 24. Я случайно знаю номер его телефона. 25. Он оказался хорошим спортсменом. 26. Он, кажется, пишет новую статью: кажется, он работает над ней уже две недели. 27. Я случайно встретил его в Москве. 28. Говорят, что это здание было построено в XVII веке.

**Упр. 41. Раскройте скобки, употребляя голы в требующейся форме.**

1. I should be delighted if I (to have) such a beautiful fur-coat. 2. If it (to rain), we shall have to staj, at home. 3. If he (to work) hard, he would have achieved great progress. 4, If it is not too cold, i (not to put) on my coat. 5. I (to write) the composition long ago if you had not disturbed me. 6. If ho (not to read) so much, he would not be so clever. 7. If my friend (to be) at home, he will tell us what to do. 8. If he were not such an outstanding actor, he (not to have) so many admirers. 9. If you (to give) me your address, I shall write you a letter 10. If she (not to be) so absent-minded, she would be a much better student. 11. If my sister does no go to the south, we (to spend) the summer in St Petersburg together. 12. If they (not to go) to Moscow last year, they would not have heard that famous musician. 13. If you (not to get) tickets in the Philharmonic, we shall stay at home. 14. If you were not so careless about your health, you (to consult) the doctor.

**Упр. 42. Раскройте скобки, употребляя глаголы в требующейся форме.**

1. If she (to ask) me yesterday, I should certainly have told her all about it. 2. If you (to do) you1 morning exercises every day, your health would b much better. 3. If he is not very busy, he (to agree) to go to the museum with us. 4. If I (not to be) present at the lesson, I should not have under stood this difficult rule. 5. If he reads fifty page every day, his vocabulary (to increase) greatb 6. If they (to know) it before, they would ha\ taken measures. 7. If I (to get) this book, I shall I1 8- If you really loved music, you (to go) to the Philharmonic much more often. 9. If you had not wasted so



much time, you (not to miss) the train. 10. If you (not to miss) the train, you would have arrived in time. 11. You (not to miss) the teacher's explanation if you had arrived in time. 12. You would have understood the rule if you (not to miss) the teacher's explanation. 13. If you (to understand) the rule, you would have written the test-paper successfully. 14. If you had written the test-paper successfully, you (not to get) a «two». 15. Your mother (not to scold) you if you had not got a «two». 16. If your mother (not to scold) you, you would have felt happier.

**Упр. 43. Раскройте скобки, употребляя требующуюся форму сослагательного наклонения после «/ wish».**

1. I wish I (to know) Spanish. 2. I wish I (not to drink) so much coffee in the evening: I could not Bleep half the night. 3. I wish you (to read) more in future. 4. I wish I never (to suggest) this idea. 5. I wish I (to be) at yesterday's party: it must have been very merry. 6. I wish we (to meet) again next summer. 7. Don't you wish you (to see) that performance before? 8. They wished they (not to see) this horrible scene again. 9. The unfortunate pupil wished he (not to forget) to learn the rule. 10. I wish I (to have) a season ticket to the Philharmonic next winter. 11. I wish I (to consult) the teacher when I first felt that mathematics was too difficult for me. 12. I love sunny weather. I wish it (to be) warm and fine all the year round. 13.1 wish I (not to lend) Nick my watch: he has broken it. 14.1 wish you (to send) word as soon as you arrive. 15.1 wish I (not to have) to do my homework every day. 16. I wish you (to go) skiing with me yesterday: I had such a good time!

**Упр. 44. Перефразируйте следующие предложения, употребляя «/ wish ».**

E.g. It's a pity you are ill. I wish you were not ill.

1. It's a pity you are not with us these days. 2. My friend regrets not having entered the university. 3. He was sorry not to have had enough time to finish his test-paper. 4. It's a pity we shan't be able to reach home before tea-time. 5. I am sorry I made you upset by telling you this news. 6. What a pity you don't know enough physics.

7. Unfortunately they won't return before Christmas. 8. The student was sorry he had not studied the material better and had shown such poor knowledge at the examination. 9. It's a pity that you did not send for us last night.

**Упр. 45. Переведите на английский язык.**

1. Если бы он был умнее, он бы не пошел вчера в лес. 2. Если бы она не прислала вчера это письмо, мой брат был бы сейчас дома. 3. Что бы мы сейчас делали, если бы мама не испекла вчера пирог? 4. Жаль, что вы не слышали музыку Рахманинова. Если бы вы ее слышали, вы бы знали, какой это замечательный композитор. 5. Я уверен, что все были бы рады, если бы вечер состоялся. 6. Он так изменился! Если бы вы его встретили, вы бы его не узнали. 7. Если бы я был на вашем месте, я бы посоветовался с родителями. 8. Если бы сейчас подошел трамвай, мы бы не опоздали. 9. Если бы он знал, что это вас расстроит, он был бы осторожнее. 10. Если бы вы мне помогли решить эту задачу, я был бы вам очень благодарен. 11. Жаль, что нам раньше не пришло в голову поис-

кать книгу в библиотеке. Мы бы сделали работу вовремя и сейчас были бы уже свободны. 12. Жаль, что у нас было так мало уроков. Если бы мы больше поработали, мы бы лучше знали язык. 13. Если бы он регулярно не посещал спортивные тренировки, он не добился бы такого успеха на состязаниях. 14. Если бы ты предупредил меня заранее, я бы уже был в Москве. 15. Жаль, что она уже ушла. Если бы ты позвонил раньше, она была бы сейчас здесь.

**Упр. 46. Переведите на английский язык.**

1. Если бы я знал французский, я бы уже давн о поговорил с ней. 2. Если бы я знал немецкий язык, я бы читал Гете в оригинале. 3. Если бы я жил близко, я бы чаще заходил к вам. 4. Если бы вы не прервали нас вчера, мы бы закончили работу в срок. 5. Если бы он не следовал советам врача, он бы не поправился так быстро. 6. Если бы он не был талантливым художником, его картину не приняли бы на выставку. 7. Если бы вы тогда послушались моего совета, вы бы не были сейчас в таком затруднительном положении. 8. Если бы я не был так занят в эти дни, я бы помог тебе вчера. 9. Если бы он не был так близорук, он бы узнал меня вчера в театре. 10. Она здорова. Если бы она была больна, ее брат сказал бы мне об этом вчера. 11. Вы бы много знали, если бы регулярно читали этот журнал. 12. Если бы я узнала об этом раньше, то не сидела бы сейчас дома. 13. Если бы мои родители были богаты, они бы уже давно купили мне машину. 14. Она очень талантлива. Хорошо бы родители купили ей пианино. Если она начнет играть сейчас, она будет выдающимся музыкантом.

## REVISION GRAMMAR EXERCISES

### THE PASSIVE VOICE

**Ex. 1. A.** 1. There are a number of coloured substances, in a natural fibre that are changed to colourless products by reaction with oxygen. Many of these substances are not affected by atmospheric oxygen. 2. Complete precipitation is often ensured by the use of the common ion effect. 3. A few of the uses of aluminium have already been referred to in the article published this month. 4. Ions, such as the hydronium ions, which are made up of several atoms held together by covalence, are known as radicals. 5. An unsaturated compound is defined as one in which the maximum valency is not exerted by all the component atoms. 6. Cellulose acetate is unaffected by weak acids, oils and most solvents. 7. Since X-ray patterns for some amorphous substances are similar to those of fluid liquids, they are looked upon as liquids which have high viscosities and are often referred to as supercooled liquids. 8. The preparation of sodium chromate from chromate ores has already been spoken of. 9. The discovery of manganese is usually credited to Cahn. 10. This question can't be answered at once. It should be thoroughly studied. 11. The heating of the solution was followed by a sudden cooling, which resulted in forming of a new product. 12.



Oxidation has been defined as the losing of electrons. 13. The same procedure is followed in deriving the formula of a compound containing more than two elements. 14. Gold is slowly attacked by fused nitrates and alkali-metal hydroxides. 15. Glass and silica are not attacked by sulphuric acid of any strength.

B. 1. The experimental results will be referred to in the article which is to be published in our local journal. 2. Enough has already been m1tten about this new discovery. 3. After a long discussion the decision was arrived at. 4. Lately much attention has been given to the artificial fibres which can be produced from oil. 5. All his remarks about this new work have been taken into account and particular consideration is given to the experimental part. 6. The conference was attended by many foreign scientists working in the field of nuclear physics. 7. They have been given the results of the tests carried out in our laboratory. 8. The agreement between these two relations can be reached if you examine the data thoroughly. 9. Once the distribution of gas velocities has been calculated, the final step is to determine the nature and extent of the separation of uranium isotopes in the gas. 10. The composition of the product is profoundly affected by addition of chlorine and hydrogen chloride. 11. The rate of reduction of the amount of oxygen was affected bi the oxidizing conditions. 12. Any neutrons and protons left over after the formation of the maximum number of alpha-particles are looked upon simply as being present in the nucleus. 13. This technique has been followed in our research work and it proved to be very reliable. 14. They were offered a very interesting work which could result in a new discovery. 15. The method of preparation of oxygen by the decomposition of potassium chlorate was described in chapter 5. 16. Special mention must be made of the extensive research now being conducted in biochemistry. 17. The electrons in any one energy level were spoken of as if they all possessed exactly the same quantity of energy. 18. In general the oxidation number is thought of as representing the net electrical charge on the atom. 9. These calculations can be fully relied on as they have been checked repeatedly. 20. The coefficient of heat transfer in any vaporator is considerably affected by the magnitude of the temperature drop, the rate of circulation and some other factors. 21. For many years it has been known that some substitution reactions of complex ions are hastened by light. 22. The reactions were followed by titration with a standard base. Methyl Red — Metylene Blue was used as indicator. 23. Platinum is attacked only slowly by fluorine. Copper and steel can be used as containers for the gas; they are attacked by it, but become coated with a thin layer of copper fluoride or iron fluoride which then protects them against further attack.

### THE PARTICIPLES

1. This behaviour can be understood in the light of the formation reaction in which the electric fields of completed molecules or ions interact with adjacent ions or molecules, thus forming compounds of a higher order. 2. Based on the laws of conservation we can formulate chemical equations with a somewhat greater measure

of justification. 3. Depending on their chemical compositions, solvents are divided into polar and non-polar solvents, and intermediary types, non-polar solvents being organic hydrocarbons. 4. The pressure exerted on the walls of a container by a gas is entirely due to collisions that take place between the moving molecules and the walls. 5. All of the carbonions described are powerful nucleophiles, they being used for the reactions given below. 6. When considering the stability of equilibrium, we should start from some definition and, using this, investigate the given system, the investigation might proceed in two ways. 7. Some of the compounds involved have not been reported previously, additional data being reported in the appendix referred to in this report. 8. The results obtained for the analyses of a group of synthetic mixtures were as satisfactory as those obtained from other group methods. 9. All the processes described above take place more or less simultaneously, the hydrolysis of acetylchlorine resulting from a combined action of all the functional groups. 10. This indicates that the carbon dioxide evolved on heating results solely from the decomposition of carboxyl groups referred to earlier, one carboxyl group giving one mole of carbon dioxide. 11. The temperature remaining constant, the volume of a given mass of a gas is inversely proportional to the pressure to which it is subjected. 12. Having replaced some of the details of the new device they could get better results which were of great importance for the research concerned. 13. The results obtained were in good agreement with the values involved. 14. A small amount of common salt when added to water will be taken up by the water and become invisible. 15. Having examined the new work carried out by our research workers we could say that various lines of technological progress, ranging from the invention of new devices to the development of some industrial chemical processes were characterized by a steady improvement. 16. The terms insisted on in this statement are to be discussed again. 17. The data derived are to be found in table 5, they being reliable. It's obvious from the results given above. 18.Surrounding the nucleus were electrons, their number depending upon the atom. 19. The experiment spoken of is to be carried out again. 20. Substances thought of as radioactive should be treated carefully. 21. The conference attended by our students was devoted to the pollution problem. 22. When solving a non-linear problem described by differential equation, we must first design the computing diagram of the machine. 23. The temperature having been raised, the vapour began forming again. 24. Any neutrons and protons left over after the formation of maximum number of alpha-particles are looked upon simply as being present in the nucleus.

## THE SUBJUNCTIVE NOOD AND CONDITIONAL SENTENCES

1. Had they taken into account the weight before heating they would have made less mistakes. 2. Thus, the deuterium, the nucleus of H2 could be considered to be built up from a proton and a neutron. 3. Had the condenser been placed in a direct current the current would have started flowing as though the condenser were not present. 4. Were water allowed to run back into the generator an explosion might result. 5. It is necessary that they should determine whether or not this inorganic



substance is contained in the sample to be analysed. 6. It is necessary that atomic energy should be used only for peaceful purposes.7. A reliable device for neutron storage could greatly simplify the procedure, so that only one detector would be needed. 8. It is desirable that the determination of the effect of glass composition should be made. 9. If no catalyst were employed in cracking, the process would be called "thermal cracking" 10. If the gas were colourless, we should not notice its formation; we should have noticed the formation of this gas if it hadn't been colourless. 11. If analytical balances were used the results would be much more precise. 12. If air were a single compound the bubbles escaping from the solution would have the same composition as those of undissolved air. 13. If the liquid were placed between the plates of a condenser and an electric field applied, the molecules would tend to orient themselves both —.o positive and negative plates. 14. Had water been purified carefully they wouldn't. repeat the experiment. Remember; water has to be purified lest it should contain microbes. 15. If two liquids had been mutually insoluble, neither one would have lowered the vapour pressure of the other. 16. It is desirable that the sample should be weighed again as the weight does not confirm our data. 17. If a crucible filled with pure arsenic were heated to a temperature above the melting point of the arsenic, and the system were then allowed to cool, it would be noted that the temperature would increase steadily with time. 18. If pure lead were used the falling drops would solidify rather suddenly on reaching the temperature 327'C. 19. If we contemplated water in a glass, the water would appear optically uniform. At any rate, we cannot discern any difference in the appearance of the water at the bottom of the glass and on the surface.20. If there was no order in the way in which atoms of different elements combine to form the molecules and crystals of compounds, it would be necessary for us to - memorize one by one the formulas of thousands of substances. 21. If an electron were to be removed from the sodium atom, leaving only 10 electrons around the nucleus, the resulting partic1e would have a positive charge, this particle composed of a sodium nucleus and 10 electrons, being called a sodium ion. 22. If the absolute temperature were doubted, the speed of the molecules would increase. 23. If some iodine crystals are put into a flask, which is then stoppered and allowed to stand at room temperature it would soon be seen that the gas in the flask becomes violet in colour, showing that a quantity of iodine evaporated.

## THE INFINITIVE

1. Reaction appears to be almost instantaneous at room temperature. 2. To test the validity of these assumption, we have to study the reactions of two representative nitrones. 3. However, since the problems to be investigated cannot be solved even in an idealized form by linear differential equation, the differential equation, which we are to use wi.l have to be non-linear. 4. The system under investigation is considered to be in a state of equilibrism, when all the co-ordinates are constant with respect to the time. 5. Hence, the Young's model appears to be too simple and needs to be modified to fit the present experimental findings. 6. He was always the first to take up

the most difficult problems and to solve them. 7. One can hardly expect a true scientist to work in the limits of one narrow field. 8. To find the length of an object was a very difficult task and we had to carry out a lot of experiments. 9. Once the distribution of gas velocities has been calculated, the final step is to determine the nature and extent of the separation of uranium isotopes in the gas. 10. The only practical way to detect a slow neutron is to allow it to be absorbed by a nucleus. 11. Since we are to deal very largely with ions in our reactions it is necessary to remember that the solution should be diluted. 12. The science of organic chemistry is a very extensive one, and the selection of a small number of facts to e resented in these two chapters has to be restricted. 13. Urea was ong considered to be the first organic compound, it is known first to be produced in the laboratory. 14. Nylon is known to have been made in several different firms; the first to be produced commercially was the most important. 15. The order of some reactions is known to have been determined by measuring the time required for a constant fraction of reaction to occur. 16. Every living organism can be shown to be made of cells. 17. Since the enzyme concentration in living cells is likely to be difficult to estimate we often speak about their activities. 18. Over the past few years much attention is known to have_been given to unimolecular reactions driven by lasers. It has also been stated lasers to find wide application in chemical industry. 19. This assignment is too difficult to be carried_out at once, it is to take at least ten days or even more. 20. In qualitative analysis we have to deal with the amphoteric characteristics of the hydroxides.2l. Since we are to deal very largely with ions in our reactions it is necessary to remember that the solution has to be diluted.to su a degree that the substance is largly ionized. 22. The absorption of a quantum of visible or ultraviolet radiation could be exected to alter the state of excitation electronic structure of an atom or a molecule.

## PART II

### Методические указания к выполнению реферативных переводов и аннотирования

#### 1. Учебные цели и задачи реферативных переводов.

**Реферирование** – краткое изложение текста. Цель – в наиболее краткой форме передать содержание подлинника, но выделить особо важное или новое, что содержится в реферируемом материале.

Целью реферативного перевода является подготовка студентов (будущих специалистов в той или иной области и ученых) к работе с иноязычной литературой по выбранной специальности, так как часто возникает



необходимость краткого изложения по-русски тех или иных иноязычных материалов, содержащих ценную информацию.

Работа над реферативным переводом заключается в рамках следующих действий:

- выделение ключевых фрагментов текста
- полное или частичное перефразирование части выделенных ключевых фрагментов.
- обобщение смысловых кусков реферируемого текста и их стяжение на родном языке
- изложение полученных стяжений при условии введения в новый текст переходных элементов, подсказываемых логикой развития мысли.

#### П. Структура реферативного перевода

2.1. реферативный перевод должен содержать:

- титульный лист
- план
- выходные данные печатного материала (название, имя автора, источник, год издания)
- основное содержание текста
- выводы

Оптимальный объем 5-7 страниц машинописного текста через 1,5 интервал

**Аннотация** – это предельно сжатая характеристика материала. В отличие от реферата, аннотация не может заменить самого материала, так как она призвана дать лишь общее представление о содержании книги или статьи. Именно поэтому для аннотирования важно определить что является самым главным.

**Аннотированием** называется процесс составления кратких сведений о печатном произведении (книге, статье, докладе и т.д.), позволяющих судить о целесообразности его более детального изучения. При аннотировании учитывается содержание произведения, его назначение, ценность и направленность.

Аннотация должна быть написана простым языком без использования ненужных и малопонятных терминов. Она должна в сжатой форме сообщать, о чем говорится в тексте и какую пользу от его прочтения можно получить, т.е.

какие теоретические и/или практические знания дает это произведение, и какие требования к читательским знаниям предъявляет.

**План реферирования.**
**The Plan of Rendering Newspaper Article**

1. The title of the article.
   a) The headline of the article is ...
   b) The article is headlined ...
   c) The headline of the article I've read is...
2. The author of the article
   a) The author of the article is...
   b) The author of the article is ...
   c) The article is written by ...

3. Where and when the article was published.
   a) The article is taken from the newspaper...
   b) It is (was) published in ...
   c) it is (was) printed in ...

4. The main idea of the article.
   a) The main / central idea of the article is ...
   b) The article is about ...
   c) The article is devoted to ...
   d) The article deals with ...
   e) The article touches upon ...
   f) The purpose of the article is to give the reader some information on ...
   g) The aim of the article is to provide the reader with some facts/material/data on ...

5. Give a summary of the article (no more than 10-20 sentences).
   a) The author starts by telling (the reader) (about, that ...)
   b) The author writes (states, stresses upon, thinks, points out) that ...
   c) The article describes ...
   d) According to the text ...
   e) Further the author reports (says) that ...
   f) The article goes on to say that ...

6. State the main problem discussed in the article and mark off the passages of the article that seem important to you.



7. Look for minor peculiarities of the article.

8. Point out the facts that turned out to be new for you.

9. Look through the text for figures, which are important for general understanding.

10. State what places of the article contradict your former views.

11. State the questions, which remained unanswered in the article and if it is possible add your tail to them.
12. Speak on the conclusion the author comes to.
   a) In conclusion ...
   b) The author comes to the conclusion that ....
13. Express your own point of view on the problem discussed.
   a) I find/found the article topical=urgent (interesting, important, dull, of no value, too hard to understand) because ...
   b) In my opinion the article is worth reading because ....

**Союзы и коннекторы:**

| | |
|---|---|
| 1. according to | в согласии с, по, согласно чему-либо |
| 2. accordingly | соответственно |
| 3. and | вследствие |
| 4. and | итак, и так как |
| 5. and so | и потому |
| 6. as a result | в результате |
| 7. as | так как; потому что |
| 8. consequently | в соответствии с, следовательно |
| 9. due to the fact (that) | из-за, в результате |
| 10.hence | следовательно, отсюда |
| 11.in accordance with | согласно, в соответствии с |
| 12.now that | в силу того что, теперь, когда |
| 13.or else | а иначе |
| 14.otherwise | в противном случае |
| 15.owing to the fact (that) | из-за, в результате |
| 16.seeing that | принимая во внимание |

| | |
|---|---|
| 17.so II | итак, и поэтому |
| 18.so that, so…that,<br>19.such that | из-за этого, так что, так…что |
| 20.thanks to the fact (that) | благодаря (тому что) |
| 21.that's why | вот почему |
| 22.then | в таком случае, тогда |
| 23.thereby | вследствие этого, в результате,<br>и таким образом |
| 24.thereupon | в результате |
| 25.thus | таким образом |
| 26.whereby | и поэтому |

## TEXTS FOR RENDERING AND ANNOTATION

### Advanced Chemistry Projects - Corrosion

Corrosion is important to the economy of every country as also to the world. It is widely studied as bridges and buildings uses iron supports. Untreated iron would collapse and lead to loss of both, life and economy. At the K-11or K-12 grades the study of corrosion is dealt using electrochemical principles. A project based on quantitation of oxygen in the formation of ferric oxide is suggested.

Corrosion is the process wherein a metal is oxidized by loss of electrons to more electronegative elements like oxygen, sulfur etc. With the formation of metal sulfides and oxides. Corrosion of iron occurs primarily in the presence of moisture and oxygen. It is an electrochemical phenomena where iron acts as an anode and oxygen as cathode.

Oxidation: Fe(s)-Fe2+(aq) + 2e-
Reduction : O2(g) + 4H+(aq) + 4e-2H2O (l)
Atmospheric oxidation-
2Fe2+(aq)+2H2O(l) +1/2 O2(g) Fe2O3(s)+ 4H+(aq)

In the process of corrosion, iron gets oxidized to ferric oxide. Hence an informative study would entail, tracking the consumption of oxygen. Weigh a known amount of iron filings or iron wire and place it in a netted bag. Place this in a measuring cylinder. In a beaker containing a known volume of water invert a measuring cylinder containing one third the volume of water. The height of the water in the empty measuring cylinder rises till the point where there is air trapped. Note this volume of air. Similarly, placing the netted bag containing iron filings in the measuring cylinder, filled one third with water and invert it into a beaker containing the same volume of water.



Note the volume of air trapped. As rust begins to form and oxygen is utilized the water level in the measuring cylinder rises. The process of rusting may take a maximum of three to four days at 30oC.

The experiment at the K-11 or K-12 grade can be made more quantitative by calculating the amount of oxygen that has combined with the iron filings. The rust formed is weighed. From the weight of the iron oxide formed, the amount of oxygen that has stoichiometrically combined with the given amount of iron filings can be determined.

From the volume change of the water level, the amount of oxygen utilized can be approximated. Thus the first part of the project on corrosion would throw light on the oxygen consumption in the formation of rust. A further step ahead would be to determine the oxygen consumption and formation of rust under different pH conditions. Similarly, presence of electrolytes that would expedite the formation of rust can also be studied.

### All that is small is not nano

14 September 2009

US and French scientists say the term 'nanoparticle' needs to be redefined to provide a focus for environmental, health and safety studies, and future regulation. According to the researchers, nanomaterials should be categorised based on novel properties that are related to their small size - not, crucially, their size alone.

In most countries, few or no specific regulations exist to govern the safe use of nanoparticles, despite their wide use in cosmetics, sun screens and some drug products. Until a decision can be reached on what exactly constitutes a nanoparticle, however, there can be no clear path forward. Although traditionally thought of as any particle smaller than 100nm, the researchers argue in a review published in *Nature Nanotechnology* that for the purposes of health and safety, a more rigorous approach to classification is needed[1].

Lead researcher Mark Wiesner of Duke University, US, says it is too easy to tar all nanoparticles with the same brush. 'All that is small is not necessarily nano,' he says. 'You need to have that novel property. The question then becomes: what's the taxonomy of these nanomaterials?'

The review highlights various novel physicochemical characteristics of nanoparticles that might help form the basis for Wiesner's new taxonomy. Size-dependent changes in the crystal structure of particles, for example, can influence their reactivity - importantly, changing how they interact with their environment.
Despite stressing 'novel properties', however, the study points towards particles at the lower end of the nano spectrum as being the most likely to bear characteristics that

would provoke cause for concern. If you want to find a hazardous nanoparticle, you should probably look below the 30nm barrier, says Wiesner.

But by narrowing the focus to particles below 30nm, is Wiesner falling into the same trap as those who claim the 100nm barrier holds any special significance? Ken Donaldson of the Safety of Nanomaterials Interdisciplinary Research Centre in Edinburgh and the author of another recent review of nanoparticle safety[2], argues that there is no proven consequence of any size-related change in properties. 'If you focus only on this "quantum effect" of the change in physicochemical reactivity... then [the study] shows that this does set in only at sizes below 30nm. But in general there is no rational basis for restricting the definition of nanoparticles to those below 30nm. It would be premature and without toxicological basis,' he says.

Teresa Fernandes, a nano safety expert at Edinburgh Napier University, worries that redrawing the boundaries will encourage the idea that there is no need to regulate above 30nm. But she says Wiesner's work is important because it promotes debate.

Wiesner reasons that the 30nm limit is simply a guide. 'I think it helps us focus on what materials might be of concern in developing regulations, but you can't imagine that you define something at 30nm as toxic and 31nm as non-toxic,' he says. 'The focus on novel properties, I think, is one categorisation scheme that might have some relevance for long term approaches to regulation.'

*Hayley Birch*

## Chemical Properties of Stainless Steel

Stainless steel is widely used for making utensils. Read on to know about the chemical properties of stainless steel that make it so popular in utensil-making...

Stainless steel is a metal alloy which is preferred for making kitchen utensils, because it does not affect the flavor of food. The surfaces of stainless steel utensils are easy to clean. Minimal maintenance and total recycling of stainless steel utensils also contribute to their popularity. Stainless steel is the universal name for a metal alloy, that is made up of chromium and iron. It is called stainless as it is highly resistant to stains (rusting).

### Chemical Properties of Stainless Steel

Pure iron is the main element of stainless steel. Pure iron is prone to rusting and is highly unstable, as it is extracted from iron ore. Rusting of iron is due to its reaction with oxygen, in the presence of water. Chromium is a metal that stalls the oxidization of iron. Chromium forms a transparent and passive layer of chromium oxide, which prevents mechanical and chemical damage. The other minor constituents of steel are



nickel, nitrogen and molybdenum. Small contents of nickel increase the corrosion resistance further, and protect stainless steel from rough usage and harsh environmental conditions. Pitting or scarring is avoided by adding molybdenum to steel. Chemical properties and structure of the stainless steel is improved using other alloys. Titanium, vanadium and copper are the alloys which make stainless steel more suitable for specific uses. Not only metals, but also non-metals like nitrogen, carbon and silicon are used to make stainless steel.

### Classes Depending on Chemical Properties of Stainless Steel

The five classes of stainless steel are austenitic, martensitic, duplex, ferritic and precipitation-hardening. The chemical composition of these five classes are as follows:

***Austenitic Stainless Steel***: This steel is called austenitic because it is made from austenitizing elements. Iron, nickel and chromium are the basic austenitizing constituents of this type of stainless steel. This steel has high ductility and relatively high tensile strength. Approximately, 16-26% chromium and less than 35% nickel are the typical contents of this steel. Applications are:

- Petrochemical industries
- Food processing industries
- Kitchen sinks
- Chemical plants

***Martensitic Stainless Steel***: This steel is called martensitic as it possesses a martensitic crystal structure in hardened condition. Chromium and carbon are the main contents of martensitic stainless steel. This type of stainless steel are less resistant to corrosion. Around 18% chromium and 1% carbon make the martensitic stainless steel. Applications are:

- Surgical instruments
- Knives and blades
- Shafts and spindles

***Ferritic stainless steel***: This type of stainless steel is ferromagnetic in nature. This steel has relatively good ductility and is usually used to make kitchen utensils. Approximately 30% chromium is present along with iron. Applications are:

- Automotive exhaust
- Automotive trims
- Computer floppy disk hubs

***Duplex stainless steel***: This type of steel is used in chloride and sulphide environments and is least corrosive. It is a mixture of ferritic and austenitic stainless steel.

Primary constituents are chromium and nickel. Applications of duplex stainless steel are

- Oil and gas explorations and off-shore rigs
- Chemical processing, transport and storage
- Pulp and paper manufacturing

***Precipitation hardening stainless steel***: This type of steel is made from chromium and nickel. Precipitation hardening stainless steel is made from annealed martensitic or annealed austenitic stainless steel. Annealing of stainless steel is the process of heating steel to change the chemical and physical properties of stainless steel.

Chemical properties are responsible for the corrosion resistance and mechanical structures of stainless steel which are important for selecting the perfect grade for the required application. Stainless steel has a basic property of corrosion-resistance. The factors affecting this property are chemical composition of the corrosive medium, chemical composition of metals used, temperature and temperature variations, oxygen content and aeration of the medium. Thus, slight variations in chemical compositions can be used to make wide variety of stainless steel. Stainless steel is 100% recyclable and is therefore environment friendly.

## Chemistry Experiments for Kids

Kids chemistry experiments are a fantastic way of teaching kids about chemistry through a practical perspective. Keeping that in mind, we have a look at some simple chemistry experiments for kids in the following article.

Kids have always been fascinated with chemistry and chemistry experiments. I am no different either. Pouring some strange sort of magic potion into a test tube filled with another weird looking liquid, and watching the colorful reaction that follows...chemistry experiments are an absolute visual treat, in addition to being extremely educational and entertaining. Kids will be thrilled to know that there are quite a few kids chemistry experiments that can be performed at home itself. No complicated laboratory stuff required, no smelly fumes involved. Home chemistry experiments are quite simple and can be real fun! On that note, let us have a look at a few easy to perform middle school chemistry experiments for kids.

### Chemistry Experiments for Kids

Before we proceed to any sort of experiments based on chemistry for kids, these are some precautions that you need to take:



- Wear old cotton clothes while performing these experiments. If possible, wear a chemistry lab coat to protect your clothes from getting stained.
- Do not fool around with chemicals or chemical elements. They can be extremely dangerous and can cause serious harm if misused.
- Always perform these experiments under the supervision of your parents or any other elder person.

**Experiment #1: Invisible Ink**

Many of you may have read about this one in the mystery novels for children. You can make invisible ink in two ways:

- Squeezing a couple of lemons into an empty bowl.
- Mixing an equal amount of baking soda and water.

If you have a spare ink pen, fill it with this newly created invisible ink. Alternatively, you can also use a cotton swab to serve the purpose of a pen. Take a blank sheet of white paper. Using the ink pen (or the cotton swab dipped in the liquid solution) write a few words on the sheet of paper. Wait for a couple of minutes after which you should hold the paper over a low flame. You will see the invisible ink darkening and you will be able to read the secret message!

**Experiment #2: Density Column**

This experiment is aimed at teaching you the concept of density of liquids. You will need a regular cocktail glass for this purpose. If you do not have a cocktail glass, a regular tall glass will also do. We will use a variety of liquids, namely - water, honey, lamp oil, maple syrup and dish washing soap. First pour the honey, then the maple syrup, followed by the dish washing soap. Finally, pour the water and top it with lamp oil. Let the liquids settle for a minute after which you can observe the density column. As we have poured the liquids in decreasing order of densities, you will see lamp oil as the topmost layer whereas the layer of honey will be right at the bottom.

**Experiment #3: Vinegar Volcano**

You will need an empty soda bottle and some flour dough to cover the bottle from all sides. Mold the dough around the bottle (leaving the top uncovered) such that it resembles a cone-shaped volcano. Fill sixty percent of the bottle with colored warm water. Now add a little bit of dish washing detergent to the warm water. Top that with a couple of spoons of baking soda. Finally, pour the vinegar into this mixture and lo and behold, you have a volcano erupting right here in your kitchen!

**Experiment #4: Disappearing Eggshell**

Place a hard-boiled egg into an empty glass jar. Fill the jar all the way to the top with vinegar and seal it tightly. Place the jar on a shelf and let it remain that way for a week. After a week has passed, unscrew the lid and take the egg out of the jar. You will notice that the eggshell has disappeared! Where did it go? Was this a magic

trick? No, it wasn't. The eggshell reacted with the vinegar due to which it got absorbed into the vinegar solution, leaving you with a bare, boiled, rubbery egg!

These were some easy home-based chemistry experiments for kids. Try them out and boast about your chemistry knowledge in front of all your friends!

**Chemistry of Acid Rain**

Any form of precipitation which is acidic in nature is called acid rain. Acid rain is the result of excessive emissions of sulfur and nitrogen caused by human activity, which reacts with other compounds to form acids. Acid rain has detrimental effects on animals, plants and infrastructure.

In its purest state, rain water is like distilled water. It does not have carbon dioxide dissolved in it. It is neutral, with a pH level of 7. pH is the concentration of hydrogen ions in an aqueous solution. If the pH level is above 7, it is said to be basic, and if it is below 7, it is said to be acidic in nature.

As rain water falls through the atmosphere, particles suspended in the air are dissolved in it. These substances are generally dust, pollen grains and carbon dioxide ($CO_2$). Emissions of volcanoes and lightning tend to decrease the pH level of acid rain, making it even more acidic. $CO_2$ combines with water to form carbonic acid ($H_2CO_3$).

$H_2O(l) + CO_2(g) = H_2CO_3(aq)$

Carbonic acid ionizes in water to form low concentrations of carbonate and hydronium ions.

$2H_2O(l) + H_2CO_3(aq) = CO_3^{2-}(aq) + 2H_30^{+}(aq)$

Carbonic acid is a weak acid. It brings down the pH of the rain water to 6.0-5.2. With pH levels ranging between 6.0-5.2, rain water is acidic, but still not dangerous. This is a reversible reaction.

The problem occurs when rain water combines with gaseous oxides of sulfur, nitrogen, and phosphoric and hydrochloric acid mists. The latter two and sulfur are released into the atmosphere from automobile exhausts, industries and electric power plants. Nitrogen forms a major part of atmospheric composition. These chemicals bring down the acid rain pH level to 5.6-3.5. Sometimes, the pH level can even become as low as 2. This phenomenon of acidic rain water precipitation, is called acid rain. Rain, snow, sleet, freezing rain, hail, fog and dew are other forms of precipitation.



**Chemistry of Acid Rain**

Sulfuric acid and nitric acid are the main acids present in acid rain. Sulfuric acid is formed as follows:

- Sulfur released into the atmosphere combines with atmospheric oxygen to form sulfur dioxide ($SO_2$)
- Sulfur dioxide reacts with atmospheric water to form sulfurous acid - $SO_2(g) + H_20(l) = H_2SO_3(aq)$
- Sulfurous acid is also present in acid rain.
- Sulfur dioxide gradually oxidizes to form sulfur trioxide ($SO_3$) - $2SO_2(g) = O_2(g) = 2SO_3(g)$
- Sulfur trioxide reacts with water to form Sulfuric acid ($H_2SO_4$) - $SO_3(g) + H_20(l) = H_2SO_4(aq)$

Nitrogen dioxide($NO_2$) is formed as follows:

- Nitrogen combines with atmospheric oxygen to form nitrogen dioxide ($NO_2$). Nitrogen dioxide reacts with water to form nitrous acid ($HNO_2$) and nitric acid ($HNO_3$) - $2NO_2(l) + H_2O(l) = HNO_2(aq) + HNO_3(aq)$

Acid rain is a mild combination of mainly sulfuric and nitric acid. Sulfurous acid and nitrous acid are less stable and are present only in very low amounts. Following are the various adverse effects of acid rain on living organisms and infrastructure.

**Buildings and Monuments:** Acid rain causes severe damage to buildings and marble statues. Acid rain reacts with the calcium carbonate ($CaCo_3$) to form soluble calcium hydrogen carbonate or calcium bicarbonate, $Ca(HCO_3)_2$ - $CaCO_3$ + Acid rain = $Ca(HCO_3)_2(aq)$
Calcium bicarbonate is a powdery substance, which is easily washed away with water or more specifically, rain water. This is the way acid rain has partly eroded many world-famous monuments and buildings like the Taj Mahal in India, St. Paul's Cathedral in London, and the Statue of Liberty in New York.

Acid rain can destroy stained glass windows in churches, bridges made of steel, and railway tracks. It corrodes metal, ruins the paint color, weakens leather and forms a crust on glass surfaces.

**Trees and Plants:** Acid rain washes away important minerals from leaves and soil. Acid rain also blocks the small pores on the leaves' surface, through which they take in carbon dioxide. With improper functioning of leaves, the growth of trees gets retarded. This results in a loss of leaves, stunted growth and damaged bark. Such trees are more prone to attacks by fungi and insects. This can even result in the death of trees.

**Soil:** Soil contains many harmful minerals such as mercury and aluminum. These elements can't be absorbed by plants and trees and are thus harmless. Upon contact with acid rain, these chemicals undergo chemical reactions with the acids. As a result, compounds of aluminum, lead and mercury are formed. Plants and trees can easily absorb these compounds. Such elements, which are extremely harmful to living forms, ultimately affect the entire food chain. These chemicals not only harm the flora, but also the animals that feed on them.

**Water Bodies:** Harmful substances like aluminum, lead and mercury, as discussed above, are washed away from the soil to neighboring water resources by the acid rain, thus resulting in water pollution. These chemicals and their acids do not allow the flora and fauna to grow and reproduce. This also results in depletion of oxygen levels in water, thereby making it difficult for fish to respire. They die due to suffocation and poisoning caused by the presence of these chemicals.

Birds that feed on fish that are affected by these harmful chemicals, accumulate these elements in their systems. These chemicals are then passed on to animals that feed on such birds. In this manner, chemicals get introduced to each trophic level of the food chain. In each trophic level, the concentration of chemicals gets multiplied. This phenomenon is known as biomagnification.

**Human Health:** Acid rain is harmful to human health. Drinking water contaminated by aluminium, mercury and lead is highly dangerous for human health.

Acids are very small and fine particles. They are normally in a liquid state. When they are present in the atmosphere, they easily enter the lungs while breathing. Research has proven that these particles can even lead to cancer.

**Solutions to Acid Rain**

Acid rain is potent enough to destroy life on Earth. It damages anything it comes in contact with. It ruins forests, water bodies, soil, infrastructure, and the health of living beings. It's high time we take all possible measures to control it. There is a solution to every problem, and acid rain is no exception. Take a look at the various measures we can take.

- Human beings should reduce the use of fossil fuels. This would lessen the emission of nitrogen and sulfur in the environment.
- Public transportation, car pools and walking can reduce nitrogen, sulfur and lead emissions into the atmosphere.
- Sulfur and nitrogen are mostly released into the atmosphere from the burning of fossil fuels (e.g. Coal). Switching over to alternative forms of energy such as geothermal, water, wind, and solar power would help to a great extent.



All of the above measures are simple steps that can easily be adopted on an individual level. Acid rain has become an international issue because of its serious and definite danger to life on earth. Many international treaties have been signed i.e. the Sulfur Emissions Reduction Protocol and the Convention on Long-Range Transboundary Air Pollution. Installing Flue Gas Desulfurization e.g. wet scrubber in coal-burning power plants to remove sulfur-containing gases - is one of the steps taken by the USA, and is followed by a number of developed and developing countries.

Let's take all the steps possible to give the next generation of the human race and all living organisms on this planet, a cleaner and safer environment to live in.

## Chinese melamine crisis prompts call for better tests

09 October 2008

Hepeng Jia/**Bejing, China**

The Chinese government must invest in a systematic program of research to improve testing methods if it is to avoid further problems with food contamination, say analytical chemistry experts. Their calls come after milk powder contaminated with melamine sickened at least 54,000 babies, killed four in China through kidney stones, and made its way into chocolates and biscuits exported around the world.

Melamine, a nitrogen rich crystalline compound used to make plastics, fertilizers and cleaning products, was added by many Chinese dairies and distributors to inflate the protein content of their milk powder, with fatal results. Protein content - determined by measuring nitrogen concentration - is the standard measure of milk quality.

While the government's food safety watchdog found no traces of melamine in liquid milk during its round of tests in early October, industry experts say that testing methods for food contamination need to be better studied and updated to take advantage of the latest technology. And instrument makers have warned that current testing methods may be inadequate.

**Analytical uncertainty**

Wang Bing, CEO of Beijing Techmate, which represents Japanese cosmetics firm Shiseido's analysis wing in China, says that the methods currently being used to analyse milk may not detect other contaminants that might also be present.

This is important because the impure industrial melamine added to milk often contains a second compound, cyanuric acid. The two chemicals together can form insoluble crystals, which can lead to the formation of kidney stones and ultimately kidney failure. Melamine alone is less toxic - though prolonged exposure to the compound could also cause health problems.

In addition, Wang says, different technical approaches - such as liquid chromatography and gas chromatography - give quite different results when used to test for melamine. But so far there have been no efforts from either the government or aca-

demia to work out why. 'More systematic approaches must be adopted in food contamination tests,' Wang told *Chemistry World*.

Zhu Min of Perkin Elmer, who is responsible for melamine analysis at the firm, says contamination testing should make better use of the latest technologies. 'Molecular analysis technologies have been mature for 10 years, yet nitrogen levels remain the sole measure used to determine milk's protein content,' Zhu says.

But the price tag attached to molecular analysis technology may be holding back its wider use. Bo Tao, an LC/MS application engineer at Agilent, says even the cheapest HPLC costs more than US$10,000 and the consumables needed to run the tests are also expensive.

Meanwhile, China's Ministry of Science and Technology posted a note on its website asking members of the public to submit testing methods able to identify the presence of melamine in under 30 minutes. According to media reports, the ministry had received more than 100 solutions by its 8 October deadline.

**Research gap**

The health implications of the melamine scandal remain uncertain. Though the compound is known to cause kidney stones in babies, no adult incidence of the problem has yet been reported - possibly because milk forms only a small part of the adult diet.

On 7 October, the Chinese government stipulated that milk powder should contain no more than 1mg of melamine per kilogram (approximately 1 part per million).

But the US Food and Drug Administration (FDA) said on 3 October that it is unable to establish any 'safe' level of melamine and melamine-related compounds in infant formula 'because of gaps in our scientific knowledge about the toxicity of melamine and its analogues in infants'. In foods apart from infant formula, it declared that 2.5 parts per million melamine content did not raise concern. Meanwhile, the European Food Safety Authority (EFSA) has stated that adults in Europe who consume chocolates and biscuits containing milk powder contaminated with melamine would not exceed the TDI (Tolerable Daily Intake) of 0.5mg/kg body weight.

**Toxic economics**

Meanwhile, the economics behind the melamine scandal have become clearer. Industrial melamine costs about 12,000 yuan (US$1765) per tonne, much higher than the price of milk - 1200-1800 yuan per tonne. But the practice of adding melamine to milk is profitable because just one gram of melamine per kg of milk is enough to lift the apparent protein content of milk from less than 27 grams of protein per kilogram (the cheapest grade of milk in China) to greater than 31 grams per kilogram - the most expensive grade.

So for 0.012 yuan (0.0018 US cents), producers can illegally boost the price of a litre of milk from 1.2 yuan (17.6 US cents) to 1.8 yuan (26.5 US cents) per kilogram. If the milk is diluted, the resulting profits can be even greater.



According to Chinese media reports, some milk collection stations may also have heated milk and added citric acid to increase the amount of melamine they could dissolve - the compound is only 'slightly soluble' (less than 0.9 grams in 100 grams) in water at room temperature, but around 6 grams will dissolve into 100 grams of water at 100°C, while the addition of citrate may keep the melamine from coming out of solution when the milk cools down.

## Controversial new theory for nanotube growth

10 February 2009

US scientists have proposed a new theory for how carbon nanotubes grow. If their predictions are borne out experimentally, the theory could have practical implications for researchers trying to control nanotube growth in the lab. But experts say the theory may be unrealistic.

Carbon nanotubes are essentially rolls of graphene - hollow cylinders of carbon in which the atoms are arranged in a hexagonal lattice. But they don't roll up like sheets of paper; they self-assemble or 'grow' in the direction of a tube's length, prompting scientists to wonder how exactly each new layer of carbon is formed.

Houston, and the Honda Research Institute in Ohio have now put forward a formula that they say provides a model for the extension process. Yakobson likens it to weaving a rug - the more atomic kinks or 'threads' are exposed at the growing end, the faster growth proceeds.
'The kinks are an extension of the spiral lines of atoms that make up the tube,' explains Yakobson. 'You can visualise these kinks as the ends of threads, so the more thread ends you have, the faster the tube will grow.'

The number of kinks at the growing edge is ultimately dependent on the tube's chirality, or the angle at which it is 'rolled'. Chiral tubes expose many kinks and so form quickly. A non-chiral tube, by contrast, is not formed by adding to a spiral 'thread' but by the addition of complete rings of carbon atoms. Therefore, explains Yakobson, an energy barrier has to be overcome each and every time a new ring is initiated.

Nicole Grobert, a nanotubes expert based at the University of Oxford, UK, warns that the team's work is purely theoretical and unlikely to explain growth processes in real life systems. 'It has nothing to do with reality, I think, because the conditions in which the tubes grow are very chaotic,' she says. 'You have to look at the different methods that are used to grow nanotubes and I should think all of these have different growth scenarios, so you can't come up with one theory and explain all of them.'

David Tománek, who studies nanostructured materials at Michigan State University, East Lansing, US, says the model contradicts everything that is known about the formation process of nanotubes in the presence of catalytic particles. 'It also contradicts common sense in claiming that a couple of yarns,

representing monoatomic carbon chains, should nicely attach to each other to form a hollow tube,' he says.

'The jury is still out,' admits Yakobson. 'We're going to have to go through never-ending verification processes.' But he argues that data from previous studies has so far supported his team's findings - for example, data taken from different growth methods shows an abundance of nanotubes with large chiral angles, as predicted by the formula.

Understanding how nanotubes grow would help scientists gain control over their structure, potentially leading to tubes with predefined properties and applications, says Grobert. But she thinks Yakobson's theory of nanotube growth is too far fetched.

*Hayley Birch*

## Cracking water with sunlight

28 March 2008

A power plant that makes hydrogen by splitting water with concentrated sunlight launches in Almeria, Spain, on 31 March. It's a glimpse into a possible carbon-free future that uses solar-driven chemical reactions to produce the gas.

The reactor, Hydrosol II, is the largest pilot-scale project of its kind, though hundreds of thermochemical water splitting schemes have been sketched out on paper and tested in laboratories. The system will take in half a litre of water every minute and should produce around 3 kilograms of hydrogen an hour - equivalent to a thermal output of 100kW, explains project coordinator Athanasios Konstandopolous, who works for the Chemical Process Engineering Research Institute based in Thessaloniki, Greece.

That's small fry compared to the tonnes of hydrogen produced every day by reforming natural gas, but the concept does avoid using up fossil fuels and emitting carbon dioxide - a must if hydrogen is to be a truly environmentally-friendly source of energy.

The pilot plant is the scaled-up version of a concept which has been tested in the solar furnace of the German Aerospace Centre (DLR), Cologne, for four years, and which shared the European Commission's 2006 Descartes prize for scientific research. Industrial R&D partners Johnson Matthey Fuel Cells and Stobbe Tech Ceramics (Denmark) have joined the German, Greek and Spanish research teams making up the Hydrosol consortium. So far the whole programme has required only €7 million of funding, half of which came from the EU. If the larger system works and is economically feasible, the researchers hope to secure funding for a 1MW mass production plant, Konstandopoulos says.



### Drive it off

At the core of the reactor are two honeycomb-like ceramic chambers coated with oxygen-deficient ferrite structures containing zinc and nickel. At high enough temperatures (800-1200°C) these materials strip water of its oxygen, leaving hydrogen gas to bubble away ($Zn_{0.x}Ni_{(1-0.x)}Fe_2O_4 + yH_2O \rightarrow Zn_{0.x}Ni_{(1-0.x)}Fe_2O_{4+y} + yH_2$). The oxidised materials must then be recycled, driving off their collected oxygen as gas, in a separate reaction step at 1000-1200°C.

As Christian Sattler of Cologne's DLR explains, the high temperatures required are achieved by focusing sunlight onto the chambers, using a field of silvered mirrors that track the sun's movement. The hydrogen-producing (water-splitting) and oxygen-producing (recycling) steps take place in two parallel chambers, so that there is no need to separate hydrogen and oxygen gases. When each chamber's metal oxides have completed their reaction, their functions are swapped over - so that hydrogen is produced almost continuously, rather than in batches. Crucially, this modular approach means the system can easily be scaled up even further.

Sattler says that hundreds of similar thermochemical routes to hydrogen have been mooted, and tested, over the last decade. Among other popular options are zinc/zinc oxide cycles run at much higher temperatures. But much of the funding - particularly from the US Department of Energy's (DOE) hydrogen programme - has been focused not on metal oxide reactions, but on more complicated lower temperature cycles involving sulfur and iodine chemistry, because these might be powered by advanced nuclear reactors (which generate temperatures of only 800-1000°C, not as high as solar concentrators). 'I don't think there will be one best way, but the Hydrosol II project is the closest to a mass production scale,' he says.

'It's the biggest,' confirms Alan Weimer, who works on the US DOE's Solar Thermochemical Hydrogen Team (STCH) at the University of Colorado.

### Competitive within a decade

Challenges for the Hydrosol team include checking whether their metal oxides and ceramics can withstand the high temperatures required for thousands of cycles - and, hardest of all, to produce hydrogen at a price economically competitive with steam reforming. 'This will be competitive within a decade,' Konstandopoulos claims. 'We are hoping to generate energy (via hydrogen) at €0.06 per kWh, which will be roughly the price of hydrogen from steam reforming if you include the expected taxes on carbon dioxide production.' Most of the cost, he adds, came from installing the field of solar concentrators rather than from the reactor itself - so the longer it runs, the more economical it becomes.

Konstandopoulos believes that alternative clean routes to hydrogen are not as attractive as thermochemical methods: electrolysis of water is too inefficient, while using a catalyst means extra steps have to be invested to separate hydrogen and oxygen gases. 'On the thermochemical side, more activity is definitely expected in the future,' he says.

*Richard Van Noorden*

## Types of Chemical Reactions

All the chemical reactions involve certain changes in the substances and energy. There are basic six types of chemical reactions. Here is some interesting information about the types of chemical reactions.

During any chemical reaction, there is a conversion of the reactants into a single or many products. A reactant means a substance or substances that are involved in a chemical reaction. The chemical reactions occur under the appropriate conditions of pressure and temperature in the presence of a catalyst. The catalyst plays a significant role in increasing the rate of a chemical reaction without actually getting involved in that reaction.

Types of chemical reactions are characterized by the type of chemical changes. Any chemical reaction yields a single or more products, which are quite different from the reactants. The chemical reactions include some changes that involve the motion of electrons during the formation and breakage of chemical bonds. The chemical reactions could be written in a symbolic form. Chemical equations are used to describe a chemical transformation of elementary particles, which takes place during the reaction. The chemical reactions involve a change in energy; either released or absorbed. Chemical reactions are described as exothermic reactions (in which energy is released) or endothermic reactions (in which energy is absorbed).

**Types of Chemical Reactions**

There are 6 basic types of chemical reactions such as synthesis reaction, decomposition reaction, single replacement reaction, double replacement reaction, combustion reaction and acid-base reaction.

- **Synthesis Reaction**: In this reaction, two or more simple substances (reactants) combine together to yield a more complex substance. For example, hydrogen gas combines with oxygen to form a more complex product, water. The chemical equation of this reaction looks as follows: $2H_2 + O_2 = 2H_2O$
- **Decomposition Reaction**: In this type of chemical reaction, a complex substance breaks down into some simple substances. A single reactant produces two or more products. For example, a water molecule can be broken down into hydrogen and oxygen. This chemical reaction can be presented as: $2H_2O = 2H_2 + O_2$
- **Single Replacement or Displacement Reaction**: In this kind of reaction, a less active element is replaced by a more active element present in a compound. Two reactants produce two products. For example, when zinc reacts with hydrochloric acid, hydrogen molecule is replaced by zinc to form ZnCl2. This reaction looks like: $Zn + 2HCL = ZnCl_2 + H_2$
- **Double Replacement or Displacement Reaction**: In this chemical reaction, the cations and anions of two different substances switch their places to yield two totally different compounds. For example, when silver nitrate reacts with sodium chloride, sodium and silver switch their places and there is a formation of sodium nitrate and silver chloride. The chemical equation of this reaction is: $AgNO_3 + NaCl = AgCl + NaNO_3$
- **Combustion**: During this chemical reaction, a hydrocarbon is burnt in the presence of oxygen to form carbon dioxide (in complete combustion), or carbon monoxide (in partial combustion due to a limited amount of oxygen). This reaction can be presented as: $C_{10}H_8 + 12O_2 = 10CO_2 + 4H_2O$
- **Acid-base Reaction**: It is a special type of double displacement reaction, which is characterized by the reaction between an acid and a base. In this chemical reaction, $H^+$ ion in the acid reacts with $OH^-$ ion present in the base, leading to formation of water. Generally, the end products of this reaction are water and some ionic salts. For example, hydrobromic acid reacts with sodium hydroxide to yield water and NaBr. The equation of this chemical reaction is: $HBr + NaOH = NaBr + H_2O$

Other types of chemical reactions include organic reactions, which involve the compounds having carbon as the major element. Some basic types of organic chemical reactions are addition reaction, redox reaction, elimination reaction, rearrangement reaction, pericyclic reaction and substitution reaction.

## History of the Periodic Table

The periodic table helps us to classify and compare various elements on the basis of their chemical behavior. Read on to know how the periodic table evolved over a period of time...

The periodic table is an arrangement of chemical elements in the form of a table, to get a first-hand glimpse of 'periodically' recurring properties of elements. Since the ancient period, scientists have suggested various forms of the periodic table, but the credit for the modern form of periodic table goes to the Russian professor of chemistry, Dmitri Ivanovich Mendeleev. With the discovery of new elements and new theories on the structure of atoms; however, the basic structure of Mendeleev's original periodic table has undergone several changes.

**Aristotle's Theory**
During the ancient times, Greek philosopher Aristotle believed that the four main elements are: air, earth, fire and water. He proposed that combining these elements can lead to the formation of a new one. For instance, lava can be formed by combining earth and fire. However, his proposals were dismissed, when the chemical elements were discovered.

**Concept of Laws of Triads**
The German chemist Johann Wolfgang Döbereiner created a periodic table called Laws of Triads, in 1829. His periodic table was based on the atomic weight of chemical elements. According to his periodic table, the atomic weight of the middle element in the triad was an average of the atomic weights of the other two elements. Later, when new elements were added to the triads, his theory could not be established.

**Concept of Law of Octaves**
The English chemist John Newlands came up with his form of periodic table in 1865. He, too, classified the elements on the basis of atomic weight. He observed that when the elements are graded in the increasing order of their atomic weight, then their physical as well as chemical properties are repeated after an interval of eight. He compared this trend of elements with the octaves of music, and hence, he referred to it as the Law of Octaves. However, this law was not valid for those elements whose atomic weight was higher than that of calcium. The main drawback of this table was that it could not accommodate the inert gases (helium, neon, etc).

**Mendeleev's Periodic Table**
The renowned Russian professor Mendeleev developed his periodic table in 1869. Mendeleev's conceptualization of the periodic table was far more superior than any of the periodic tables developed in his time. It was very systematically devised with a lot of clarity and consistency. He kept some of the cells in his table empty, to accommodate the missing elements, which would be discovered in future. He could predict the chemical properties of those unknown elements. Later, when those elements were discovered, their properties actually matched with Mendeleev's predictions. He included additional rows in the table in order to fit in some elements with recurring properties into the same column. He made corrections in the values of the atomic mass of some of the elements. The drawback of this table, however, was that the lengths of all the rows were fixed.

**Modern Form of Periodic Table**
In the modern form of periodic table, the elements are arranged in accordance with their increasing atomic number. There are a total of 117 chemical elements in the periodic table. Out of them, 94 elements are obtained naturally on Earth and the rest are all synthetic elements. The elements are grouped in four blocks: s, p, d and f. The transuranium elements or the radioactive elements are placed below the main table as



lanthanides and actinides. Usually, each element is represented with its symbol, atomic number and atomic mass in the periodic table.

The vertical column of the periodic table, also called a 'group', includes those elements which have the same electronic configuration in the outermost shell of their atoms. For this reason, elements in the same group show similar properties. The horizontal row of the periodic table is called a 'period'. A row of the table signifies the number of shells that are filled by electrons in an atom. In some sections of the periodic table, the horizontal trends of the characteristics of elements are more significant than the vertical trends. This holds true, particularly, for lanthanides and actinides (f-block) and transition elements (d-block).

The periodic table is a complete database that has all the required information about chemical elements. Its utility is not just confined to the field of chemistry alone, but it is equally useful in biology, physics, engineering, etc.

## Краткий грамматический справочник
## Неличные формы глагола.

Неличные формы глагола, к которым относятся причастие, инфинитив и герундий отличаются от личных тем, что не имеют категории лица, числа, времени и наклонения и не употребляются в предложении в функции сказуемого, хотя могут быть его частью.

**To translate** (инфинитив) **the text I used a dictionary.** Чтобы перевести текст, я воспользовался словарём.

**Smoking** (герундий) **is not allowed here**. Курить (курение) здесь не разрешается.

**The stars shining** (причастие I) **in the dark sky seem blue**. Звёзды, сияющие в тёмном небе, кажутся голубыми.

### Инфинитив.

Инфинитив (**the Infinitive**) – это неличная форма глагола, которая называет действие. Инфинитив является основной (или I) формой глагола и представляет глагол в словаре. Признаком инфинитива является частица **to**: **to help** – помогать, **to read** – читать. Инфинитив употребляется без частицы **to** в следующих случаях:

1) После глаголов **shall, will. He will write to his parents tomorrow**. Завтра он напишет своим родителям.

2) После модальных глаголов (кроме глагола **ought**). **She can ski and skate.** Она умеет кататься на коньках и на лыжах.

3) После глаголов чувственного восприятия **feel, see, hear, watch** и др. **We saw him enter**. Мы видели, как он вышел.

4) После глаголов **let** (разрешать), **have, make** (заставлять). **What makes you think so ?** Что заставляет тебя так думать ? **Let me take this book, please**. Пожалуйста, разрешите мне взять эту книгу.

5) После выражений **had better** (лучше), **would rather** (лучше бы). **You had better go now.** Лучше уйди / иди сейчас. **I must see you at once.** Мне надо сейчас же встретиться с тобой.

В современном английском языке инфинитив имеет следующие формы.

| | Active | Passive |
|---|---|---|
| Indefinite | to write | to be written |
| Continuous | to be writing | -- |
| Perfect | to have written | to have been written |
| Perfect Continuous | to have been writing | -- |

Инфинитив в форме действительного залога обозначает действие, произведённое лицом, выраженным в предложении подлежащим, а в страдательном залоге – действие, направленное на это лицо. **I like to help**. Я люблю помогать. **I like to be helped.** Я люблю, когда мне помогают.

Инфинитив в **Indefinite Active** обозначает действие, не уточняя характер его протекания. Инфинитив в **Continuous Active** подчёркивает длительность действия. **She likes to write letters**. Она могла писать письмо. **She must be still writing**. Она, должно быть, всё ещё пишет.

Неперфектный инфинитив выражает действие, одновременное с действием глагола-сказуемого (или следующее за ним).

Перфектный инфинитив выражает действие, предшествующее действию, выраженному глаголом-сказуемым. **I am glad to study at the University.** Я рад, что учусь в университете. **I am glad to have studied at the University**. Я рад, что учился в университете.

**Функции инфинитива.**

В предложении инфинитив может быть:

а) Подлежащим. **To walk in the garden was very pleasant.** Гулять в саду было очень приятно**. To read a lot is to know much.** Много читать – много знать.

б) Обстоятельством цели. **To read the book I went to the reading-hall**. Чтобы прочитать эту книгу, я пошёл в читальный зал.

в) Определением. Инфинитив в функции определения переводится на русский язык тремя способами:

1. Придаточным определительным предложением с модальным сказуемым. **He is going to take part in the conference to be held in Moscow**. Он собирается принять участие в конференции, которая должна состояться в Москве.

2. Неопределённой формой глагола. **I have nothing to sky.** Мне нечего сказать.



3. Личной формой глагола, если определение относится к порядковому числительному. **She was the first to come.** Она пришла первой.

г) Дополнением. **He was glad to have been given a new job**. Он был рад, что ему дали новую работу. **I decided to read this book.** Я решил прочитать эту книгу.

д) Частью сказуемого (часто модального). **You may come in.** Вы можете войти. **We ought to leave early in the morning**. Мы должны уехать рано утром. **My wish is to read much.** Моё желание – много читать.

**Подлежащее + сказуемое + существительное (местоимение) + инфинитив**

**Инфинитивные конструкции**.

**I. Сложное дополнение.**

**The Complex Object (Objective – with – the – Infinitive Construction).**

Эта конструкция состоит из существительного в общем падеже или местоимения в объектном падеже и инфинитива.

Обычно переводится на русский язык придаточным дополнительным предложением. **He wants the book to be returned tomorrow.** Он хочет, чтобы книгу вернули завтра.

**II. Сложное подлежащее**.

**The Complex Subject (The Nominative – with – the – Infinitive Construction).**

Эта конструкция состоит из существительного или местоимения в именительном падеже и инфинитива. Переводится на русский язык придаточным предложением.

**She is expected to come any minute.** Ожидается, что она приедет с минуты на минуту.

**The water seems to be boiling.** Кажется, вода кипит.

**The Delegation is reported to have left London**. Сообщается, что делегация покинула Лондон.

**He is likely to know her address.** Он, вероятно, знает её адрес.

**He is sure to be asked about it**. Его, наверняка, об этом спросят**.**

**She is said to be very beautiful**. Говорят. что она очень красива.

**The car was seen to disappear**. Видели, как машина скрылась.

Эта конструкция употребляется:

1. С глаголами, обозначающими чувственное восприятие -- **to see, to hear, to notice** и др. и с глаголами, обозначающими умственную деятельность -- **to**

**think, to consider, to expect** и др. (в страдательном залоге); а также с глаголами **to say, to report, to ask, to order, to announce** (в страдательном залоге).

2. Со словосочетаниями **to be likely** (вероятно), **to be unlikely** (маловероятно), **to be certain / to be sure** (несомненно / обязательно).

3. С глаголами в действительном залоге **to seem / to appear** (казаться / по-видимому), **to prove / to turn out** (оказываться), **to happen** (случаться).

### Инфинитивная конструкция с предлогом for.
### The For – to – Infinitive Construction.

В этой конструкции перед существительным или местоимением находится предлог **for**. При переводе на русский язык используется или придаточное предложение или инфинитив.

**It's easy for me to answer this question.** Мне легко ответить на этот вопрос.

**It will be very pleasant for us to spend a week in England.** На будет очень приятно провести неделю в Англии.

**There was nothing else for me to say.** Мне больше нечего было сказать.

**It is for you to decide.** Вам решать.

**Here are some books for you to read.** Вот несколько книг для вашего чтения (вам почитать).

### Причастие I.

Причастие I (**Participle I**) – неличная форма глагола, обладающая свойствами глагола, прилагательного и наречия. Соответствует формам причастия и деепричастия в русском языке.

Формы причастия.

| | active | passive |
|---|---|---|
| Indefinite | asking | being asked |
| Perfect | having asked | having been asked |

**Participle I Indefinite** обозначает действие, одновременное с действием глагола-сказуемого. **While translating difficult texts we use a dictionary**. Переводя трудные тексты, мы пользуемся словарём.

**Participle I Perfect** обозначает действие, предшествующее действию, выраженному глаголом-сказуемым. **Having read the book I returned it to the library**. Прочитав книгу, я вернул её в библиотеку.

### Функции причастия I.

В предложении причастие I (**Participle I**) может быть:

1. Определением. В этой функции употребляется только **Participle I Indefinite**, которое соответствует русскому причастию настоящего времени в той



же функции. **A smiling girl.** Улыбающаяся девочка. **A swimming man**. Плывущий человек. **The men building our house with me are my friends.** Люди, строящие наш дом вместе со мной, -- мои друзья. **The house being built in our street is a new building of school.** Дом, строящийся на нашей улице -- это новое здание школы.

2. Обстоятельством. В этой функции **Participle I Indefinite Active** чаще всего стоит в начале предложения и переводится на русский язык деепричастием несовершенного вида. **Translating the article he consulted the dictionary.** Переводя статью, он пользовался словарём.

Перед таким причастием в функции обстоятельства часто стоят союзы **when** или **while**. Такие словосочетания переводятся либо деепричастным оборотом (или деепричастием) с опущением союза, либо придаточным предложением, которое начинается с союзов "когда", "в то время как". **While translating the article the student consulted the dictionary**. Переводя статью, студент пользовался словарём. / Когда студент переводил статью, он пользовался словарём.

**Participle I Indefinite Passive** переводится на русский язык обстоятельственным придаточным предложением. **Being built of wood the bridge could not carry heavy loads.** Так как мост был построен из дерева, он не мог выдержать больших нагрузок.

**Participle I Perfect Active** переводится деепричастием совершенного вида. **Having built a house he began building a greenhouse**. Построив дом, он начал строить парник.

**Participle I Indefinite Passive** в функции обстоятельства (времени, причины) переводится обстоятельственным придаточным предложением. При этом в качестве подлежащего русского придаточного предложения употребляется подлежащее английского предложения. **Having been built of concrete, the house was cold in winter**. Так как дом был построен из бетона, зимой в нём было холодно.

3. Частью сказуемого. **Participle I Indefinite Active** может быть частью сказуемого. **They are playing chess.** Они играют в шахматы.

### Причастие II.

Причастие II (**Participle II**) – неличная форма глагола (III основная форма глагола), имеет одну неизменяемую форму со страдательным значением и обозначает действие, которое испытывает на себе лицо или предмет. Оно соответствует в русском языке причастию страдательного залога.

Причастие II правильных глаголов имеет ту же форму, что и **Past Indefinite**, и образуется при помощи прибавления суффикса **–ed** к основе глагола **to ask – asked, to help – helped.**

Подобно причастию I, причастие II обладает свойствами глагола, прилагательного и наречия. Как и глагол, оно обозначает действие. Время действия, обозначаемое причастием II, определяется временем действия глагола-сказуемого или контекстом. **The book discussed yesterday was interesting.** Кни-

га, обсуждавшаяся вчера, была интересной. **The books discussed at the lessons are always interesting**. Книги, обсуждаемые на уроках, всегда интересны.

### Функции причастия II.

В предложении причастие II может быть:

а) Определением**. Last time is never found again**. Потерянное время никогда не вернёшь (дословно – не найти). **A written letter lay on the table.** Написанное письмо лежало на столе. **They are reconstructing the house built in the 18th century**. Они реставрируют здание, построенное в 18 веке.

б) Обстоятельством. Перед причастием II в функции обстоятельства могут стоять союзы **if, unless, when**. В таком случае английское причастие переводится обстоятельственным придаточным предложением, в котором подлежащее то же, что и в главном предложении. **If built of the local stone, the road will serve for years**. Если построить дорогу (Если дорога построена) из местного камня, она будет служить долгие годы.

### Конструкция с причастием.<br>Объектный падеж с причастием.

Она состоит из личного местоимения в объектном падеже или существительного в общем падеже и причастия. **I saw her crossing the street**. Я видел, как она переходит улицу. Эта конструкция "объектный падеж с причастием I" – **the Objective – with – the – Participle I Construction** -- употребляется тогда, когда говорящий хочет подчеркнуть, что действие, выраженное причастием, на завершено и протекает в момент речи. В этой конструкции употребляется только одна форма причастия I – **Participle I Indefinite Active.**

В этой конструкции местоимение в объектном падеже или существительное в общем падеже называют лицо или предмет, производящее действие. Она употребляется после глаголов чувственного восприятия **to see, to hear, to watch, to feel** и др. Переводится придаточным предложением. **They watched him entering the house**. Они наблюдали за тем, как он входит в дом. **I saw John passing our house.** Я видел, как Джон проходил мимо нашего дома.

Конструкция "объектный падеж с причастием II" – **the Objective – with – the – Participle II** отличается от аналогичной конструкции с причастием I, тем, что в ней причастие II называет действие, направленное на лицо или предмет, выраженные личным местоимением в объектном падеже или существительным в общем падеже. Эта конструкция переводится на русский язык в основном придаточным предложением. Она употребляется:

1) После глаголов чувственного восприятия **to see, to hear, to feel, to watch** и др.;

2) После глаголов, выражающих желание **to want, to wish** и др.;

3) После глаголов **to have, to get.**

**We head his name mentioned.** Мы слышали, как упомянули его имя.



**I want the work done.** Я хочу, чтобы работа была сделана.

**I have my photo taken**. Я сфотографировался.

Такие предложения с данной конструкцией переводятся простым предложением.

### II. Независимый причастный оборот.

В состав независимого причастного оборота, также называемого абсолютным причастным оборотом, (**the Nominative Absolute Participial Construction**) может входить как **Participle I,** так и **Participle II**.

1. Независимый причастный оборот с причастием I. В этой конструкции причастие I выражает действие, не связанное с действием, обозначенным глаголом-сказуемым предложения. Сам оборот состоит из существительного в общем падеже (реже местоимения в именительном падеже) и причастия I. Действие, выраженное причастием, относится к этому существительному (или местоимению). Этот оборот характерен для письменной речи и почти не употребляется в разговорной. В предложении этот оборот выступает в роли различных обстоятельств и на письме всегда отделяется запятой от остального предложения. На русский язык переводится придаточным предложением.

**The weather permitting, we shall go to the country.** Если погода позволит, мы поедем за город. (обстоятельство условия)

It being very cold, we could not go for a walk. **Так как было холодно, мы не смогли пойти на прогулку. (обстоятельство причины)**

**The sun having risen, we continued our way**. После того, как солнце взошло, мы продолжили свой путь. (обстоятельство времени)

**The article having been translated, the student showed it to the teacher**. После того как (когда) статья была переведена, студент показал её преподавателю. (обстоятельство времени)

2. Независимый причастный оборот с причастием II. Этот оборот также состоит из двух частей: личного местоимения в именительном падеже или существительного в общем падеже, которые претерпевают действие, выраженное причастием II. Этот оборот употребляется в функции различных обстоятельств и переводится на русский язык соответствующим обстоятельственным предложением.

**His work finished, he went home**. Когда его работа была закончена, он пошёл домой.

### Герундий. **The Gerund.**

Герундий имеет свойства как глагола, так и существительного. Подобной неличной формы в русском языке нет. Как существительное он может выполнять в предложении функции подлежащего, дополнения, определения и обстоятельства с предлогом. Как глагол может иметь после себя прямое дополнение и

определяться наречием, иметь перфектную форму, категорию залога, а также выражать действие как процесс.

Герундий образуется от основы глагола с помощью суффикса –**ing**. **To translate – translating, to read – reading.**

| | active | passive |
|---|---|---|
| Indefinite | writing | being written |
| Perfect | having written | having been written |

Формы герундия совпадают с формами **Participle I и Perfect Participle**. Однако, это разные формы глагола, отличающиеся и по значению и по синтаксическим функциям. Формы **Indefinite Gerund** обозначают действия, одновременные с действием, выраженным глаголом-сказуемым.

**He likes inviting friends to his place.** Он любит приглашать друзей к себе.

**He likes being invited to his friends**. Он любит, когда его приглашают к себе его друзья.

Перфектные формы герундия (**Perfect Gerund**) обозначают действия, предшествующие действию, выраженному глаголом-сказуемым.

**He is proud of having invited this man to his place**. Он гордится тем, что пригласил этого человека к себе.

**He was proud of having been invited to the party**. Он гордился тем, что его пригласили на вечер.

### Функции герундия.

***В предложении герундий может быть:***

а) Подлежащим. **Smoking is not allowed here**. Курить (Курение) здесь не разрешается.

б) Определением. **There are different ways of obtaining this substance.** Существуют различные способы получения этого вещества.

в) Именной частью сказуемого. **His hobby is driving a car**. Его хобби – вождение (водить) машину (ы).

г) Прямым дополнением. **The car needs repairing**. Машина нуждается в ремонте (Машину нужно ремонтировать).

В вышеприведённых функциях герундий переводится существительным или инфинитивом.

д) Предложным дополнением. **They spoke about their travelling.** Они говорили о своём путешествии (том, как они путешествовали).

В данной функции герундий переводится существительным или придаточным предложением.

е) Обстоятельством. **Learning rules without examples is of little use**. Изучение правил (изучать правила) без примеров приносит мало пользы.

**I like reading.** Я люблю чтение (читать).



**Think before answering**. Подумай прежде чем ответить.

**By doing that you'll save a lot of time.** Делая это, ты сэкономишь много времени.

**I am tired of waiting.** Я устал от ожидания (устал ждать).

**The floor of the room needs painting**. Пол этой комнаты нуждается в покраске (нужно покрасить).

**Everybody laughed on hearing his answer**. Все рассмеялись, услышав (когда услышали) его ответ.

**Thank you for coming.** Спасибо за то, что вы пришли.

**He is proud of having won in the tournament.** Он гордится тем, что победил в турнире.

**She is sorry for being late**. Она сожалеет, что опоздала.

**He ran without stopping**. Он бежал, не останавливаясь.

**Before going to bed, she locked the door.** Прежде чем лечь спать, она заперла дверь.

В данной функции герундий переводится существительным с предлогом, деепричастием, придаточным предложением.

### Сослагательное наклонение.
### The Subjunctive Mood.

В русском языке сослагательное наклонение выражается сочетанием глагола в форме прошедшего времени с частицей "бы" и имеет только одну форму, которая может относиться к настоящему, прошедшему или будущему. Если бы я закончил работу. я смог бы проводить Вас на вокзал сегодня (завтра, вчера).

В английском языке имеются аналитические и синтетические формы сослагательного наклонения. Аналитическая форма – это сочетание глаголов **should** или **would** с инфинитивом (**Indefinite Infinitive** или **Perfect Infinitive**). **He demanded that the car should be repaired**. Он потребовал, чтобы машина была отремонтирована. **He would come.** Он бы пришёл. **He would have come then.** Он бы пришёл тогда.

Глагол **to be** имеет формы **be** и **were** для всех лиц при выражении предположения, желания или возможности, относящихся к настоящему и будущему временам. **If I were ….** . Если бы я был … .

В современном английском языке имеются также синтетические формы сослагательного наклонения.

Для всех других глаголов в этом случае используются формы **Past Indefinite. If you came earlier, you should speak to him.** Если бы вы пришли раньше, вы бы поговорили с ним.

## Условные придаточные предложения.

Условные предложения могут выражать реальные, маловероятные (условные предложения I типа) и нереальные условия (условные предложения II типа).

### Условные предложения I типа.

Условие, содержащееся в условном придаточном предложении, рассматривается говорящим как реально предполагаемый факт, относящийся к настоящему, прошедшему или будущему временам. Сказуемые главного и придаточного предложений выражаются глаголами в формах изъявительного наклонения. **If the weather is nice, we go for a walk**. Если погода хорошая, мы ходим на прогулку. **If the weather was nice, we went for a walk.** Если погода была хорошая, мы ходили на прогулку. **If the weather is nice, we'll go for a walk.** Если погода будет хорошая, мы пойдём на прогулку.

### Условные предложения II типа.

Условие, содержащееся в условном придаточном предложении, рассматривается говорящим как маловероятное. Для выражения малой вероятности осуществления действия в настоящем или будущем временах сказуемое главного предложения употребляется в форме сослагательного наклонения **should / would + Indefinite Infinitive** без **to**, а сказуемое придаточного предложения – в форме сослагательного наклонения, аналогичной **Past Indefinite** или **were** для всех лиц от глагола **to be. If he were free, he would do it.** Если бы он был свободен, он бы это сделал. **If we paid more attention to grammar, we should know the language better**. Если бы мы уделяли грамматике больше внимания, мы бы знали язык лучше.

### Условные предложения III типа.

Условие, содержащееся в условном придаточном предложении, рассматривается говорящим как неосуществимое, так как относится к прошлому времени. Сказуемое главного предложения употребляется в форме сослагательного наклонения **should / would + Perfect Infinitive**, а сказуемое придаточного предложения в форме сослагательного наклонения, аналогичной **Past Perfect. I should not have been late yesterday, if my watch had been write**. Я бы не опоздал вчера, если бы мои часы шли правильно.

### Союзы условных придаточных предложений.

**if** – если; **in case** – в случае, если; **suppose (that)** – предположим, что; **on condition (that)** – при условии, что; **provided (that)** – при условии, что; **unless** – если … не; **but for** – если бы не.



## Список наиболее употребляемых неправильных глаголов

| | | |
|---|---|---|
| 1. Be | Was/Were | Been |
| 2. Beat | Beat | Beaten |
| 3. Become | Became | Become |
| 4. Begin | Began | Begun |
| 5. Blow | Blew | Blown |
| 6. Break | Broke | Broken |
| 7. Breed | Bred | Bred |
| 8. Bring | Brought | Brought |
| 9. Build | Built | Built |
| 10.Burn | Burnt/Burned | Burnt/Burned |
| 11. Buy | Bought | Bought |
| 12. Catch | Caught | Caught |
| 13. Choose | Chose | Chosen |
| 14. Come | Came | Come |
| 15. Cost | Cost | Cost |
| 16. Cut | Cut | Cut |
| 17. Deal | Dealt | Dealt |
| 18. Dig | Dug | Dug |
| 19. Do | Did | Done |
| 20. Draw | Drew | Drawn |
| 21. Dream | Dreamt/Dreamed | Dreamt/Dreamed |
| 22. Drink | Drank | Drunk |
| 23. Drive | Drove | Driven |
| 24. Eat | Ate | Eaten |
| 25. Fall | Fell | Fallen |
| 26. Feed | Fed | Fed |
| 27. Feel | Felt | Felt |
| 28. Fight | Fought | Fought |
| 29. Find | Found | Found |
| 30. Fly | Flew | Flown |
| 31. Forget | Forgot | Forgotten |
| 32. Forgive | Forgave | Forgiven |
| 33. Freeze | Froze | Frozen |
| 34. Get | Got | Got/Gotten |
| 35. Give | Gave | Given |
| 36. Go | Went | Gone/Been |
| 37. Grow | Grew | Grown |
| 38. Have | Had | Had |
| 39. Hear | Heard | Heard |
| 40. Hold | Held | Held |

| | | |
|---|---|---|
| 41. Keep | Kept | Kept |
| 42. Know | Knew | Known |
| 43. Lay | Laid | Laid |
| 44. Lead | Led | Led |
| 45. Learn | Learnt/Learned | Learnt/Learned |
| 46. Leave | Left | Left |
| 47. Let | Let | Let |
| 48. Lie | Lay | Lain |
| 49. Lose | Lost | Lost |
| 50. Make | Made | Made |
| 51. Mean | Meant | Meant |
| 52. Meet | Met | Met |
| 53. Pay | Paid | Paid |
| 54. Put | Put | Put |
| 55. Read | Read | Read |
| 56. Run | Ran | Run |
| 57. Say | Said | Said |
| 58. See | Saw | Seen |
| 59. Sell | Sold | Sold |
| 60. Send | Sent | Sent |
| 61. Set | Set | Set |
| 62. Shake | Shook | Shaken |
| 63. Shine | Shone | Shone |
| 64. Shoot | Shot | Shot |
| 65. Show | Showed | Shown |
| 66. Shut | Shut | Shut |
| 67. Sing | Sang | Sung |
| 68. Sit | Sat | Sat |
| 69. Sleep | Slept | Slept |
| 70. Smell | Smelt/Smelled | Smelt/Smelled |
| 71. Sow | Sowed | Sown |
| 72. Speak | Spoke | Spoken |
| 73. Stand | Stood | Stood |
| 74. Steal | Stole | Stolen |
| 75. Strike | Struck | Struck/Stricken |
| 76. Sweep | Swept/Sweeped | Swept/Sweeped |
| 77. Swim | Swam | Swum |
| 78. Take | Took | Taken |
| 79. Teach | Taught | Taught |
| 80. Tear | Tore | Torn |
| 81. Tell | Told | Told |
| 82. Think | Thought | Thought |



| | | |
|---|---|---|
| 83. Throw | Threw | Thrown |
| 84.Understand | Understood | Understood |
| 85. Wake | Woke | Woken |
| 86. Wear | Wore | Worn |
| 87.Win | Won | Won |
| 88.Write | Wrote | Written |

**Список принятых сокращений**

| | |
|---|---|
| **adj** (adjective) | имя прилагательное |
| **adv.** (adverb) | наречие |
| **conj.** (conjunction) | союз |
| **n.** (Noun) | имя существительное |
| **num.** (numeral) | числительное |
| **part.** (particle) | частица |
| **pl.** (plural) | множественное число |
| **sg.** (singular) | единственное число |
| **pron.** (pronoun) | местоимение |
| **v.** (verb) | глагол |

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Учебное издание

# АНГЛИЙСКИЙ ЯЗЫК
## для химиков

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