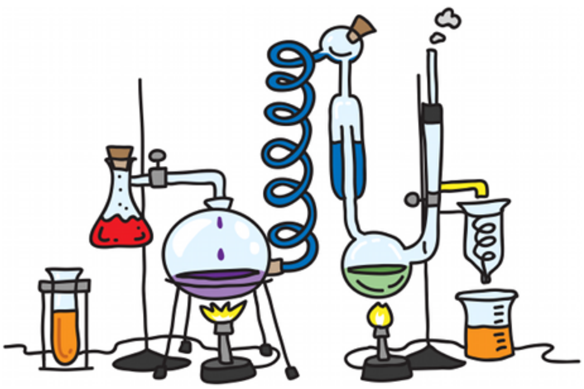
ОБУЧЕНИЕ ПРОФЕССИОНАЛЬНО-ОРИЕНТИРОВАННОМУ ЧТЕНИЮ НА АНГЛИЙСКОМ ЯЗЫКЕ

Учебное пособие
для студентов-бакалавров 2 курса



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под редакцией Е.В. Костиной

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Авторы: А.Ю. Благовестный, В.В. Ганина, Е.В. Костина, Р.В. Кузьмина
Под редакцией Е.В. Костиной.
Обучение профессионально-ориентированному чтению на английском языке: учеб. пособие для бакалавров 2 курса; под ред. Е.В. Костиной; Иван. гос. хим.-технол. ун-т.- Иваново: ИГХТУ, 2017.- 88 с.

Учебное пособие предназначено для аудиторной и самостоятельной работы бакалавров 2 курса направлений 04.03.01, 18.03.01, 29.03.04, 11.03.04, 18.03.02, 22.03.01, 20.03.01. дневной формы обучения, изучающих английский язык. За основу взято пособие по английскому языку для химико-технологических вузов под редакцией В.Б. Тресвятской, материалы которого были переработаны и адаптированы к современным стандартам обучения, а также дополнены текстами для самостоятельного изучения.

Цель пособия — обучить студентов необходимым лексико-грамматическим навыкам извлечения информации из профессионально-ориентированных текстов, подготовить слушателей к самостоятельной работе с оригинальной литературой.

Материал пособия профессионально ориентирован и структурирован, что формирует умение осуществлять иноязычную коммуникацию (устную и письменную) для решения задач личностного роста в межкультурном взаимодействии (ОК-5), способность к поиску, анализу и трансформации профессионально ориентированной информации (ОПК – 4). Концепция пособия предполагает формирование алгоритма самостоятельной работы с необходимой теоретической литературой (ПК-1). Тексты для чтения и анализа включают материал, содержащий профессионально - ориентированную лексику.

Учебное пособие включает 11 уроков: 6 для изучения в 1-м семестре и 5 для изучения во 2-м семестре. Структура каждого урока идентична: предтекстовые упражнения для снятия фонетических, лексических и грамматических трудностей, два текста (А и В), послетекстовые упражнения для развития навыков чтения, разговорной речи и интерпретации полученной информации.

Текст А каждого урока предназначается для изучающего чтения.

Текст В предназначен для формирования навыков ознакомительного чтения.

Также пособие содержит 18 текстов для формирования и развития навыков просмотрового и поискового чтения для самостоятельной работы.

В каждом уроке содержатся упражнения на повторение пройденных и закрепление изучаемых лексических и грамматических явлений, а также список лексических единиц, подлежащих обязательному озвучиванию.

Материалы пособия позволяют применить принцип дифференциации и индивидуализации обучения, предоставляя преподавателю возможность выбора заданий в зависимости от уровня подготовки студента (минимальный, базовый, продвинутый).

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LESSON 1

Грамматика. Различные значения **it.** Различные значения глагола **to have**. Придаточные определительные предложения.

Предтекстовые упражнения

I. *Определите значения* **it** *и глагола* **to have**. *Переведите предложения на русский язык:*

1. Chemistry is a science; **it** deals with the properties, composition and structure of matter. 2. **It** is necessary to know foreign languages. 3. **It** was Mendeleev who gave the world the periodic table of elements. 4. We find **it** necessary to translate this article. 5. **It** is known that titanium is widely used in industry. 6. We **have** many laboratories at our University. 7. Many inventions **have brought** fame to Russian science. 8. Our scientists **have to solve** many vital problems. 9. We **shall have to do** many experiments.

II. *Найдите определительные придаточные предложения и переведите их.*

1. Toriccelli was the first **who** discovered how to measure air pressure. 2. The distance **that** light travels in one second is 300 thousand kilometers. 3. Rubber is a durable material **which** is very important in industry. 4. Water dissolves very many substances, **which** makes it a universal solvent. 5. There are many Russian scientists **whose** names are famous all over the world. 6. The process **which** oxygen takes part in is known as oxidation. 7. The molecules **which** every substance is composed of are in a state of constant motion. 8. The facts **that** the article referred to were very interesting. 9. This is the laboratory **where** we work. 10. September is the month **when** the academic year begins.

III. *Переведите предложения, обращая внимание на значение следующих слов и словосочетаний*:

to make contribution to – вносить вклад
Niels Bohr made great contribution to theoretical physics.

as early as – еще
The art of producing glass was known as early as the first century of our era.

rank among – занимать достойное место
Many inventions of our scientists rank among the greatest achievements of the world science.

give birth to – положить начало

Rutherford gave birth to the theory of atomic structure.

lay the foundation – заложить основу
M.V. Lomonosov laid the foundation of research in Russia in very many fields of science.

far and wide – повсюду
The name of Yuri Gagarin is known far and wide.

in order to – для того чтобы
In order to get acquainted with scientific achievements abroad we must know foreign languages.

instead of – вместо
Instead of using ordinary water for cooling purposes, its place has been taken by ethylene glycol.

only – только
I have only one sister.

the only – единственный
Your brother was the only person I met there.

IV. *Переведите следующие слова, не пользуясь словарем*:

academician [əˌkædə'mɪʃn], astronomy [əs'trɒnəmɪ], atom ['ætəm], chemist ['kemɪst], chemistry ['kemɪstrɪ], electricity [ɪlek'trɪsɪtɪ], electric lamp [ɪ'lektrɪk 'læmp], element ['elɪmənt], engineer [ˌenʤɪ'nɪə], isotope ['aɪsəʊtəʊp], machine [mə'ʃi:n], mathematician [ˌmæθɪmə'tɪʃən], periodic [ˌpɪərɪ'ɒdɪk], production [prə'dʌkʃən], radio ['reɪdɪəʊ], radioactive [ˌreɪdɪəʊ'æktɪv], radiation [ˌreɪdɪ'eɪʃn], rocket ['rɒkɪt], structure ['strʌkʧə], technique[tek'ni:k], technology [tek'nɒləʤɪ], terror ['terə], problem ['prɒbləm]

V. *Прочитайте следующие слова, обращая внимание*:
а) *на изменение чтения гласной под влиянием согласной*:

all, almost, glass, after, branch, want, eight, weight, flight, light, right, kind, work, world, other, above, among, month, rule;

б) *на чтение буквосочетаний* **ck, qu, ci + гл.**:

black, rocket, quite, quick, question, quarter, social, academician, mathematician, artificial

TEXT 1 A

Science in Russia

The Russians *made a great contribution* to world science. Peter I founded the St. Petersburg Academy of Science *as early as* 1724. It is there that the great scientist Lomonosov worked in the fields of *Physics*, Chemistry, Astronomy, and *laid the foundation* of the Russian literary language. The peoples of our country produced many geniuses such as D.I. Mendeleev who gave the world the Periodic Table of Elements, mathematicians like N.I. Lobachevsky who is known *all over* the world as «Copernicus in Geometry» and many others.

The peoples of Russia are rightly proud of scientists like A.S. Popov, who invented the radio, A.N. Lodygin, who produced the electric lamp, K.E. Tsiolkovsky, who was the founder of the modern theory of space rockets. Among our *prominent* scientists we must also mention the names of I.I. Mechnikov, N.I. Zinin, S.V. Lebedev, I.Z. Kondakov, Academician I.P. Pavlov and many others whose names are known *far and wide*.

Russian scientists and inventors have enriched science and technology with many *outstanding* achievements which enable them to solve the most complex problems. Many inventions have *not only* brought fame to Russian science *but also rank among* the greatest achievements of mankind.

The development of the theory of chain reaction is linked with the name of Russian scientist N.N. Semenov, a Nobel Prize winner. N.D. Zelinsky's works formed the basis for the synthesizing of a large number of new chemical compounds.

Russian space research has opened a new era of scientific knowledge. It is in our country that the first artificial satellite for the research in outer space was launched. It was created by Academician S.P. Korolev, and it was Yury Gagarin who accomplished the first space flight.

Academicians I.V. Koorchatov and G.N. Flerov made a great contribution to the development of the theory of the construction of the atom. It was in Russia that the first atomic power station in the world was built and the first atom-powered ice-breaker «Lenin» was launched. Russian scientists, engineers and workers have done *a lot in order to* ensure that the energy of the atom should bring people well-being and prosperity *instead of* terror and death. The peaceful atom *gave birth to* a new branch of industry – the production of radioactive isotopes.

A lot of modern scientific inventions have laid the foundation of new branches of science such as bio technology, information technology, nano technology as well as they are widely used in medicine and everyday life.

Примечания к тексту

in order to ensure that the energy of the atom should bring people – для обеспечения того, чтобы энергия атома принесла людям

Запомните следующие слова и словосочетания:

all over, a lot, as early as, complex, far and wide, in order to, instead of, give birth to, lay the foundation, make a contribution, not only … but also, outstanding, physics, prominent, rank among

Упражнения

I. *Выпишите из текста:*

а) эмфатические предложения, начинающиеся с **it**, *и переведите их на русский язык;*
б) определительные придаточные предложения;
в) предложения, в которых встречается глагол to have, определите его значение и переведите эти предложения на русский язык.

II. *Определите значения* **it** *и переведите следующие предложения:*

1. It was not easy to translate this article. 2. The students study foreign languages; they find it useful to know them well. 3. It was in Russia that the first atomic station in the world was built. 4. It is known that oxygen makes up one half of the earth's crust. 5. It was in Russia that the large scale production of synthetic rubber was established. 6. It was the Russian scientist Popov who invented the radio. 7. It is often necessary to determine what weight of a substance is required or produced in a given reaction. 8. It is the laboratory where we will do our experiments. 9. It is often convenient to divide the elements into two groups: metals and non-metals. 10. Chemistry is a very interesting science; we study it at school and at university.

III. *Определите по суффиксу, к какой части речи относятся следующие слова и переведите их на русский язык*:

Science, scientific, scientist, development, contribution, literary, chemistry, mathematician, rightly, founder, accessible, inventor, technology, radioactive, particular

IV. *Заполните пропуски следующими словами или словосочетаниями*: **rank among, very, have made a great contribution, as early as, the very, the foundation, far and wide, in order to, instead of, such as.**

1. From … beginning students must work systematically. 2. I am … fond of reading. 3. Russian investigators … to world science. 4. The art of producing glass was known … the first century of our era. 5. M.V. Lomonosov laid … of the Russian literary language. 6. In recent years many natural recourses … coal, natural gas and others have been discovered in our country. 7. The names of many

Russian scientists and inventors are known … . 8. Many outstanding discoveries of Russian scientists … the greatest achievements of mankind. 9. Large sums of money were spent … train many thousands of researchers. 10. In an electric lamp, the efficient use of electricity requires that the largest part of energy should be converted into light … heat.

V. *Ответьте на следующие вопросы*:

1. What contribution did the Russians make to world science? 2. Who established the St. Petersburg Academy of science? 3. When was the academy of science established in St. Petersburg? 4. Who founded this Academy? 5. What field of science did M.V. Lomonosov worked in? 6. What did D.I. Mendeleev give the world? 7. What scientists are Russian people proud of? 8. Who was the founder of modern theory of space rockets? 9. Who accomplished the first space flight? 10. What new branches of science have appeared recently?

VI. *Дайте недостающие основные формы следующих глаголов*:

to make, to know, to become, to bring, to build, to give.

VII. *Переведите на английский язык, пользуясь словами и словосочетаниями из текста*:

1. М.В. Ломоносов, Д.И. Менделеев, Н.И. Лобачевский, так же как и другие русские ученые, внесли большой вклад в мировую науку. 2. Весь мир признает достижения русских ученых во всех областях науки. 3. Еще в 1724 году Петр I основал академию наук в Петербурге.

VIII. *Прочитайте текст 1 В не пользуясь словарем.*

TEXT 1 B

Science Serves Man

In the 20th century science has become a force of tremendous social and economic significance.[1] It is becoming a branch of economy serving as the foundation and source[2] of economic and engineering[3] progress.

Important historic events such as the Russian revolutions and World Wars I and II exerted a tremendous influence[4] on scientific progress. Many advanced countries regarded science as an important part of industrial development.

Russia took one of the leading positions in scientific researches in the world. A lot of research institutions and higher schools were established in our country in the 20th century. They carry out investigations in all the main branches of science from the study of the structure of matter to space exploration.

Примечания к тексту

1. **significance -** значение
2. **source -** источник
3. **engineering -** технический
4. **exerted a tremendous influence -** оказали огромное влияние

LESSON 2

Грамматика. Бессоюзные определительные придаточные предложения.

Предтекстовые упражнения

I. *Переведите следующие предложения, определив границы придаточных предложений:*

1. The radio Russian scientist A.S. Popov invented was a great contribution to world science. 2. The prominent scientists' names you mentioned are known far and wide. 3. The atomic power station built in our country was the first in the world. 4. Russian Academy of Science our Government established in our country carries out research in all the main branches of science. 5. K.E. Tsiolkovsky is the man we call the father of space flights.

II. *Найдите придаточные предложения и поставьте в начале их союзное слово с относящимся к нему предлогом. Предложения переведите на русский язык:*

1. The Academy M.V. Lomonosov worked **in** was established by Peter I. 2. The outstanding inventions Russian scientists have enriched science **with** rank among the greatest achievements of mankind. 3. A new branch of industry the peaceful atom gave birth **to** is the production of radioactive isotopes. 4. Any mineral a metal can be obtained **from** is called ore. 5. Water is one of the things man cannot live **without.**

III. *Переведите следующие слова, не пользуясь словарем*:

absorption [əb'sɔ:pʃən], analytical [ˌænə'lıtıkəl], automation [ˌɔ:tə'meıʃən], colloidal [kə'lɔıdəl], electrochemistry [ıˌlektrəʊ'kemıstrı], electronics [ılek'trɒnıks], form (n) [fɔ:m], insulator ['ınsjʊleıtə], magnet ['mægnıt], material [mə'tıərıəl], metal ['metl], method ['meθəd], mineral ['mınırəl], organic [ɔ:'gænık], plastics ['plæstıks], polymer ['pɒlımə], synthesis ['sınθısıs], transistor [træn'zıstə], typical ['tıpıkəl]

IV. *Переведите следующие предложения, обращая внимание на значение следующих слов и словосочетаний:*

deal with – иметь дело с
Both chemistry and physics **deal with** matter and energy.

as well as – так же, как и
Chemistry **as well as** physics are our key subjects.

be concerned with – касаться, иметь отношение к
Physics **is concerned with** the production, nature and effects of different forms of energy.

have to do with – иметь отношение к…
Many of the most interesting and important things in nature **have to do with** solutions.

in part – частично
Organic chemistry deals with substances which are composed **in part** of carbon.

result in – приводить к…
A physical change may **result in** a change of the properties of a substance.

on the one hand – с одной стороны
on the other hand – с другой стороны
On the one hand chemistry is connected with biology, **on the other hand** – with physics.

so far – до настоящего времени
So far no chemical reaction has ever converted one element into another.

such as – такой как
Some metals, **such as** gold, platinum and silver do not combine with oxygen directly.

since – так как
Since oxygen in living plants and animals is chemically combined with other elements, it is difficult or impossible to obtain it from them in a pure condition.

whereby – посредством чего
Distillation is a process **whereby** liquids are purified.

in some way – в некотором отношении
Organic chemistry is concerned with substances which are connected **in some way** with living nature.

V. *Прочитайте следующие слова, обращая внимание на чтение буквосочетаний:*

tion:	consumption, production, connection, transformation, absorption, liberation, separation, composition
ture:	structure, nature, culture, mixture, future
sion:	division, conclusion, fusion
sure:	measure, measurement, pleasure

TEXT 2 A

The Science of the Chemistry

Chemistry deals with the properties, composition and structure of the materials our world and all that it contains are composed of, with the changes by which these materials are converted into other materials and the accompanying energy changes. On the one hand chemistry is linked with biology through biochemistry, and on the other with physics through physical chemistry. Chemistry is concerned with different forms of matter, such as water, salt, iron, sugar, oxygen, etc. The connection of chemistry with energy has to do with the energy changes that accompany chemical transformations of matter from one form to another. All changes of one kind into another are accompanied by the absorption or liberation of energy, usually in the form of heat.

Now there are more than 30 different branches of chemistry. Some of them are: inorganic chemistry, organic chemistry, physical chemistry, analytical chemistry, nuclear chemistry, colloidal chemistry and electrochemistry.

Inorganic chemistry deals with substances obtained directly or indirectly from minerals, ores and similar sources.

Organic chemistry deals with substances which are composed in part of carbon, and many of which are associated in some ways with living bodies, plants, and animals.

Physical chemistry is concerned with those parts of chemistry which are closely linked with physics. Physical chemistry includes many of the principles of physics as well as those of chemistry. The knowledge of this division of the science is particularly important in all fields of chemistry, since its fundamental laws are the basis all the different divisions are established upon.

Analytical chemistry is concerned with the identification, separation and quantitative measurements of the composition of different substances that occur in nature.

Nuclear chemistry deals with the transformations of atomic nuclei and with the reactions which take place between them.

Colloidal chemistry is concerned with special properties of substances in a finely dispersed condition.

Electrochemistry is concerned with the relation between electrical energy and chemical change. Electrolysis is a 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 of metals from a solution.

Запомните следующие слова и словосочетания:

be concerned (with), deal with, directly, form, have to do with, in part, in some ways, on the one hand, on the other hand, particularly, solution, such as, transformation, whereby

Упражнения

I. *Выпишите из текста бессоюзные определительные предложения. Дайте анализ следующего предложения*:

The kind of energy we are most familiar with is mechanical energy.

II. *Найдите в следующих предложениях придаточные предложения и переведите их на русский язык:*

1. The materials chemists produce by organic synthesis occupy a very important place in industry and everyday life. 2. Some polymers our scientists discovered possess remarkable properties. 3. The subject they have chosen for discussion was connected with the chemistry of solids. 4. The task my friend is responsible for is very important. 5. The laboratory we work in is equipped with modern apparatus. 6. We suppose that method he is insisting upon is reliable. 7. The tube Roentgen was experimenting with had been invented by Crookes. 8. The results of the research they carry out will be published.

III. *Переведите следующие слова, обращая внимание на суффиксы и префиксы*:

property, composition, structure, production, nature, electricity, different, connection, energy, chemical, transformation, liberation, inorganic, analytical, directly, indirectly, substance, physical, closely, division, particularly, important, separation, measurement

IV. *Переведите следующие словосочетания на английский язык:*

заложить основу, внести вклад, занять место среди, с одной стороны, с другой стороны, быть с чем-нибудь связанным, в некотором отношении

V. *Переведите слова и словосочетания, данные в скобках, на английский язык:*

1. Chemistry (рассматривает) the properties of the materials (из которых состоит мир). 2. The connection of chemistry with energy (связана с изменениями энергии) that accompany chemical transformation of matter. 3. All changes of one kind of matter into another (сопровождаются) by the absorption or liberation of energy. 4. Physical chemistry (рассматривает) those parts of chemistry (которые тесно связаны с физикой).

VI. *Ответьте на следующие вопросы:*

1. What does chemistry deal with? 2. What sciences is chemistry linked with? 3. What forms of matter is chemistry concerned with? 4. What are all changes of one kind of matter into another accompanied by? 5. How many branches of chemistry are there now? 6. What are they? 7. What substances does inorganic (organic) chemistry deal with? 8. What is physical chemistry concerned with? 9. Why is the knowledge of physical chemistry particularly important? 10. What branch of chemistry is concerned with the identification, separation, and composition of different substances? 11. What process is called electrolysis?

VII. *Выберите правильный английский эквивалент:*

1. источник	а) deal with
2. рассматривать	б) in part is composed of
3. частично состоит из	в) have to do with
4. отношение	г) branch
5. особенно	д) source
6. быть связанным с	е) particularly
7. иметь отношение к	ж) be concerned with
8. количественный	з) quantitative
9. отрасль	и) relation

VIII. *Поставьте вопросы к выделенным словам:*

1. Chemistry is linked **with biology**. 2. **Chemistry** is concerned with **different** forms of matter. 3. Now there are **more than 30** different branches of chemistry. 4. Substances may be obtained **directly or indirectly** from **minerals, ores and other sources**.

IX. *Прочитайте текст 2 B, не пользуясь словарем*:

TEXT 2 B

Looking Into the Future of the Science of Chemistry

The most typical materials now are the products of organic synthesis, the polymers, that is, the various synthetic materials. These materials, produced by chemists in the past few decades, have occupied a very important place in industry, construction and everyday life. This does not mean that natural materials have lost their importance.

Combined with synthetic materials[1], they have become even more valuable.

Synthetic plastics have taken the place of metals[2] in machine-building and in many respects[3] their properties are better than those of metals. Ordinary polymers are better insulators of electricity, and some of them provide the best heat insulation.

Russian scientists discovered that some polymers possessed properties which in some respects are similar to those of iron, although in a much weaker form. So far[4] industrial application of some materials has not been reached yet. But further research along such lines may result in[5] the development of materials with sufficient electrical conducting and magnetic properties to make them important in automation, electronics and the creation of new types of transistors.

Примечания к тексту

1. **combined with synthetic materials** – в сочетании с синтетическими материалами
2. **have taken the place of metals** – заменили металлы
3. **in many respects** – во многих отношениях
4. **so far** – до настоящего времени
5. **may result in** – может привести к

X. *Поставьте 3 вопроса к каждому абзацу.*

XI. *Изложите краткое содержание текста на английском языке.*

LESSON 3

Грамматика. Сложносочиненные предложения и их союзы. Различные значения **one**.

Предтекстовые упражнения

I. *Переведите следующие предложения, обращая внимание на союзы:*

1. Iron is strong **but** steel is much stronger. 2. Chemistry is linked with biology **and** it is also connected with physics through physical chemistry. 3. Chemistry is concerned with different forms of matter **while** physics mostly deals with the nature, transformation and effects of different forms of energy. 4. Knowledge of physical chemistry is very important in all fields of chemistry, **for** its fundamental laws are the basis all the different divisions of chemistry are established upon. 5. Many polymers are good insulators, **so** some of them provide the best heat

insulation. 6. The law of conservation of heat applies to chemical **as well as** physical changes. 7. Rain water is not really pure, **nor** is ground water pure from the chemical point of view. 8. Gases have **neither** shape of their own, **nor** a constant volume. 9. Nitric acid is decomposed **not only** when it is heated, **but also** under the action of light. 10. The Fahrenheit scale is very inconvenient, **still (nevertheless)** it is used in England and the USA. 11. Earlier this scientist had no lab of his own, **yet (however)** he achieved much in his research work. 12. Electrical energy may be changed into radiant energy, **or** it can be changed into mechanical energy. 13. All energy is **either** potential **or** kinetic. 14. Nitrogen does not burn **nor** does it support burning.

II. *Определите значения* ***one****. Переведите следующие предложения:*

1. This worker has become **one** of the most honoured men in the city. 2. **One** has to study languages systematically. 3. **One** can easily forget words that **one** does not use. 4. Metal is a good conductor of heat while wood is a bad **one**.

III. *Прочитайте и переведите следующие слова, не пользуясь словарем:*

acetone ['æsɪtəʊn], basis ['beɪsɪs], conception [kən'sepʃən], extract (v) [ɪks'trækt], phenol ['fi:nɒl], product ['prɒdəkt], propylene ['prɒpɪli:n], synthetic [sɪn'θetɪk], theoretical [θɪə'retɪkəl]

IV. *Переведите предложения, обращая внимание на значение следующих слов и словосочетаний:*

win recognition – получать признание
Many inventions of our scientists have **won** world-wide **recognition**.

hold a place – занимать место
Russia **holds one of the first places** in the production of steel.

set up – учреждать
National academies of sciences **have been set up** in all countries.

no longer – уже не
play a role (a part) – играть роль
Great Britain **no longer plays a role** of a leading country.

V. *Прочитайте следующие двусложные слова:*

а) с ударением на конечном слоге:

consist, exist, provide, arise, increase, prepare, until, between, research, affair;

б) с ударением на начальном слоге:

chemical, industry, second, volume, basis, number, modern, progress, thousand, country, method, plastics, textile, product

VI. *Запомните чтение следующих слов:*

achievement, synthesizing, phenol, physicist

Text 3 A

Russian Chemical Science

Since eighteenth century Russia has been one of the leaders in world's chemistry science and chemical industry. The research and *achievements* of our scientists *have won* world-wide *recognition*. The classical works by D.I. Mendeleyev, A.M. Butlerov, N.D. Zelinsky, S.V. Lebedev, A.E. Favorsky and many others not only served as a theoretical basis for the development of the chemical industry, but *enabled* Russia *to set up a number of* modern branches of the chemical industry.

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

It was in Russia that the large-*scale* production[1] of *synthetic* rubber *was established*.

N.D. Zelinsky's works formed the basis for the *synthesizing* of a large number of new chemical *compounds*. There are thousands of them now, and they are *extremely* important in the economy of our country. Our scientists *elaborated* a new method of extracting phenol and acetone *simultaneously* from *benzene* and *propylene*. Both these substances are necessary for *manufacturing* plastics, textile fibres, organic glass and other chemical products.

Together with *physicists*, our chemists have elaborated an *industrial* method for manufacturing *artificial diamonds* which are 40 per cent harder than *natural* ones.

Many Russian scientists and engineers work at the *creation* of new polymers which are used in different combinations in order to produce different materials.

Many discoveries Russian chemists made in the *field* of biology in *recent* years are forming the basis of new conceptions of matter and will help in *creating* materials unknown in *nature*.

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

Примечание к тексту

1. **large-scale production** – производство большого масштаба

Запомните следующие слова и словосочетания:

achieve, achievement, artificial, benzene, between, close, compound, create, creation, diamond, elaborate, enable, engineering, establish, extremely, field, hold, important, industry, industrial, link, manufacturing, nature, natural, a number of, physicist, propylene, recent, recognition, scale, set up, simultaneously, space (*зд.* космос), success, synthetic, synthesize, together, volume, win

Упражнения

I. *Найдите в тексте сложносочиненные предложения и переведите их на русский язык, обращая внимание на союзы.*

II. *Дайте анализ следующего предложения:*

Aluminium is a metal which is found in clay and it is the most abundant metallic element which is found in nature only in the form of a compound.

III. *Определите значения* **one** *и переведите следующие предложения:*

1. One of the greatest problems of our era is that of outer space. 2. One must be careful with explosive substances. 3. Artificial diamonds are 40 per cent harder than natural ones. 4. Our new atomic stations are more powerful than the old ones. 5. One can see a great number of new houses in our city. 6. One has to take into account that sulphuric acid is a strong acid. 7. One should take into account that sulphides of many metals are used in paint industry.

IV. *Образуйте существительные от следующих глаголов:*

develop, produce, create, combine, discover, achieve

V. *Образуйте прилагательные, соответствующие следующим существительным:*

theory, chemistry, industry, nature, success

VI. *Дайте недостающие основные формы следующих глаголов:*

hold, know, make, set up, win

VII. *Переведите следующие предложения на английский язык:*

1. Достижения русских ученых получили мировое признание. 2. Классические работы русских ученых-химиков легли в основу многих отраслей химической промышленности. 3. Именно в России было освоено широкое производство синтетической резины.

VIII. *Заполните пропуски следующими словами:*

established, enables, holds, served, large-scale, development, recognition, close, overall, basis, progress

1. Russian chemical industry … the second place in the world in … volume of production. 2. The achievements of our scientists have won a world-wide … . 3. The classical works of Russian scientists … as a theoretical … for the … of the chemical industry. 4. The … links between science and industry … the chemical industry to make great … . 5. The … production of synthetic rubber was … in Russia.

IX. *Выберите соответствующий английский эквивалент*:

1. уже не	a) volume
2. занимать место	b) together
3. целый ряд	c) simultaneously
4. получить признание	d) field
5. достижения	e) extremely
6. отрасль	f) research
7. создание	g) creation
8. чрезвычайно	h) achievements
9. одновременно	i) win recognition
10. вместе	j) a number
11. объем	k) hold a place
12. исследование	l) no longer

X. *Прочитайте текст 3 B, не пользуясь словарем:*

Text 3 B

Age of Chemistry

Chemistry and physics play a very important part in the 21^{st} century. Physicists solve[1] many vital problems, but the present great progress in the production of man-made materials is due to chemistry[2].

Objects made of natural materials do not possess all the properties required. Man had to use things given by nature. We know three long periods in the history of human progress, named after the basic material used – the stone, the bronze and the iron ages. Now we live in the age of chemistry, which produces synthetic materials.

Due to the great discoveries of the past few decades we are able to go over to a new age[3] – the age of synthetic polymers. Chemistry is to remake[4] existing materials and create new ones. It is now able to make such wonderful products that very often natural materials have to give way[5] to the man-made ones. Synthetic materials will play a still more important part in future.

Примечания к тексту

1. **solve** – решать
2. **is due to chemistry** – обязан химии
3. **to go over to a new age** – перейти к новому веку
4. **remake** – преобразовывать
5. **to give way to** – уступить дорогу

XI. *Поставьте 2 вопроса к каждому абзацу.*

XII. *Изложите содержание текста на английском языке.*

LESSON 4

Грамматика. Придаточные предложения в функции подлежащего, именной части сказуемого и обстоятельства времени.

Предтекстовые упражнения

I. *Переведите следующие предложения, предварительно определив тип придаточного предложения:*

A. 1. That water is a universal solvent is known to everybody. 2. Whether steel or stone is taken as building material depends on many factors. 3. Who was the inventor of this apparatus is not known.

B. 1. The decision of the commission was that the discovery was of great importance to industry. 2. This is what we were talking about. 3. One of the advantages of higher education in our country is that it is available to all.

C. 1. The Bronze Age began when bronze replaced copper. 2. As the temperature is raised the total vapour pressure increases. 3. After electricity had been discovered, it was widely used in all branches of industry. 4. While you work in the laboratory, you must be very careful. 5. Before you leave the laboratory you must put everything in proper order. 6. As soon as I finish the experiment I'll go home. 7. As long as I stay here, I'll go sightseeing. 8. I won't leave the laboratory until I finish my work. 9. I have known him since he came to Moscow.

II. *Переведите предложения, обращая внимание на значение следующих слов и словосочетаний:*

as – в то время как (когда); по мере того как; так как; в качестве; как

1. **As** he was making his experiments he observed an interesting phenomenon.

2. **As** the reaction goes on the reacting substances are used up (расходуются) and new ones are formed.

3. **As** chlorine is 2.5 times heavier than air it may be collected by displacing (вытеснением) air.

4. In the laboratory, time is usually measured and expressed **as** the unit.

5. **As** we have already learned, the molecules of ideal gases do not interact with each other.

be a common knowledge – быть общеизвестным
That water is a universal solvent **is a common knowledge**.

be familiar with – быть знакомым с, знать
We **are most familiar with** water in its liquid state.

III. *Прочитайте следующие слова, обращая внимание на чтение буквосочетаний:*

kn [n]: know, knew, known, knowledge
wr [r]: write, wrong

IV. *Прочитайте следующие многосложные слова с ударением на третьем от конца слоге:*

physical, evaporate, gaseous, normally, liquefy, vaporize, definite, molecule, different, difference, quantity

V. *Запомните произношение следующих слов:*

extraordinary, temperature, liquefy, thorough, essential

Text 4 A

The States of Matter

That *matter* may *exist* in three physical states: *solid*, *liquid* or gas *is a common knowledge*. It is *usually* possible to change matter from one state to the other by *changing* its temperature. For instance, a piece of *ice* is called a solid; it may *melt* and form a liquid; as it *evaporates*, liquid water changes into a *vapour*, i.e. into the gaseous state.

Many kinds of matter, *like* water, can be *obtained* in each of the three states; for some, *however*, *extraordinary means* have to be used in order to *produce* one, or even two of the states; and for others, only two states are known or can be produced.

Common salt, for example, exists normally as a solid; at a temperature of several hundred *degrees*, it can be *liquefied*; and at *still* higher temperature it is *converted* into vapour. *Carbon*, a solid under normal conditions, can be *vaporized*, but it has never been liquefied.

Solids have both a *definite* volume and a definite shape. Liquids too, have a definite volume, but they take the *shape* of their containers. Gases have neither a definite shape nor a definite volume. A chemist must have a *thorough* knowledge[1] of the states of matter and of the physical *laws* which govern the *behaviour* of matter in various states.

That all matter *is composed* of molecules is known to everybody. The question which must be answered, then, is: if all matter is composed of molecules, what is the *essential* difference between the states of matter? The answer to this question is that the essential difference between these states is the *relative quantities* of energy molecules possess in different states.

Примечание к тексту

1. **a chemist must have a thorough knowledge –** химик должен хорошо знать

Запомните следующие слова и словосочетания:

be a common knowledge, be composed of, behaviour, carbon, change, common salt, convert, definite, degree, essential, evaporate, exist, extraordinary, however, ice, law, liquid, liquefy, like, matter, means (*n*), melt, obtain, produce, quantity, relative, shape, solid, still, thorough, usually, vapour, vaporize

Упражнения

I. *Выпишите из текста предложения, в которых встречаются придаточные предложения в функции подлежащего, именной части сказуемого и обстоятельства.*

II. *Дайте анализ следующего предложения:*

That the conductivity of a solution is due to the ions it contains was first realized by I.A. Kublookov.

III. *Переведите следующие предложения на русский язык, определив вид придаточного предложения:*

1. That oxygen can be liquefied only under high pressure was proved by experiments. 2. When elements combine, a definite number of atoms of each element are used in forming a molecule of a given compound substance. 3. Whether a substance is a solid, a liquid, or a gas is determined entirely by the conditions of temperature and pressure to which it is subjected. 4. The

characteristic property of an acid is that it is capable of giving hydrogen ions when dissolved in water. 5. The elements carbon dioxide is composed of are carbon and oxygen. 6. The process oxygen takes part in is known as oxidation. 7. The liquid a substance dissolves in is called a solvent. 8. The substance oxygen acts upon is oxidized. 9. Everybody knows that a gas expands as the temperature rises. 10. As long as water evaporates in an open vessel, water vapour mingles (смешивается) with the atmosphere because of diffusion. 11. As soon as the experiment is done we'll see its result. 12. Many years have passed since Popov invented radio. 13. While Maria and Pierre Curie were working at the laboratory, they discovered a new substance. 14. Shortly after Roentgen had discovered X-rays, in Paris Professor Becquerel began experiments with a number of X-rays.

IV. *Определите, какими частями речи являются следующие слова и переведите их на русский язык:*

vapour, evaporate, evaporation; define, definition, definite, indefinite; know, knowledge; possible, impossible, possibility; state, statement; change (v), change (n), changeable, unchangeable; produce, product, production; behave, behaviour; differ, difference, different

V. *Заполните пропуски следующими словами и словосочетаниями и переведите предложения на русский язык:*

thorough, various, neither … nor, as, among, relative, possess, a common knowledge, never, govern, both … and

1. That matter exists in three physical states is … . 2. A piece of ice may melt and form a liquid … it evaporates. 3. Carbon has … been liquefied. 4. Solids have … a definite volume … a definite shape. 5. Gases have … a definite shape … a definite volume. 6. A chemist must have … knowledge of the physical laws which … the behaviour of matter in … states. 7. The essential difference … the three states of matter is the … quantities of energy molecules … in different states.

VI. *Дайте недостающие основные формы следующих глаголов:*

to deal, to win, to make, to melt, to know, to take

VII. *Выберите правильный английский эквивалент для следующих русских слов и словосочетаний*:

в самом начале, вносить большой вклад, еще в начале века, мы должны упомянуть, заложить основу, исследовательские институты, учебные заведения, проводить исследование, отрасли науки, иметь дело с чем-либо (рассматривать), известные повсюду, занимать место среди, оказывать влияние

known far and wide, to exert influence on, to deal with, branches of science, to carry on research, educational establishments, research institutes, to lay the foundation, to rank among, we have to mention, as early as the beginning of our age, to contribute much, in the very beginning

VIII. *Составьте краткое резюме к тексту А на русском языке.*

IX. *Прочитайте текст 4 В, не пользуясь словарем:*

Text 4 B

Different Forms of Matter. Their Changes and Properties

Matter exists in three states: solid, liquid, and gaseous. Water, for example, exists sometimes as a solid (ice) and sometimes as vapour (the gaseous state), although we are most familiar with its liquid state. Common salt, for example, exists normally as a solid; at a temperature of several hundred degrees, it can be liquefied; and at still higher temperature it is converted into vapour. Carbon, a solid under normal conditions, can be vaporized, but it has never been liquefied.

Changes from one state of matter to another are accompanied by changes in the energy content of the substance. When one gram of ice melts, 78 calories of heat are absorbed. When the same weight of water is changed into steam at the boiling point of water, 539 calories of heat must be absorbed. The transitions[1] in the opposite direction – vapour to liquid and liquid to solid – are accompanied[2], of course, by liberation of energy. It should be mentioned[3] that some substances change from the solid to the vapour state as the temperature falls, without passing[4] through the intermediate[5] state. This change is called sublimation.

Примечания к тексту

1. **transition** – переход
2. **accompany** – сопровождать
3. **it should be mentioned** – следует упомянуть
4. **without passing** – не переходя
5. **intermediate** – промежуточный

X. *Расскажите, что вы знаете о различных формах материи и о их свойствах.*

LESSON 5

Грамматика. Обстоятельственные придаточные предложения причины, места, условия, цели и уступительные**.**

Предтекстовые упражнения

I. *Определите типы придаточных предложений. Переведите следующие предложения на русский язык:*

A.

1. **Since** aluminium is light and strong, it is widely used in industry. 2. One must be careful with mercury **as** it is poisonous. 3. **Because** carbon monoxide is odourless, its presence is not easily detected.

B.

1. **I** found the book **where** I had left it. 2. He put the test-tube **where** the teacher told him. 3. **Wherever** she lived, she always found friends.

C.

1. **If** a piece of tin is warmed, it melts. 2. Water freezes at 0^0 **unless** it contains salt. 3. Oxygen can be liquefied **provided that** pressure is sufficiently high. 4. You will finish your experiment in time **provided** you work hard.

D.

1. We heat ice **so as** to melt it. 2. **In order to** know what happens when a metal rusts we must study the properties of metals before and after rusting occurs. 3. I shall give you the article immediately **so that** you may be able to translate it in time. 4. You must put down the words **lest** you should forget them. 5. The vessel was closed **in order that** the liquid might not evaporate.

E.

1. He finished the experiment in time **though (although)** it was very difficult for him. 2. **However** busy he may be, he will prepare his report.

II. *Переведите предложения, обращая внимание на значение следующих слов и словосочетаний*:

to turn + black (прилагательное) – чернеть, становиться черным
Acids are substances that **turn** blue litmus **red.**

to learn – учить
All the students of our University **learn** chemistry.

to learn – узнавать

We **learned** the news from the newspapers and the radio.

III. *Прочитайте следующие многосложные слова:*

property, enumerate, century, particle, energy, possible, chemical, general, quantity, physical, molecule, molecular, similar, oxygen, visible

IV. *Запомните произношение следующих слов:*

admixture [ədˈmɪkstʃə], transparent [trænsˈpærənt], granite [ˈɡrænɪt], homogeneous [ˌhɒməˈdʒiːnɪəs], heterogeneous [ˌhetərəʊˈdʒiːnɪəs], sample ['sɑ:mpl]

TEXT 5 A

Substances

Substances are *distinguished* by their *properties* – colour, smell, taste, *specific gravity*, greater or less *hardness*, *melting* and *boiling points*, *volatility*, etc. For example, in describing the properties of sugar, one can state that sugar is a hard, *brittle* substance, white in colour, sweet to the taste, without *odour*, easily *soluble* in water, *heavier* than water and it turns brown when it is heated, etc.

In order to learn the properties of a substance one must have it in its *pure* form. Even small *admixtures* of foreign substances may change the properties of a substance. For example, pure water is both colourless and *transparent*, but if a drop of milk is added to a glass of water, the water becomes *clouded*; if a drop of ink is added, the water becomes coloured. All the *enumerated* properties are not those of water[1] but they are properties of admixtures.

In some *cases,* one may see at once that a substance is *heterogeneous*, that is, a *mixture* of different substances.

Granite, cement, petroleum are examples of *non-homogeneous* materials; they consist of mixtures of substances. Thus, granite is a mixture of *varying* quantities of silica, *feldspar*, and *mica*, each of which possesses its own *set* of properties[2]. Coal is not a substance too because different *samples contain* different relative *amounts* of *ash*, water, carbon, and other components.

Every material, therefore, consists of a single (pure) substance, or it is a mixture of two or more substances, each of which *retains* in the mixture its own characteristic properties.

Примечания к тексту

1. **are not those of water** – не являются свойствами воды
2. **set of properties** – ряд свойств

Запомните следующие слова и словосочетания:

admixture, amount, ash, boiling point, brittle, case, clouded, contain, distinguish, enumerate, feldspar, hardness, heavy, homogeneous, heterogeneous, melting point, mica, mixture, odour, property, pure, retain, sample, set, soluble, specific gravity, substance, transparent, varying, volatility

Упражнения

I. *Найдите в тексте придаточные предложения: определительные и обстоятельства времени, цели, условия и следствия.*

II. *Дайте анализ следующего предложения:*

Analytical chemistry has for its aim the determination of the constituents of which a substance or a mixture is composed by methods which are qualitative when the identification is to be carried out or quantitative when the quantity or proportion is determined.

III. *а) Определите типы придаточных предложений, обращая внимание на союзы. б) Переведите предложения на русский язык:*

1. Any element when it combines with oxygen forms an oxide. 2. The methods of determination of specific gravity are well known to everybody as they are used on a large scale. 3. That oxygen can be liquefied only under high pressure was proved by experiments. 4. The process oxygen takes part in is known as oxidation. 5. In order to learn the properties of a substance we must have it in its pure form. 6. Oxygen has been known since the 18^{th} century. 7. Oxygen can be liquefied provided that pressure is sufficiently high. 8. If sugar and water are mixed, crystals of sugar disappear, but those crystals form again as water evaporates. 9. Whether water or other liquid is used as a solvent depends on many factors.

IV. *Напишите глаголы, от которых образованы данные существительные:*

production, mixture, activity, difference, existence, application

V. *Сгруппируйте антонимы, переведите их на русский язык:*

similar, heterogeneous, soluble, different, transparent, colorless, pure, heavy, easily, hard, homogeneous, insoluble

VI. *Заполните пропуски следующими словами и словосочетаниями и переведите предложения на русский язык:*

one must, foreign, in order to, properties, turns brown, easily, pure

1. Substances are distinguished by their … . 2. Sugar is … soluble in water. 3. Sugar … when it is heated. 4. … learn the properties of a substance … have it in its … form. 5. Small admixtures of … substances change the properties of a substance.

VII. *Выберите правильный вариант перевода:*

1.	примесь	а)	brittle
2.	углерод	б)	enumerate
3.	образец	в)	distinguish
4.	полевой шпат	г)	transparent
5.	постороннее вещество	д)	specific gravity
6.	неоднородный	е)	property
7.	свойство	ж)	heterogeneous
8.	удельный вес	з)	foreign substance
9.	прозрачный	и)	feldspar
10.	различать	к)	sample
11.	перечислять	л)	carbon
12.	хрупкий	м)	admixture

VIII. *Прочитайте следующие числа*:

3.725, 13.819, 12/16, 3/125, ¼, ½, 0.115, 0.003, 5^2, 3^3

IX. *Ответьте на следующие вопросы:*

1. What are the properties substances are distinguished by? 2. Is sugar easily soluble in water? 3. What colour is sugar? 4. Is sugar lighter or heavier than water? 5. What taste has sugar? 6. What is its specific gravity? 7. In what form must one have a substance in order to learn its properties? 8. What may change the properties of a substance? 9. What happens if a drop of milk is added to a glass of water? 10. What substances does granite consist of?

X. *Проделайте парную работу на перевод с русского языка на английский:*

A	B
Все окружающие нас предметы состоят из веществ. (All objects surrounding us consist of substances.)	All …

They …	Они состоят из одинаковых молекул. (They consist of similar molecules.)
Гранит состоит из нескольких веществ. (Granite consists of several substances.)	
Therefore …	Поэтому гранит состоит из разных молекул. (Therefore granite consists of different molecules.)
Химия изучает вещества и их состав. (Chemistry studies substances and their composition.)	Chemistry …
It …	Она также изучает процессы и законы, по которым происходит изменение их состава. (It also studies processes and laws according to which the change of their composition takes place.)

XI. *Прочитайте текст 5 B, не пользуясь словарем:*

TEXT 5 B

Physical and Chemical Properties of Substances

Properties. Bodies are composed of materials such as wood, steel, cement, stone, silver, gold, lead, iron, etc. These materials may be either homogeneous or heterogeneous. A substance is defined[1] as a variety of matter which has definite properties and definite composition. All samples of a substance possess the same properties and have the same composition, regardless of their source[2]. Every substance therefore possesses specific physical properties, such as colour, odour, density, hardness, melting point, and boiling point.

Every substance also possesses definite chemical properties; these concern its transformations[3] into other substances, and especially, the different kinds of substances into which it can be transformed. Water is an example of a substance; one sample of water is like all others and there is only one set of properties by which all samples of water can be described and identified.

Примечания к тексту

1. **define –** определять
2. **regardless of their source –** независимо от их источника
3. **these concern its transformations –** они связаны с его превращением

XII. *Поставьте три вопроса к каждому абзацу текста и передайте содержание прочитанного на английском языке.*

XIII. *Переведите на английский язык, пользуясь словами и словосочетаниями из предыдущих текстов:*

Химия изучает вещества, их состав, а также процессы и законы, по которым происходит изменение их состава. Все окружающие нас предметы состоят из веществ. Вещества состоят из одинаковых молекул и различаются по своим свойствам. Свойства веществ можно разделить на две группы: физические и химические. При изменении физических свойств состав вещества не меняется. Изменение химических свойств веществ связано с изменением их состава.

LESSON 6

Грамматика. Дополнительные придаточные предложения. Различные значения **that.**

Предтекстовые упражнения

I. *Укажите, какими союзами и союзными словами вводятся придаточные дополнительные предложения, и переведите следующие предложения на русский язык:*

1. By means of this formula one can easily determine whether a given gas is lighter or heavier than air. 2. One can show experimentally that hydrogen does not support burning. 3. At the beginning of the experiment it is not known yet if the necessary data will be obtained. 4. Everybody knows how closely chemistry is connected with the progress of the world. 5. The students want to know who will deliver lectures on chemistry. 6. Newton first explained why all objects on the Earth attracted one another.

II. *Найдите придаточные предложения и переведите их на русский язык:*

1. The students told their teacher they were ready to start their work. 2. The newcomer said he had come from the Far East. 3. We didn’t know you could speak German. 4. My friend thinks he can finish his work in an hour.

III. *Определите значения слова* **that** *и переведите следующие предложения на русский язык:*

1. Now we know **that** all substances consist of atoms. 2. It was in Russia **that** the large-scale production of synthetic rubber was established. 3. **That** water is a compound was proved at the end of the 18^{th} century. 4. The decision of the commission was **that** the discovery was of great importance to industry. 5. The distance **that** light travels in one second is 300 thousand kilometers. 6. The melting

point of titanium is $2{,}000^0$ above **that** of aluminium. 7. The properties of metals are different from **those** of wood.

IV. *Переведите следующие слова, не пользуясь словарем:*

barometer [bə'rɒmɪtə], character ['kærɪktə], condensation [ˌkɒnden'seɪʃən], formula ['fɔ:mjʊlə], fundamental [ˌfʌndə'mentl], information [ˌɪnfə'meɪʃn], platinum ['plætɪnəm], progress ['prəʊgres]

V. *Переведите предложения, обращая внимание на значение следующих слов и словосочетаний:*

effect n – действие; влияние; результат
1. **The effect** of heat influences the rate of many reactions. 2. Scientists study **the effect** of cosmic radiation upon the human body. 3. **The effect** of our experiment was excellent.

effect v – производить; выполнять; осуществлять
1. They **effected** a change in the plan of their work. 2. The scientists **effected** the plan of their research before the time appointed. 3. They **effected** the isolation of a new substance.

to affect v – воздействовать на
Moisture **affects** many metals.

it takes – нужно, требуется
It takes energy to move a body.

to mean – значить, означать
Isotopes are different forms of the same element (simple type of a substance). The word "isotope" **means** "same place".

means n – средство; средства
1. Atoms cannot be broken down by chemical **means**, so it's impossible to break up an element into simpler substances by chemical changes. 2. At present we have many **means** of defense against air and chemical danger.

by means of – посредством
One can express the composition of a compound **by means of** a chemical formula.

VI. *Обратите внимание на ударение в следующих словах. Переведите эти слова:*

'element – ele'mentary, 'atom – a'tomic, 'molecule – mo'lecular, 'oxidize – oxi'dation, re'duce – re'duction, e'lectric – elec'tricity, 'metal – me'tallic, 'stable – sta'bility, 'compound – com'pound, 'transport – trans'port

VII. *Запомните произношение следующих слов:*

necessary ['nesɪsərɪ], acquainted [ə'kweɪntɪd], essential [ə'senʃəl], lustrous ['lʌstrəs]

TEXT 6 A

Changes of Matter

None of the properties of a substance is more important to the chemist than the changes the substance can *undergo*, and no knowledge about the substance is more important than information concerning the conditions that are necessary to *effect* these changes. We know of many changes that *occur* continually *around* us and that *alter greatly* the different forms of matter we are acquainted with. These changes are either physical or chemical.

Chemical Changes

Chemical changes are those matter changes in which a change of composition takes place. Such changes are *permanent, i.e.* they cannot be undone[1] by simple application of some physical means, such as *heating, cooling*, or evaporation, but the new substance, or substances formed persist[2] unless they are *subjected* to another chemical change. In determining whether a given matter change is a physical or chemical change, the *essential* question is whether or not one or more substances, with properties different from those of the substance or substances existing before the change, have been formed.

Thus iron is a *hard, grayish, lustrous* substance but when it is left exposed to *moist* air it is slowly *transformed* into a red crumble material (iron rust) quite different in properties from the original iron.

A chemical change has, therefore, taken place; the change in properties is the *outward indication* of the formation of a different substance. The new, reddish substance will not become iron again when it is allowed to stand, although the iron can be obtained from it, if it is subjected to the right conditions. It took a chemical change to convert iron into iron rust, and another chemical change would be necessary[3] to turn the iron rust into iron again.

In the burning of *wood* a chemical change takes place, since the wood disappears and new substances (gases, ash, etc.) *appear* which are very different in their properties from wood.

Примечания к тексту

1. **they cannot be undone –** они не могут быть уничтожены
2. **substances formed persist –** образовавшиеся вещества сохраняются
3. **and another chemical change would be necessary –** и потребовалось бы другое химическое изменение

Запомните следующие слова и словосочетания:

after, appear, around, cooling, effect, essential, gray, greatly, hard, heating, indication, i.e., lustrous, moist, occur, outward, permanent, subject to, transform, undergo, wood

Упражнения

I. *Выпишите из текста: а) дополнительные придаточные предложения; б) предложения, в которых встречается* **that**, *и определите его значения; в) бессоюзные определительные придаточные предложения.*

II. *Поставьте вопросы к выделенным словам:*

1. **When iron is exposed to moist air** it is slowly transformed **into iron rust.** 2. **In the burning of wood a chemical change** takes place. 3. During the burning **wood disappears** and **new substances** appear.

III. *Переведите следующие предложения на русский язык, обращая внимание на значение* **that**:

1. Some properties of air are similar to those of water. 2. We know that air has pressure. 3. A barometer is an instrument that measures air pressure. 4. The production of ozone requires that a large quantity of energy be absorbed. 5. It is the law of conservation of mass that makes possible the writing of chemical equation. 6. The amount of heat liberated by slow oxidation is the same as that liberated by rapid combustion. 7. That water is a compound was proved at the end of the 18^{th} century.

IV. *Определите по суффиксам, к какой части речи относятся данные слова, и переведите их на русский язык:*

property, substance, chemist, information, important, necessary, continually, chemical, composition, different, essential, grayish, lustrous

V. *Переведите следующие слова, обращая внимание на суффикс* **-ish**:

reddish, bluish, yellowish, grayish

VI. *Сгруппируйте синонимы и переведите их на русский язык:*

important, moist, to permit, to occur, right, to alter, to convert, essential, to change, since, to allow, to take place, because, wet, proper

VII. *Сгруппируйте антонимы и переведите их на русский язык:*

necessary, to disappear, greatly, similar, heating, moist, slowly, to allow, right, to appear, to prohibit, rapidly, dry, cooling, to a little extent, different, wrong, unnecessary

VIII. *Дайте недостающие основные формы следующих глаголов:*

to undergo, to take, to give, to leave, to become

IX. *Заполните пропуски следующими словами и словосочетаниями:*

to turn, takes place, whether, unless, in time, to subject, to take

1. Chemical changes are those matter changes in which a change of composition … . 2. It is essential … you finish your experiment … . 3. This substance will not change its properties … you … it to a chemical change. 4. It … a chemical change to convert iron into iron rust. 5. A chemical change is necessary … the iron rust into iron again.

X. *Ответьте на следующие вопросы:*

1. What changes of matter do we call chemical changes? 2. What is the essential question in determining whether a matter change is a physical or a chemical one? 3. What are the properties of iron? 4. What happens if iron is left exposed to moist air? 5. Why do we say that in the burning of wood a chemical change takes place?

XI. *Выберите правильный английский вариант перевода:*

1.	означать	а)	by means of
2.	превращаться в ржавчину	б)	necessary
3.	изменяться	в)	to turn into rust
4.	осуществлять, производить	г)	rust
5.	иметь место	д)	it took a chemical change
6.	посредством	е)	although
7.	если … не	ж)	to allow
8.	необходимый	з)	outward
9.	применение	и)	to determine
10.	подвергать действию	к)	to subject to
11.	определять	л)	application
12.	внешний	м)	unless
13.	позволять	н)	to take place
14.	хотя	о)	to effect

15.	потребовалось химическое изменение	п)	to mean
16.	ржавчина	р)	to alter

XII. *Прочитайте текст 6 В, не пользуясь словарем:*

TEXT 6 B

Physical changes

When physical changes occur, some of the properties of a substance may be altered for a time, but no new substances are formed. The following are the examples of a physical change: 1) the melting of ice and the condensation of steam; 2) the mixing of sugar with water to form a solution; 3) the change observed when a platinum wire[1] is heated to redness. In each of these there is a change in properties.

Thus, a liquid is produced from a solid when ice melts, and a gas is changed into a liquid when steam condenses.

When sugar dissolves, it, too, changes from the solid to the liquid state.

The platinum wire changes, when heated[2], from a silvery lustrous metal that reflects light to one that emits[3] light. But there is no alternation of the fundamental character of any of the substances during these changes.

Sugar dissolved in water retains[4] its original properties and only forms a mixture from which it is readily obtained again in its crystalline form by allowing the water to evaporate.

Примечания к тексту

1. **wire** [waɪə(r)] – проволока
2. **when heated** – при нагревании
3. **emit** [ɪ'mɪt] – испускать
4. **retain** [rɪ'teɪn] – сохранять

XIII. *Поставьте три вопроса к каждому абзацу текста.*

XIV. *Переведите, пользуясь словами и словосочетаниями из текстов А и В*:

Плавление, кипение веществ, изменение их формы, нагревание или охлаждение – все эти явления (phenomena) называются физическими. В результате физических изменений состав вещества не меняется.

Такие изменения веществ, в результате которых из одних веществ получаются другие, называются химическими явлениями или химическими реакциями.

В природе химические реакции иногда протекают весьма медленно, поэтому мы их не всегда замечаем.

XV. *Расскажите на английском языке, в чем заключается разница между физическими и химическими изменениями.*

LESSON 7

Грамматика. Условные предложения.

Предтекстовые упражнения

I. *Определите тип условного предложения в следующих сложных предложениях и переведите их на русский язык:*

1. If a substance cannot be decomposed or produced by combination of other substances, it is called an element. 2. If a gas were colourless, we would not notice its formation. 3. We should have obtained better results if we had used some other materials. 4. Unless the achievements of the scientists of our research Institute had been so great, many of the complex problems would not have been solved. 5. If a substance changes from one state into another, its energy content will change too. 6. If a substance passed from the solid state directly to the vapour state, this change would be called sublimation. 7. You will see a great variety of apparatus if you visit some laboratory. 8. The liquid in the test-tube would change its colour if they raised the temperature. 9. They would have measured the weight of a substance more accurately provided they had taken an analytical balance.

II. *Прочитайте и переведите следующие предложения, обращая внимание на выделенные слова:*

due to – благодаря

Due to Russian scientist D. I. Mendeleyev elements have been arranged in the order of their atomic weights.

be due to – объясняться, обуславливаться
The change of colour is **due to** heating.

slightly – слегка
The colour of this liquid changes **slightly** on heating.

III. *Прочитайте и переведите следующие слова, не пользуясь словарем:*

component [kəmˈpəʊnənt], gas [gæs], distillation [ˌdɪstɪˈleɪʃ(ə)n], analyse [ˈænəlaɪz], temperature [ˈtemprɪtʃə], proportion [prəˈpɔːʃ(ə)n], apparatus [ˌæpəˈreɪtəs], nitrate [ˈnaɪtreɪt], barium peroxide [ˈbɛərɪəm pəˈrɒksaɪd]

IV. *Запомните чтение следующих слов:*

air [ɛə], nitrogen [ˈnaɪtrɪdʒən], physical [ˈfɪzɪkl], occur [əˈkɜ:], infer [ɪnˈfɜ:], vary [ˈvɛərɪ], precisely [prɪˈsaɪslɪ]

Text 7 A

Air

One can *prove in several ways* that *air* is not a chemical compound, but a mixture of nitrogen and oxygen with small amounts of other gases.

The composition of air varies *slightly* with *elevation*, being a little[1] richer in oxygen and *poorer* in nitrogen at *sea level* than at elevations of a few miles. *If* it were a single[2] compound, it would have a definite composition *by weight*.

Air is *readily* separated into its *components* by fractional distillation of liquid air. If it were a compound, it would all distil over in a single fraction[3] at a definite temperature.

The air that surrounds us is about one fifth oxygen by volume. When cold water is *slowly* warmed, we see *bubbles* of "dissolved air" coming out of the solution. If we analyse such bubbles, we shall find that they are about one third oxygen by volume. The change in composition *is due to* the difference in the *solubility* of the gases that *make up* the mixture known as air. If air were a single compound, the bubbles that escape from the solution would have *the same* composition as those of the undissolved air.

The *density* and physical properties of air are *precisely* those that would be inferred from the proportions and physical properties of its component gases. If a chemical change *occurred* in *mixing* these gases to form air, there would be *either* a change in properties *or* a change in volume.

No chemical formula can be written that would *exactly* show the proportions in which nitrogen and oxygen are present in air. The nearest simple formula would be N_4O, but this would indicate far too great a density[4] for air, and the proportion of oxygen in air is slightly greater than this formula indicates.

Примечания к тексту

1. **a little** – немного
2. **single** – *зд.* простой
3. **distil over in a single fraction** – перегоняются в одну фракцию
4. **far too great a density –** слишком большая плотность

Запомните следующие слова и словосочетания:

air, be due to, bubble, component, density, either … or, elevation, exactly, if, in several ways, make up, mix, occur, poor, precisely, prove, readily, (the) same, sea level, slightly, slowly, solubility, weight

Упражнения

I. *Определите тип условного предложения в следующих сложных предложениях и переведите их на русский язык:*

1. If water had been poured into concentrated sulphuric acid, an explosion would have occurred. 2. If an aqueous solution of chlorine yellow in colour is exposed to light, the yellow colour will gradually disappear. 3. The volume the gas would occupy provided it were dry, is less than that which it occupies when water vapour is present. 4. The study of any substance would be incomplete unless we investigated the properties of that substance and the methods of obtaining its components. 5. If a solution of barium peroxide in water were concentrated by boiling, the hydrogen peroxide would be decomposed by heating. 6. The gas would have occupied much smaller volume if it had been compressed enough. 7. If the oxides of antimony were even moderately basic in character, they would react with nitric acid to form the nitrate of antimony. 8. The low density of ice is an important property, for our climate would certainly be quite different unless ice floated. 9. If ozone were suddenly withdrawn from the atmosphere, we should all be killed within a few minutes by the sun's ultra-violet light. 10. If petroleum suddenly disappeared, we would find ourselves without any gasoline for our machines.

II. *Выпишите из текста условные предложения II типа, переведите их на русский язык.*

III. *Закончите следующие предложения, пользуясь русским текстом:*

1. If we analysed the bubbles of dissolved air, (мы бы увидели, что они по объему состоят на 1/3 из кислорода). 2. If we wrote the formula N_4O for air, (она не показала бы точных соотношений, в которых кислород и азот присутствуют в воздухе). 3. If the composition of air were analysed at sea level, (можно было бы видеть, что он немного богаче кислородом и беднее азотом, чем на высоте в несколько миль). 4. If we separated air into its components, (мы бы получили кислород, азот и небольшое количество других газов).

IV. *Выпишите из текста существительные, соответствующие следующим глаголам, подчеркните их суффиксы и переведите их на русский язык:*

distil, differ, compose, dissolve, elevate, mix

V. *Дайте антонимы к следующим словам:*

cold, large, rich, different, absent, complex, far

VI. *Заполните пропуски данными словами или словосочетаниями:*

components, amounts, to separate, escape, mixture, chemical compound, bubbles, density

1. We know that air is not a … . 2. When water boils we see … of "dissolved air" … from the solution. 3. Air is a … of nitrogen and oxygen with small … of other gases. 4. Fractional distillation is used … air into its … . 5. The formula N_4O indicates far too great a … for air.

VII. *Найдите в тексте эквиваленты следующих словосочетаний:*

несколькими способами, дробная перегонка, примерно на одну пятую, никакая химическая формула, слишком большая плотность

VIII. *Переведите на русский язык, обращая внимание на выделенные слова:*

1. **Due to** its greater energy content ozone is more reactive than oxygen. 2. Oxygen is **slightly** denser than air and **slightly** soluble in water. 3. The bleaching effects of sulphurous acid **are due to** its reducing properties. 4. The composition of water varies **slightly** with elevation. 5. The energies **due to** Van der Vaals' forces seldom exceed a few Kcal/mole.

IX. *Ответьте на следующие вопросы:*

1. What is air? 2. Under what conditions is air richer in oxygen and poorer in nitrogen? 3. In what way is air separated into its components? 4. How much oxygen does air generally contain?

X. *Прочитайте текст 7 B, не пользуясь словарем:*

Text 7 B

Some Physical Properties of Air

The physical properties of air were studied long before its chemical properties. Aristotle[1] (384 B. C.[2]) in spite of his confused ideas[3] on the nature of gases considered that air was a material substance which possessed weight; another Greek scientist (117 B. C.) described some experiments which were made in order to prove that air is a material substance. For instance he said: «If we invert[4] the open end of a vessel, having only one opening, in water, the water will not enter; if a hole be made in the upper part of the vessel, water comes in and air comes out. If we placed our hand over the opening we should feel a stream of wind which is moving air».

In 1774 the French scientist Lavoisier made a large number of experiments in order to prove the hypothesis that when metals are heated in air, the increase in weight is due to fixation[5] of the air by the metal.

However it was the gifted[6] Russian scientist M.V. Lomonosov who had come to the same conclusion[7] in 1756, i.e. eighteen years before Lavoisier.

Примечания к тексту

1. **Aristotle** [ˈærɪstɒtl] – Аристотель (384–322)
2. **B. C. (before Christ)** – до нашей эры
3. **confused ideas** – сбивчивые представления
4. **invert** [ɪnˈvɜ:t] – переворачивать
5. **fixation** [fikˈseɪʃ(ə)n] – *зд.* поглощение
6. **gifted** [ˈgɪftɪd] – талантливый
7. **to come to the conclusion** – прийти к заключению

XI. *Расскажите о свойствах воздуха, пользуясь текстами 7 A и 7 B.*

LESSON 8

Грамматика. Формы инфинитива. Субъектный инфинитивный оборот (сочетание глагола-сказуемого в страдательном залоге с инфинитивом).

Предтекстовые упражнения

I. *Переведите следующие предложения на русский язык:*

1. The composition of air is found to vary slightly with elevation. 2. The air is known to contain one fifth oxygen by volume. 3. Most substances have been found to expand as the temperature rises. 4. The temperature lower than -273° is not known to exist. 5. Water can be said to be a universal solvent. 6. Ground water has been stated to contain a great deal of impurities. 7. Water was believed by the ancients to be an element. 8. Oxygen can be said to represent the most widely distributed element on the Earth. 9. Hydrogen peroxide has been shown to resemble ozone in many ways. 10. Hydrogen peroxide is found to act both as a vigorous oxidizing agent and as a reducing agent. 11. Phosphorus and nitrogen have been proved by many experiments to differ radically in many respects. 12. Silicon is said to play an important part in the inorganic world. 13. The importance of carbon in organic chemistry is considered to result from its possessing the ability to form carbon-carbon bonds.

II. *Прочитайте и переведите следующие предложения, обращая внимание на выделенные слова:*

as compared (to, with) – по сравнению

The electrons and the nucleus are very small **as compared with** the size of the atom.

except (for) – за исключением

The chemical properties of ozone are similar to those of oxygen **except for** its greater chemical activity.

III. *Прочитайте и переведите следующие слова без словаря:*

portion [ˈpɔːʃ(ə)n], proton ['prəʊtɒn], neutron [ˈnjuːtrɒn], electricity [ɪlekˈtrɪsɪtɪ], neutral [ˈnjuːtrəl], equal [ˈiːkwəl], mass [mæs], opposite ['ɒpəzɪt], plus [plʌs], minus ['maɪnəs], diameter [daɪ'æmɪtə], centimeter (cm) [ˌsentɪ'miːtə]

IV. *Запомните чтение следующих слов:*

indivisible [ˌɪndɪ'vɪzəbl], impenetrable [ɪm'penɪtrəbl], negligible ['neglɪʤəbl], sign [saɪn], whole [həʊl]

TEXT 8 A

Structure of Atoms

All *kinds* of matter are now known to consist of little *particles* called molecules; these molecules *in turn* are discovered to consist of still smaller particles called atoms. The name "atom" comes from the Greek word *meaning* "indivisible" because atoms were supposed to be completely indivisible. Until the end of the nineteenth century an atom was *considered* to be a "simple, solid, hard, impenetrable particle". Now it is believed to contain (except for hydrogen) three kinds of particles, these *occupying* only a portion of the whole space of the atom. The particles are electrons, protons, and neutrons. The existence of these particles in the atoms of the elements is *fully* established.

Electrons are negatively *charged*. They are thought to lie in different groups about the nucleus of the atom.

If atoms of matter contain *negative* electricity it is evident that they must contain also *positive* electricity in an equal amount; *otherwise* they would not be electrically neutral.

The positively charged atom of hydrogen is a proton. The hydrogen atom is stated to contain only one electron and one proton, and when the electron is removed from the atom, only the proton remains. Since the electron's weight is considered to be almost negligible, the mass of the proton is very nearly equal[1] **equal**[1] to the mass of the hydrogen atom. The mass of the proton is found to be 1836 times greater than that of the electron. The electrical charge of the proton is equal in magnitude to the charge of the electron, but it has the opposite *sign* (+ instead of - [2]).

The neutron has no charge at all and its mass is assumed to be *approximately* equal to that of the proton.

The electrons are the outer portion of the atom. The electrons and the nucleus are very small *as compared with* the *size* of the atom, which, therefore, appears to be composed *largely* of *empty* space. The diameter of the whole atom is *estimated* to be of the order of 10^{-8} cm, while that of the nucleus is believed to be very much smaller.

The atomic weight of an element tells us the number of protons and neutrons in the nucleus of an atom. Now if we could determine the positive charge of the nucleus, we should then know the number of electrons in the atom, as the total charge of electrons is equal to the charge of the nucleus.

Примечания к тексту

1. **very nearly equal** – почти равна
2. **– (minus)** – минус

Запомните следующие слова:

approximately, as compared with, charge, consider, empty, estimate, fully, in turn, kind, largely, mean, negative, occupy, otherwise, particle, positive, sign, size

Упражнения

I. *Переведите следующие предложения на русский язык:*

1. Nitric acid has been found to react with many metals. 2. Hydrogen gas is said to diffuse through solid platinum, iron, etc. 3. Solutions are considered to be homogeneous mixtures which cannot be separated into their constituent parts by mechanical means. 4. Many reactions are known to be accompanied by an absorption of heat. 5. The amount of heat evolved during the formation of a given compound is proved to be the same whether the compound is formed directly or in a series of intermediate stages. 6. A very considerable number of aqueous solutions of acids, bases, and salts are reported to furnish a much greater osmotic pressure than one would expect. 7. The molecules of sodium chloride were supposed to be dissociated in aqueous solutions into two parts – Na and Cl. 8. Chemistry can be said to be largely an experimental science. 9. Thorium is not known to occur with any valence except 4.

II. *Дайте анализ следующего предложения и переведите его на русский язык:*

To obtain crystals of arsenic, grey arsenic is to be quickly heated in a current of hydrogen, black glittering crystals of arsenic being deposited near the hot portion of the tube followed by the formation of a yellow powder.

III. *Дайте недостающие основные формы следующих глаголов:*

to know, to come, to think, to tell, to find

IV. *Дайте антонимы к следующим словам:*

big, the beginning, soft, positive, complex, the same, unequal, to stay

V. *Найдите в тексте эквиваленты к следующим словосочетаниям:*

в свою очередь, еще меньшие частицы, за исключением водорода, в равном количестве, в … раз больше

VI. *Переведите следующие предложения на русский язык, обращая внимание на выделенные слова:*

1. Oxygen is twice as soluble **as compared** to nitrogen. 2. Hydrofluoric acid is a relatively weak acid **as compared** with the binary acids of the other elements. 3. Sodium is very unlike the common metals **except** that it also has a metallic luster. 4. Corundum is the hardest of all naturally occurring substances **except** diamond.

VII. *Дайте краткие утвердительные и отрицательные ответы на следующие вопросы:*

1. Do all kinds of matter consist of molecules? 2. Are atoms indivisible? 3. Must atoms contain positive electricity? 4. Has the electrical charge of the proton the opposite sign as compared with that of the electron charge? 5. Has the neutron got any charge?

VIII. *Ответьте на следующие вопросы:*

1. What do all kinds of matter consist of? 2. What is the meaning of the Greek word "atom"? 3. How many kinds of particles does an atom contain and what are their names? 4. What is a proton? 5. How many electrons and protons does the hydrogen atom contain? 6. What sign has the electrical charge of the proton?

IX. *Прочитайте текст 8 B, не пользуясь словарем:*

TEXT 8 B

Inexhaustibility of the Electron

The inexhaustibility[1] of the electron is well known. The breakdown of the concept of the indivisible, immutable atom gave rise to two fundamentally different stands[2]. First the attempt to apply to the newly discovered electrons all the properties previously ascribed to atoms, the belief that electrons (and not atoms) are the fundamental or "ultimate" particles of matter, a knowledge of which exhausts[3] the knowledge of all matter and of the world.

The second stand was a diametrically opposite one: the discovery of the electron, which revealed the complex character of the structure of the atom, its "inexhaustibility" proved that the old concepts of the structure of matter were wrong not only with regard to atoms, but they were basically false.

Примечания к тексту

1. **inexhaustibility** – неисчерпаемость
2. **stand** – точка зрения
3. **exhaust** – исчерпывать

X. *Расскажите о двух точках зрения на «неисчерпаемость» электрона, пользуясь приведенными ниже словами:*

inexhaustibility, stand, electron, particle, fundamental, the first, the second, the structure, complex, atom, nature, according to, infinite

LESSON 9

Грамматика. Объектный инфинитивный оборот.

Предтекстовые упражнения

I. *Переведите следующие предложения на русский язык:*

1. Experiments proved carbon to occur in many compounds. 2. We know carbon to occur in two crystalline forms. 3. We expect the results obtained to correspond with the formula indicated. 4. We saw the temperature of the solution fall rapidly. 5. The results of this experiment have shown the above compound to contain some unknown element. 6. M. Curie found the element radium to resemble barium in some respects. 7. We know the discovery of radium to have been made by M. Curie in 1910. 8. Scientists assume the production of the rays from uranium compounds to represent a natural process.

II. *Переведите следующие предложения, обращая внимание на выделенные слова:*

at least – по крайней мере
Arsenic occurs in **at least** three allotropic forms.

because – потому что, так как
because of – вследствие, благодаря
1. Argon, helium, neon, krypton and xenon are called the inert gases **because** they are chemically inactive. 2. Phosphorus is never found free in nature **because of** the ease with which it reacts with oxygen.

III. *Прочитайте и переведите следующие слова без словаря:*

chlorine ['klɔːriːn], tendency ['tendənsɪ], litre ['lɪtə], argon ['ɑːgɒn], helium ['hiːlɪəm], neon ['niːən], product ['prɒdəkt], catalyst ['kæt(ə)lɪst], methane ['mi:θeɪn], mixture ['mɪksʧə], characteristic [ˌkærəktə'rɪstɪk], krypton ['krɪptɒn], characterize ['kærəktəraɪz], xenon ['zi:nɒn]

IV. *Запомните чтение следующих слов:*

weight [weɪt], somewhat ['sʌmwɒt], violently ['vaɪəl(ə)ntlɪ], certain ['sɜ:t(ə)n]

Text 9 A

Chlorine

Because of its pronounced activity as a *non-metal* and its *consequent* tendency to combine with metals, chlorine is *never* found naturally in a *free* state. In the combined state, however, it is assumed to be one of the moderately abundant elements of the earth's crust. Chemists consider its most abundant natural compounds to be the chlorides of *certain* metals. Of these, sodium chloride is estimated to be *by far*[1] the most abundant.

Experiments showed chlorine to be only slightly soluble in water. Its density is stated to be almost two and one-half times[2] that of the air, a litre under normal conditions weighing about 3,2140 grams.

We know chlorine to be a typical non-metal. *As such* it resembles oxygen in *some respects*, but differs in showing more *pronounced* activity in its reactions with the metallic elements. Oxygen, on the other hand, is found to display a somewhat greater tendency to react with the non-metals.

Absolutely dry chlorine does not *seem* to attack metals; *at least* the reaction is extremely slow. Experiments prove chlorine to react with almost all of the non-metals. The reaction of hydrogen and chlorine is exothermic.

$$H_2 + Cl_2 = 2\ HCl + 44000\ cal.$$

We should expect, therefore, these two elements to combine very readily and the product to be very *stable*. In the dark, however, hydrogen does not appear to combine with chlorine with *appreciable* velocity and the reaction seems to require the presence of a catalyst. In ordinary light the reaction *is likely* to take place slowly. But if the mixture were exposed to direct sunlight we could see the reaction occur *violently*.

Since chlorine combines very readily with free hydrogen, we should expect it also to react with compounds containing hydrogen. This is really the case. Natural gas, *for instance*, which is known to consist largely of methane (CH_4) continues to *burn* when a lighted jet of the gas is *introduced* into a cylinder *filled* with chlorine, hydrogen chloride and free carbon being produced. In bright sunlight a mixture of methane and chlorine reacts more slowly, and the reaction occurs *in steps*[3] in which chlorine both combines with and replaces hydrogen.

With certain compounds, chlorine is stated to combine directly to form what are called addition compounds. Besides, chlorine may also be shown to react with compounds with certain chlorides in much the same manner as oxygen reacts with certain oxides. These reactions show chlorine to play its most characteristic role, that of a *vigorous* oxidizing agent.

Примечания к тексту

1. **by far –** значительно
2. **two and one-half times** – в два с половиной раза больше
3. **in steps** – по этапам, ступенчато

Запомните следующие слова:

at least, appreciable, as such, be likely, burn, by far, certain, consequent, fill, free, for instance, in some respects, in steps, never, non-metal, pronounced, seem, stable, vigorous, violently

Упражнения

I. *Переведите следующие предложения на русский язык:*

1. Experiments show chlorine to be a bleaching agent. 2. Microscopic determination of silicon shows it to be made up of tiny crystals and fragments of crystals. 3. M. Curie found the atomic weight of radium to be 226. 4. The experiments proved free chlorine to be present in the vapour of chromic chloride at 355°. 5. If we put gold into a beaker with aqua regia we see the metal gradually disappear. 6. We know two atoms of hydrogen to unite with one atom of oxygen when hydrogen burns. 7. The microscope reveals milk to consist of droplets of butter fat dispersed in water fluid. 8. While dissolving calcium chloride in water we saw the temperature fall rapidly. 9. Diffusion shows molecules of any substance to be in motion. 10. Lomonosov’s experiments showed the green colouration of glass to be due to the presence of chromium. 11. M. Curie found natural pitchblende, namely U_3O_8, to be several times more active than purified uranium oxide. 12. We know Joseph Priestly to have discovered oxygen by trying the effect of heat on many substances. 13. Phosphorus pentoxide appears to exist in a number of forms, one of which subliming at about 350°. 14. The hydrogen atom is believed to have one proton as its nucleus, with one electron circling around it. 15. Complex sulphites of silver do not seem to have been isolated though they occur in solutions.

II. *Переведите данные в скобках слова или группы слов на английский язык, затем переведите предложения на русский язык:*

1. (Из-за) its inactivity this substance does not react with oxygen, (если его не подогреть). 2. (Так как) white phosphorus is poisonous, it must be kept under water. 3. Ground water contains (множество) impurities, (следовательно) it is not pure. 4. (Согласно) this reaction much heat and light is liberated when the substances combine. 5. Silicon resembles carbon in having crystalline, (так же,

как) amorphous form. 6. (Что касается) its chemical behaviour oxygen is very reactive. 7. (Кроме того) we know chlorine to be a bleaching agent. 8. Absolutely dry chlorine, (однако), does not seem to attack metals.

III. *Найдите в тексте эквиваленты следующих выражений:*

в связанном состоянии; как таковой; с другой стороны; действительно; так и есть; почти таким же способом; в свободном состоянии

IV. *Переведите следующие предложения, обращая внимание на выделенные слова:*

1. There are believed to exist **at least** two modifications of sulphur. 2. A piece of granite which consists of a mixture of **at least** four constituents is heterogeneous. 3. **Because** carbon monoxide is odourless, the presence of this gas is not easily detected. 4. Hydrogen diffuses more rapidly than any other gas **because of** its very small density.

V. *Ответьте на следующие вопросы:*

1. Why is chlorine never found in a free state? 2. What ate the most abundant natural compounds of chlorine? 3. What are the properties of chlorine? 4. In what respects does chlorine differ from oxygen? 5. What elements does chlorine react with? 6. What kind of agent is chlorine? 7. What would happen to a mixture of methane and chlorine in the bright sunlight?

VI. *Охарактеризуйте приведенные ниже высказывания, относящиеся к тексту, следующим образом:* «правильно», «неправильно», «нет в тексте».

1. Chlorine is found in a free state in nature. 2. Chlorine is a typical non-metal. 3. Chlorine exists in two isotope forms. 4. Chlorine reacts with compounds containing hydrogen. 5. Absolutely dry chlorine attacks metals readily. 6. The solution of chlorine in water has the same colour as the gas.

VII. *Прочитайте текст 9 В, не пользуясь словарем:*

Текст 9 В

The Action of Chlorine on Other Elements

At ordinary temperatures chlorine is a pale green gas, with normal boiling and freezing points of -35° and -102°, respectively. It occurs in nature mainly as sodium chloride. Chlorine is prepared in very large quantities industrially. It is moderately[1] soluble in water. Dry chlorine is somewhat inert chemically and it has no appreciable action upon bright metallic sodium, copper, etc. Moist chlorine is very active. It does not combine with oxygen directly, although several compounds of chlorine and oxygen can be obtained indirectly. In sunlight, equal volumes of hydrogen and chlorine combine with explosion, whereas in the dark hydrogen does not appear to combine with chlorine with appreciable velocity. Chlorine oxides are highly reactive and unstable, they are likely to explode under various conditions. Probably the best characterized is chlorine monoxide Cl_2O. It is a yellowish red gas at room temperature, the liquid boiling at 2°C. It explodes rather easily on heating. It is known to dissolve in water forming an orange-yellow solution. Chlorine dioxide is also highly reactive and likely to explode very violently.

Примечание к тексту

1. **moderately** – умеренно

VIII. *Изложите содержание текста на английском языке.*

LESSON 10

Грамматика. Инфинитив в функции подлежащего и обстоятельства (цели и следствия).

Предтекстовые упражнения

I. *Обратите внимание на функцию инфинитива в следующих предложениях и переведите предложения на русский язык:*

1. To separate air into its components requires the use of fractional distillation of liquid air. 2. To separate air into its components one must use fractional distillation of liquid air. 3. In order to purify water it should be either thoroughly filtered or boiled. 4. The solution prepared was sufficiently saturated to be used in this case. 5. The amount of the material was too small to be studied by the method in question. 6. The experiment was repeated so as to obtain more accurate results. 7. The analysis of the compounds of silicon and those of carbon has been made in order to establish the difference between them. 8. Crystalline silicon is hard enough to scratch glass. 9. The particles were so fine as to be invisible. 10. The work was such as to require special equipment. 11. The substance was so volatile as to be collected only with great difficulty. 12. Mary Curie together with her husband Pierre Curie investigated pitchblende to discover an element of greater radioactivity than uranium itself. 13. Selenium and tellurium burn in air to form dioxides. 14. To produce penetrating rays from uranium compounds by any artificial means is not possible. 15. To produce artificial diamonds from carbon high pressure and high temperature are required.

II. *Прочитайте и переведите следующие слова без словаря:*

lithium /ˈlɪθɪəm/, rubidium /ru:ˈbɪdɪəm/, periodic /ˌpɪərɪˈɒdɪk/, calcium /ˈkælsɪəm/, caesium /ˈsi:zjəm/, amalgam /əˈmælgəm/, hydrolyze /ˈhaɪdrəlaɪz/

III. *Запомните чтение следующих слов:*

toward /təˈwɔ:d/, usually /ˈju:ʒʊəlɪ/, develop /dɪˈveləp/, slaked /ˈsleɪkt/, benzene /ˈbenzi:n/, benzine /ˈbenzi:n/

Text 10 A

Alkali Metals

The elements of the Periodic Group I A, lithium, sodium, potassium, rubidium and caesium are called the alkali metals. These are alike in having a single electron in the *outermost shell*; since this electron is *far* removed from the rest of the atom, it is easily lost. Therefore, from the chemical point of view, these elements are the most active metals known. As we progress from lithium *toward* caesium, a striking increase in radius of the atom is to be observed.

Properties. Alkali metals have relatively low melting points and boiling points. They are soft enough to be easily cut with a knife, the softest being caesium. The latter is soft enough to be moulded[1] between fingers. They are also very light, the lightest being lithium, sodium and potassium. They are so light as to *float* on water.

The untarnished[2] surfaces of these metals may be seen to have a silvery *lustre*, but they rapidly *tarnish* and lose their lustre. The metals are usually stored in oil so as to exclude air. When stored in this way, they usually do not have a metallic *appearance* because of a surface *coating*.

The alkali metals are too active to be found free in nature. They are known to react with a number of non-metals, forming binary products, *e. g.* with chlorine to form chlorides, with bromine to form bromides and with sulphur to form sulphides.

The alkali metals are such active metals as to displace hydrogen from water, producing gaseous hydrogen and the hydroxide of the metal in solution. Potassium, rubidium and caesium develop enough heat in this reaction to ignite the liberated hydrogen.

$$2\ Na + 2\ H_2O = H_2 + 2\ NaOH$$

They also *displace* hydrogen from acids, but the reaction is too violent to be of importance.

Reacting with oxygen, lithium yields the simple oxide, sodium, on the other hand, yields the peroxide unless the temperature is kept relatively low. When heated in air sodium and potassium readily take fire, each metal forming a mixture of oxides. The ordinary temperature is *sufficient* to ignite rubidium and caesium.

To prepare sodium hydroxide, a solution of sodium carbonate is added to *slaked lime*, calcium hydroxide, suspended in water. When exposed to air sodium hydroxide absorbs moisture and carbon dioxide, so it is used to remove both moisture and carbon dioxide from the air.

Примечания к тексту

1 **to mould** – *зд.* разминать
2. **untarnished** – *зд.* свежесрезанный

Запомните следующие слова:

appearance, coating, displace, far, float, e. g. (= for example), lustre, outermost, slaked lime, shell, sufficient, tarnish, toward

Упражнения

I. *Определите по характерным признакам функцию инфинитива в следующих предложениях и переведите предложения на русский язык:*

1. To determine the volume of a gas at a definite temperature is rather easy. 2. To dissolve rubber, benzene or benzine are used. 3. Nitrogen peroxide is unstable enough to support ordinary combustion readily. 4. Gold and platinum do not gain weight when heated in air because they are too inactive to unite with oxygen. 5. Elementary lithium is too active to be of much use. 6. Tin is reactive enough to displace hydrogen from dilute acids but it does not tarnish in moist air. 7. A formula is used by chemists so as to represent the composition of one molecule of a substance. 8. To determine the molecular weight of a gas it is necessary to know its density in relation to hydrogen. 9. If two or more substances react to form a single substance, that substance is a compound. 10. Radium continuously emits heat at a rate sufficient to melt its own weight of ice every 45 minutes. 11. Metallic conductors do not appear to undergo any chemical change due to the passage of a current. 12. The examination of uranium minerals by M. Curie has shown some of them to emit radiations of greater intensity than uranium itself. 13. Investigation has shown radioactive changes to take place in series, the final non-radioactive product of these series being lead. 14. The so-called “amorphous carbon”, such as charcoal, appears upon examination by X-rays to resemble graphite in structure, except its being highly porous. 15. The grains a metal is made up may be so fine as to require a magnification of 100 times or more to reveal them.

II. *Переведите следующие предложения на английский язык, пользуясь приведенной ниже рамкой:*

1. Известно, что хлор – типичный неметалл. 2. Соединения щелочных металлов отличаются по своей промышленной важности. 3. Вода влияет на

многие химические реакции. 4. Щелочные металлы хранятся в масле, чтобы исключить влияние воздуха. 5. Обычной температуры достаточно, чтобы воспламенить рубидий и цезий. 6. Гидроокись натрия используется, чтобы удалить из воздуха как влагу, так и двуокись углерода.

1. Water	differ	- to be a typical non-metal.
2. Chlorine	is used	- to remove both moisture and carbon dioxide from the air.
3. Sodium hydroxide	is known	- in their industrial importance.
4. The compounds of alkali metals	influences	- in oil so as to exclude air.
5. The alkali metals	is sufficient	- many chemical reactions.
6. The ordinary temperature	are stored	- to ignite rubidium and caesium.

III. *Дайте остальные основные формы следующих глаголов:*

to lose, to see, to keep, to show

IV. *Сгруппируйте синонимы и переведите их на русский язык:*

alike, usually, to yield, generally, to manufacture, to give, similar, to produce

V. *Сгруппируйте антонимы и переведите их на русский язык:*

with difficulty, far, known, soft, near, easily, heavy, low, high, hard, light, unknown

VI. *Укажите, к какой части речи относятся следующие слова, и переведите их на русский язык:*

easily, metallic, reaction, rapidly, mixture, importance, moisture, active, relatively, chemical

VII. *Переведите следующие предложения, обращая внимание на выделенные слова:*

1. Diffusion in liquids **takes place** much more slowly than in gases. 2. **Owing to** its solubility hydrogen sulphide should not be collected over cold water. 3. Most of sulphur occurs in the earth’s crust as iron sulphide, but oxidation **has**

given rise to large deposits of sulphate, chiefly of calcium and magnesium. 4. The reaction of magnesium with water occurs most rapidly if a small **amount** of some magnesium salt is present in water. 5. The total **amount** of radium produced up to 1940 **amounted to** about one kilogram. 6. Usually the most rapid and simplest chemical changes **take place** between dissolved substances. 7. Although the speed of a chemical reaction is modified by the presence of a catalyst, the final state of equilibrium is **practically** not affected. 8. **The only** gas giving red fumes when exposed to the air is nitric oxide.

VIII. *Найдите в тексте эквиваленты следующих словосочетаний:*

с химической точки зрения; самые активные из известных металлов; можно наблюдать поразительное увеличение радиуса атома; вследствие пленки на поверхности; при нагревании на воздухе

IX. *а) Поставьте 6 вопросов к тексту;*

б) Ответьте на следующие вопросы:

1. What elements are called alkali metals? 2. In what respects are the alkali metals alike? 3. What are the properties of the alkali metals? 4. Why are the alkali metals stored in oil? 5. Why are the alkali metals not found free in nature? 6. In what way is sodium hydroxide usually obtained?

X. *Охарактеризуйте приведенные ниже высказывания, относящиеся к тексту 10 А, следующим образом:* «правильно», «неправильно», «нет в тексте»:

1. Caesium is the most reactive member of the series of alkali metals. 2. Alkali metals are soft enough to be easily cut with a knife. 3. Alkali metals do not float on water. 4. Reacting with oxygen, lithium yields the simple oxide. 5. Sodium hydroxide is obtained by the electrolysis of common salt. 6. Alkali metals neither tarnish nor lose their lustre.

XI. *Прочитайте текст 10 B, не пользуясь словарем:*

TEXT 10 B

The Group I Elements Li, Na, K, Rb and Cs

The group I elements are all univalent, and have a remarkable affinity for oxygen; caesium and rubidium ignite spontaneously if placed in dry oxygen at room temperature. The chemical activity of the alkali metals appears to increase steadily in passing from lithium to caesium.

The metals are obtained by electrolysis of fused salts or salt mixtures. Because there is only one valence electron per metal atom, the binding energies in the close packed metal lattices[1] are relatively weak and the metals are consequently very soft and have low melting points.

Liquid alloys of alkali metals are known, the most important being the Na–K alloys. All of the alkali metals are highly electropositive and react with most other elements directly. The metals are found to dissolve in mercury to form amalgams. The group I metals are soluble in liquid ammonia to give solutions which are blue when dilute. They react directly with most non-metals to give one or more binary compounds. Owing to the highly electropositive character of the alkali metals the various oxides are readily hydrolyzed by water.

Примечание к тексту

1. **close packed metal lattice** – плотно упакованная решетка металлов

XII. *Расскажите о свойствах щелочных металлов, пользуясь текстами 10 A и B.*

LESSON 11

Грамматика. Инфинитив в функции определения.

Предтекстовые упражнения

I. *Обратите внимание на инфинитив в функции определения в следующих предложениях и переведите предложения на русский язык:*

1. This scientist was the first to point out the importance of the phenomena observed. 2. They are the last to leave the laboratory. 3. D. I. Mendeleyev was the first scientist to arrange the elements according to their atomic weights. 4. Water to be used for drinking should be thoroughly purified. 5. The action to follow the combination of equal volumes of hydrogen and chlorine in sunlight is known as explosion. 6. Gold was probably one of the first metals to attract the attention of man. 7. The best solvent to be employed for dissolving phosphorus is carbon disulphide. 8. Sodium peroxide mixed with cupric oxide to serve as a catalyst, reacts with water, liberating oxygen. 9. Oxygen has considerable ability to form double bonds. 10. The hardest substance to cut different materials with is diamond.

II. *Переведите следующие предложения, обращая внимание на выделенные слова:*

in spite of – несмотря на

In spite of the high boiling point mercury does show a small vapour presence at an ordinary temperature.

in terms of – на основании; исходя из; на языке; с точки зрения
A material system may be described **in terms of** the phases constituting it.

III. *Прочитайте и переведите следующие слова без словаря:*

mendelevium /ˌmendɪˈlɪvɪəm/, function /ˈfʌŋkʃn/, thiosulphate /ˌθɪəˈsʌlfeɪt/, ethylene /ˈeθɪli:n/, classification /ˌklæsɪfɪˈkeɪʃn/, vacant /ˈveɪkənt/, position /pəˈzɪʃn/, scandium /ˈskændɪəm/, gallium /ˈgælɪəm/, germanium /ˌdʒɜ:ˈmeɪnɪəm/, actinium /ˌækˈtɪnɪəm/

IV. *Запомните чтение следующих слов:*

contribution /ˌkɒntrɪˈbju:ʃn/, development /dɪˈveləpmənt/, subsequent /ˈsʌbsɪkwənt/, arrangement /əˈreɪndʒmənt/, periodicity /ˌpɪərɪəˈdɪsɪtɪ/, appreciate /əˈpri:ʃɪeɪt/, reverse /rɪˈvɜ:s/, considerable /kənˈsɪdərəbl/, predict /prɪˈdɪkt/, comprehensive /ˌkɒmprɪˈhensɪv/, familiar /fəˈmɪljə/, substantially /səbˈstænʃəlɪ/, fluorine /ˈflʊəri:n/

TEXT 11 A

The Periodic Law

In spite of the importance of the earlier contributions, the major portion of credit[1] for the development of the periodic system must go to the Russian scientist, Dmitri Ivanovich Mendeleyev. The realization that the properties of the elements can be *represented* as periodic functions of their atomic weights made possible classification that has *suffered* few significant changes in the *subsequent* years.

It was in March of 1869 that D. I. Mendeleyev published his first *account* of the periodic system, in which he set forth the *arrangement* of the elements in terms of their increasing atomic weights. D. I. Mendeleyev was the first to fully *appreciate* the *significance* of this *periodicity*. In his first paper D. I. Mendeleyev pointed out the similarities of a number of properties of certain elements and reversed the order of atomic weights where necessary in order to maintain this group *similarity*.

Of *considerable* interest and importance is the fact that D. I. Mendeleyev left *vacant* positions in his *proposed* table for yet undiscovered elements and *expressed* the *opinion* that the chemical and physical properties of the elements to be discovered might well[2] be *predicted* from their positions in the table. In the summer of 1871 D. I. Mendeleyev published a more *comprehensive* treatment[3] of what he called the Periodic Law. At this time he presented the more familiar form of the periodic table and although it differs *somewhat* from the one that is in use today, it is *substantially* the same. It was in his publication of 1871 that D. I.

Mendeleyev utilized the periodic character to predict the properties of the elements to be described later as those of scandium, gallium and germanium. The *remarkable agreement* of the properties of these elements as described by D. I. Mendeleyev and those to be observed later is certainly a complete *justification* of D. I. Mendeleyev's faith in his periodic law.

In December 1945 Glenn Seaberg made his first publication of a periodic table which *depicted* a new actinide series beginning with actinium. He said that American scientists were proud and happy to honour the name of D. I. Mendeleyev by calling element 101 "mendelevium".

Примечания к тексту

1. **the major portion of credit … must go** – основная заслуга … принадлежит
2. **well** – *зд.* вполне
3. **treatment** – трактат

Запомните следующие слова:

account, agreement, appreciate, arrangement, comprehensive, considerable, depict, express, in spite of, justification, opinion, periodicity, predict, propose, remarkable, represent, set forth, significance, similarity, somewhat, substantially, subsequent, vacant

Упражнения

I. *Определите функцию инфинитива в следующих предложениях и переведите предложения на русский язык:*

1. If the filtrate contains elements to be determined it is usually necessary to reduce the volume by evaporation. 2. In quantitative analysis the element or radical to be determined is isolated in the form of a precipitate. 3. M. V. Lomonosov was the first scientist to find heat, light and electricity to be different forms of motion. 4. Sodium peroxide mixed with cupric oxide to serve as a catalyst reacts with water liberating oxygen. 5. The method of qualitative analysis to be employed depends somewhat on the nature of the substance to be analysed. 6. S. V. Lebedev was the first to study synthetic rubber-like compounds. 7. Metallic palladium has an unusual ability to absorb hydrogen. 8. M. V. Lomonosov was the first to give the definition of the second law of thermodynamics. 9. Atoms in the gas have the power to add an extra electron forming a negative ion such as I^-. 10. Urea was the first organic compound to be synthesized from inorganic materials. 11. Bertholet observed ethylene to dissolve in a solution of cuprous chlorine in dilute hydrochloric acid. 12. Various attempts have been made to interpret the absorption spectra of cupric amines. 13. Among the cuprous compounds no open-chain complexes joined through oxygen seem to be known. 14. The solubility of argentous acetate in water is found to increase on addition of alkaline or alkaline earth acetates.

II. *Выпишите из текста предложения, содержащие эмфатическую конструкцию* **it is … that**, *и переведите их на русский язык.*

III. *Дайте прилагательные, соответствующие следующим существительным:*

importance, scientist, significance, atom, periodicity, similarity, chemistry, physics, completion

IV. *Переведите следующие слова как существительные и как глаголы:*

change, increase, point, order, form, use

V. *Переведите следующие предложения на русский язык, обращая внимание на выделенные слова:*

1. **In spite of** the fact that compounds of fluorine had long been known, the element is so active that it was not obtained in appreciable quantities until 1886. 2. It is assumed that pure water is a non-conductor, **in spite of** the fact that perfectly non-conducting water has not yet been made. 3. We can explain reduction **in terms of** atomic structure. 4. Sometimes the data from which molecular weights are to be calculated are expressed **in terms of** the relative densities of gases.

VI. *Ответьте на следующие вопросы:*

1. Who contributed greatly to the development of the periodic system? 2. What did D. I. Mendeleyev realize? 3. When did D. I. Mendeleyev publish his first account of the periodic system? 4. What did he set forth in his account? 5. What did he point out? 6. What were vacant positions in the Table left for? 7. How many elements did D. I. Mendeleyev predict the properties of? 8. Why did American scientists call element 101 “mendelevium”?

VII. *Прочитайте текст 11 B, не пользуясь словарем:*

TEXT 11 B

From Mendeleyev to Mendelevium – and Beyond

The year 1969 marked the one hundredth anniversary of the announcement by Dmitry Mendeleyev of his formulation of a periodic classification of elements based on their atomic weights and chemical properties. It is proper[1] that Russia celebrated this anniversary of the contribution[2] to science of one of its sons, but at the same time it must be recognized that D. I. Mendeleyev's accomplishment has had an impact on[3] science which is international in scope.

The Periodic Law has crossed national boundaries and has become the property[4] of all nations.

D. I. Mendeleyev arranged all the elements in a table consisting of vertical groups and horizontal periods. In this table all the un-co-ordinated data on the properties of elements and their compounds are collected and arranged into one well-constructed system. It enables scientists to predict the possibility of discovering new elements and their properties and to correct the errors made in previous definitions of the properties of known elements. D. I. Mendeleyev's periodic system continues to form the basis for some of the most complex research that is being done today. His name will be perpetuated[5] in the discovery of new artificial elements and in our better understanding of the mysteries of nature.

Примечания к тексту

1. **it is proper** – естественно
2. **contribution** – вклад
3. **has had an impact on** – оказало влияние на
4. **property** – достояние
5. **perpetuate** – увековечивать

VIII. *Расскажите о периодической системе Менделеева, пользуясь текстами 11 A и B.*

ТЕКСТЫ ДЛЯ САМОСТОЯТЕЛЬНОГО ЧТЕНИЯ

TEXT 1

Chemistry
4884 п.з.

Chemistry is a branch of physical science that studies the composition, structure, properties and change of matter. Chemistry includes topics such as the properties of individual atoms, how atoms form chemical bonds to create chemical compounds, the interactions of substances through intermolecular forces that give matter its general properties, and the interactions between substances through chemical reactions to form different substances.

Chemistry is sometimes called the central science because it bridges other natural sciences, including physics, geology and biology. The word chemistry comes from alchemy, which referred to an earlier set of practices that encompassed elements of chemistry, metallurgy, philosophy, astrology, astronomy, mysticism and medicine. It is often seen as linked to the quest to turn lead or another common starting material into gold, though in ancient times the study encompassed many of the questions of modern chemistry being defined as the study of the composition of waters, movement, growth, embodying, disembodying, drawing the spirits from bodies and bonding the spirits within bodies by the early 4th century Greek-Egyptian alchemist Zosimos. An alchemist was called a 'chemist' in popular speech, and later the suffix "-ry" was added to this to describe the art of the chemist as "chemistry".

The modern word alchemy in turn is derived from the Arabic word al-kīmīā (الكيمياء). In origin, the term is borrowed from the Greek χημία or χημεία. his may have Egyptian origins since al-kīmīā is derived from the Greek χημία, which is in turn derived from the word Chemi or Kimi, which is the ancient name of Egypt in Egyptian. Alternately, al-kīmī may derive from χημεία, meaning "cast together".

In retrospect, the definition of chemistry has changed over time, as new discoveries and theories add to the functionality of the science. The term "chymistry", in the view of noted scientist Robert Boyle in 1661, meant the subject of the material principles of mixed bodies. In 1663 the chemist Christopher Glaser described "chymistry" as a scientific art, by which one learns to dissolve bodies, and draw from them the different substances on their composition, and how to unite them again, and exalt them to a higher perfection.

The 1730 definition of the word "chemistry", as used by Georg Ernst Stahl, meant the art of resolving mixed, compound, or aggregate bodies into their principles; and of composing such bodies from those principles. In 1837, Jean-Baptiste Dumas considered the word "chemistry" to refer to the science concerned with the laws and effects of molecular forces. This definition further evolved until, in 1947, it came to mean the science of substances: their structure, their properties, and the reactions that change them into other substances - a characterization accepted by Linus Pauling. More recently, in 1998, Professor Raymond Chang broadened the definition of "chemistry" to mean the study of matter and the changes it undergoes.

Early civilizations, such as the Egyptians, Babylonians, Indians amassed practical knowledge concerning the arts of metallurgy, pottery and dyes, but didn't develop a systematic theory.

A basic chemical hypothesis first emerged in Classical Greece with the theory of four elements as propounded definitively by Aristotle stating that fire, air, earth and water were the fundamental elements from which everything is formed as a combination. Greek atomism dates back to 440 BC, arising in works by philosophers such as Democritus and Epicurus. In 50 BC, the Roman philosopher Lucretius expanded upon the theory in his book De rerum natura (On the Nature of Things). Unlike modern concepts of science, Greek atomism was purely philosophical in nature, with little concern for empirical observations and no concern for chemical experiments.

In the Hellenistic world the art of alchemy first proliferated, mingling magic and occultism into the study of natural substances with the ultimate goal of transmuting elements into gold and discovering the elixir of eternal life. Work, particularly the development of distillation, continued in the early Byzantine period with the most famous practitioner being the 4th century Greek-Egyptian Zosimos of Panopolis. Alchemy continued to be developed and practiced throughout the Arab world after the Muslim conquests, and from there, and from the Byzantine remnants, diffused into medieval and Renaissance Europe through Latin translations. Some influential Muslim chemists, Abū al-Rayhān al-Bīrūnī, Avicenna and Al-Kindi refuted the theories of alchemy, particularly the theory of the transmutation of metals; and al-Tusi described a version of the conservation of mass, noting that a body of matter is able to change but is not able to disappear.

TEXT 2

History of Chemistry
3804 п.з.

The development of the modern scientific method was slow and arduous, but an early scientific method for chemistry began emerging among early Muslim chemists, beginning with the 9th century Persian or Arabian chemist Jābir ibn Hayyān (known as "Geber" in Europe), who is sometimes referred to as "the father of chemistry". He introduced a systematic and experimental approach to scientific research based in the laboratory, in contrast to the ancient Greek and Egyptian alchemists whose works were largely allegorical and often unintelligible. Under the influence of the new empirical methods propounded by Sir Francis Bacon and others, a group of chemists at Oxford, Robert Boyle, Robert Hooke and John Mayow began to reshape the old alchemical traditions into a scientific discipline. Boyle in particular is regarded as the founding father of chemistry due to his most important work, the classic chemistry text The Sceptical Chymist where the differentiation is made between the claims of alchemy and the empirical scientific discoveries of the new chemistry. He formulated Boyle's law, rejected the classical "four elements" and proposed a mechanistic alternative of atoms and chemical reactions that could be subject to rigorous experiment.

The theory of phlogiston (a substance at the root of all combustion) was propounded by the German Georg Ernst Stahl in the early 18th century and was only overturned by the end of the century by the French chemist Antoine Lavoisier, the chemical analogue of Newton in physics; who did more than any other to establish the new science on proper theoretical footing, by elucidating the principle of conservation of mass and developing a new system of chemical nomenclature used to this day.

Before his work, though, many important discoveries had been made, specifically relating to the nature of 'air' which was discovered to be composed of many different gases. The Scottish chemist Joseph Black (the first experimental chemist) and the Dutchman J. B. van Helmont discovered carbon dioxide, or what Black called 'fixed air' in 1754; Henry Cavendish discovered hydrogen and elucidated its properties and Joseph Priestley and, independently, Carl Wilhelm Scheele isolated pure oxygen.

English scientist John Dalton proposed the modern theory of atoms; that all substances are composed of indivisible 'atoms' of matter and that different atoms have varying atomic weights.

The development of the electrochemical theory of chemical combinations occurred in the early 19th century as the result of the work of two scientists in particular, J. J. Berzelius and Humphry Davy, made possible by the prior invention of the voltaic pile by Alessandro Volta. Davy discovered nine new elements including the alkali metals by extracting them from their oxides with electric current.

British William Prout first proposed ordering all the elements by their atomic weight as all atoms had a weight that was an exact multiple of the atomic weight of hydrogen. J. A. R. Newlands devised an early table of elements, which was then developed into the modern periodic table of elements in the 1860s by Dmitri Mendeleev and independently by several other scientists including Julius Lothar Meyer. The inert gases, later called the noble gases were discovered by William Ramsay in collaboration with Lord Rayleigh at the end of the century, thereby filling in the basic structure of the table.

Organic chemistry was developed by Justus von Liebig and others, following Friedrich Wöhler's synthesis of urea which proved that living organisms were, in theory, reducible to chemistry. Other crucial 19th century advances were; an understanding of valence bonding (Edward Frankland in 1852) and the application of thermodynamics to chemistry (J. W. Gibbs and Svante Arrhenius in the 1870s).

TEXT 3

Mikhail Vasilyevich Lomonosov
5505 п.з.

Mikhail Vasilyevich Lomonosov (November 19, 1711 – April 15, 1765) was a Russian polymath, scientist and writer, who made important contributions to literature, education, and science. Among his discoveries were the atmosphere of Venus and the Law of Mass Conservation in chemical reactions. His spheres of science were natural science, chemistry, physics, mineralogy, history, art, philology, optical devices and others. Lomonosov was also a poet and influenced the formation of the modern Russian literary language.

In 1730, at nineteen, Lomonosov went to Moscow on foot, because he was determined to study. Not long after arriving, Lomonosov obtained admission into the Slavic Greek Latin Academy. Lomonosov lived on three kopecks a day, eating only black bread and kvass, but he made rapid progress scholastically. After three years in Moscow he was sent to Kiev to study for one year at the Kyiv-Mohyla Academy. He quickly became dissatisfied with the education he was receiving there, and returned to Moscow several months ahead of schedule, resuming his studies there. He completed a twelve-year study course in only five years, graduating at the top of his class. In 1736, Lomonosov was awarded a scholarship to St. Petersburg Academy. He plunged into his studies and was rewarded with a two-year grant to study abroad at the University of Marburg, in Germany.

The University of Marburg was among Europe's most important universities in the mid-18th century due to the presence of the philosopher Christian Wolff, a prominent figure of the German Enlightenment. Lomonosov became one of Wolff's personal students while at Marburg. Both philosophically and as a science administrator, this connection would be the most influential of Lomonosov's life. Between 1739–1740 he studied mineralogy, metallurgy, and mining at Bergrat Henckel's laboratories in Freiberg, Saxony; there he intensified his studies of German literature.

Lomonosov quickly mastered the German language, and in addition to philosophy, seriously studied chemistry, discovered the works of 17th century Irish theologian and natural philosopher, Robert Boyle, and even began writing poetry. He also developed an interest in German literature. He is said to have especially admired Günther. His *Ode on the Taking of Khotin from the Turks*, composed in 1739, attracted a great deal of attention in Saint Petersburg.

Lomonosov returned to Russia in 1741. A year later he was named adjutant to the Russian Academy of Science in the physics department. Lomonosov was made a full member of the Academy, and named professor of chemistry, in 1745. He established the Academy's first chemistry laboratory. Eager to improve Russia's educational system, in 1755, Lomonosov joined his patron Count Ivan Shuvalov in founding Moscow University.

In 1761, he was elected a foreign member of the Royal Swedish Academy of Sciences. In 1764, Lomonosov was appointed to the position of secretary of state.

In 1756, Lomonosov tried to replicate Robert Boyle's experiment of 1673. He concluded that the commonly accepted phlogiston theory was false. Anticipating the discoveries of Antoine Lavoisier, he wrote in his diary: "Today I made an experiment in hermetic glass vessels in order to determine whether the mass of metals increases from the action of pure heat. The experiments– of which I append the record in 13 pages – demonstrated that the famous Robert Boyle was deluded, for without access of air from outside the mass of the burnt metal remains the same".

That is the Law of Mass Conservation in chemical reaction, which was well-known today as "in a chemical reaction, the mass of reactants is equal to the mass of the products." Lomonosov, together with Lavoisier, is regarded as the one who discovered the law of mass conservation.

He stated that all matter is composed of corpuscles – molecules that are "collections" of elements – atoms. In his dissertation "Elements of Mathematical Chemistry" (1741, unfinished), the scientist gives the following definition: "An element is a part of a body that does not consist of any other smaller and different bodies ... corpuscle is a collection of elements forming one small mass." In a later study (1748), he uses term "atom" instead of "element", and "particula" (particle) or "molecule" instead of "corpuscle".

He regarded heat as a form of motion, suggested the wave theory of light, contributed to the formulation of the kinetic theory of gases, and stated the idea of conservation of matter in the following words: "All changes in nature are such that inasmuch is taken from one object insomuch is added to another. So, if the amount of matter decreases in one place, it increases elsewhere. This universal law of nature embraces laws of motion as well, for an object moving others by its own force in fact imparts to another object the force it loses" (first articulated in a letter to Leonhard Euler dated 5 July 1748, rephrased and published in Lomonosov's dissertation "Reflexion on the solidity and fluidity of bodies", 1760).

Lomonosov was the first person to record the freezing of mercury. Believing that nature is subject to regular and continuous evolution, he demonstrated the organic origin of soil, peat, coal, petroleum and amber. In 1745, he published a catalogue of over 3,000 minerals, and in 1760, he explained the formation of icebergs.

In 1763 he published *On the Strata of the Earth* - his most significant geological work.

TEXT 4

Dmitri Ivanovich Mendeleev
8945 п.з.

Dmitri Ivanovich Mendeleev (8 February 1834 – 2 February 1907) was a Russian chemist and inventor. He formulated the Periodic Law, created a farsighted version of the periodic table of elements, and used it to correct the properties of some already discovered elements and also to predict the properties of eight elements yet to be discovered.

Mendeleev was born in the village of Verkhnie Aremzyani, near Tobolsk in Siberia, to Ivan Pavlovich Mendeleev and Maria Dmitrievna Mendeleeva (née Kornilieva). His father was a teacher of fine arts, politics and philosophy. Unfortunately for the family's financial well being, his father became blind and lost his teaching position. His mother was forced to work and she restarted her family's abandoned glass factory. At the age of 13, after the passing of his father and the destruction of his mother's factory by fire, Mendeleev attended the Gymnasium in Tobolsk.

In 1849, his mother took Mendeleev across Russia from Siberia to Moscow with the aim of getting Mendeleev a higher education. The university in Moscow did not accept him. The mother and son continued to Saint Petersburg to the father’s alma mater. The now poor Mendeleev family relocated to Saint Petersburg, where he entered the Main Pedagogical Institute in 1850. After graduation, he contracted tuberculosis, causing him to move to the Crimean Peninsula on the northern coast of the Black Sea in 1855. While there, he became a science master of the Simferopol gymnasium №1. In 1857, he returned to Saint Petersburg with fully restored health.

Between 1859 and 1861, he worked on the capillarity of liquids and the workings of the spectroscope in Heidelberg. Later in 1861, he published a textbook named Organic Chemistry. This won him the Demidov Prize of the Petersburg Academy of Sciences.

Mendeleev became a professor at the Saint Petersburg Technological Institute and Saint Petersburg State University in 1864, and 1865, respectively. In 1865 he became Doctor of Science for his dissertation "On the Combinations of Water with Alcohol". He achieved tenure in 1867 at St. Petersburg University and started to teach inorganic chemistry, while succeeding Voskresenskii to this post. By 1871 he had transformed Saint Petersburg into an internationally recognized center for chemistry research.

Though Mendeleev was widely honored by scientific organizations all over Europe, including (in 1882) the Davy Medal from the Royal Society of London (which later also awarded him the Copley Medal in 1905), he resigned from Saint Petersburg University on 17 August 1890. He was elected a Foreign Member of the Royal Society in 1892, and in 1893 he was appointed director of the Bureau of Weights and Measures, a post which he occupied till his death.

Mendeleev also investigated the composition of petroleum, and helped to found the first oil refinery in Russia. He recognized the importance of petroleum as a feedstock for petrochemicals. He is credited with a remark that burning petroleum as a fuel "would be akin to firing up a kitchen stove with bank notes."

In 1905, Mendeleev was elected a member of the Royal Swedish Academy of Sciences. The following year the Nobel Committee for Chemistry recommended to the Swedish Academy to award the Nobel Prize in Chemistry for 1906 to Mendeleev for his discovery of the periodic system. The Chemistry Section of the Swedish Academy supported this recommendation. The Academy was then supposed to approve the Committee's choice, as it has done in almost every case. Unexpectedly, at the full meeting of the Academy, a dissenting member of the Nobel Committee, Peter Klason, proposed the candidacy of Henri Moissan whom he favored. Svante Arrhenius, although not a member of the Nobel Committee for Chemistry, had a great deal of influence in the Academy and also pressed for the rejection of Mendeleev, arguing that the periodic system was too old to acknowledge its discovery in 1906. According to the contemporaries, Arrhenius was motivated by the grudge he held against Mendeleev for his critique of Arrhenius's dissociation theory. After heated arguments, the majority of the Academy voted for Moissan. The attempts to nominate Mendeleev in 1907 were again frustrated by the absolute opposition of Arrhenius.

* * *

After becoming a teacher in 1867, Mendeleev wrote the definitive textbook of his time: Principles of Chemistry (two volumes, 1868–1870). It was written as he was preparing a textbook for his course. This is when he made his most important discovery. As he attempted to classify the elements according to their chemical properties, he noticed patterns that led him to postulate his periodic table.

On 6 March 1869, Mendeleev made a formal presentation to the Russian Chemical Society, titled The Dependence between the Properties of the Atomic Weights of the Elements, which described elements according to both atomic weight and valence. This presentation stated that

1. The elements, if arranged according to their atomic weight, exhibit an apparent periodicity of properties.
2. Elements which are similar regarding their chemical properties either have similar atomic weights (e.g., Pt, Ir, Os) or have their atomic weights increasing regularly (e.g., K, Rb, Cs).
3. The arrangement of the elements in groups of elements in the order of their atomic weights corresponds to their so-called valencies, as well as, to some extent, to their distinctive chemical properties; as is apparent among other series in that of Li, Be, B, C, N, O, and F.
4. The elements which are the most widely diffused have small atomic weights.
5. The magnitude of the atomic weight determines the character of the element, just as the magnitude of the molecule determines the character of a compound body.
6. We must expect the discovery of many yet unknown elements–for example, two elements, analogous to aluminium and silicon, whose atomic weights would be between 65 and 75.
7. The atomic weight of an element may sometimes be amended by knowledge of those of its contiguous elements. Thus the atomic weight of tellurium must lie between 123 and 126, and cannot be 128. (Tellurium's atomic mass is 127.6, and Mendeleev was incorrect in his assumption that atomic mass must increase with position within a period.)
8. Certain characteristic properties of elements can be foretold from their atomic weights.

Mendeleev published his periodic table of all known elements and predicted several new elements to complete the table in a Russian-language journal. Only a few months after, Meyer published a virtually identical table in a German-language journal. Some consider Meyer and Mendeleev the co-creators of the periodic table. Mendeleev has the distinction of accurately predicting of the qualities of what he called ekasilicon, ekaaluminium and ekaboron (germanium, gallium and scandium, respectively).The original draft made by Mendeleev would be found years later and published under the name Tentative System of Elements.

Mendeleev made other important contributions to chemistry. The Russian chemist and science historian Lev Chugaev has characterized him as "a chemist of genius, first-class physicist, a fruitful researcher in the fields of hydrodynamics, meteorology, geology, certain branches of chemical technology (explosives, petroleum, and fuels, for example) and other disciplines adjacent to chemistry and physics, a thorough expert of chemical industry and industry in general, and an original thinker in the field of economy." Mendeleev was one of the founders, in 1869, of the Russian Chemical Society. He worked on the theory and practice of protectionist trade and on agriculture.

Mendeleev devoted much study and made important contributions to the determination of the nature of such indefinite compounds as solutions.

In another department of physical chemistry, he investigated the expansion of liquids with heat, and devised a formula similar to Gay-Lussac's law of the uniformity of the expansion of gases, while in 1861 he anticipated Thomas Andrews' conception of the critical temperature of gases by defining the absolute boiling-point of a substance as the temperature at which cohesion and heat of vaporization become equal to zero and the liquid changes to vapor, irrespective of the pressure and volume.

Mendeleev is given credit for the introduction of the metric system to the Russian Empire.

He invented pyrocollodion, a kind of smokeless powder based on nitrocellulose. This work had been commissioned by the Russian Navy, which however did not adopt its use. In 1892 Mendeleev organized its manufacture.

Mendeleev studied petroleum origin and concluded hydrocarbons are abiogenic and form deep within the earth. He wrote: "The capital fact to note is that petroleum was born in the depths of the earth, and it is only there that we must seek its origin." (Dmitri Mendeleev, 1877)

TEXT 5

Antoine-Laurent de Lavoisier
3534 п.з.

Antoine-Laurent de Lavoisier (26 August 1743 – 8 May 1794) was a French nobleman and chemist central to the 18th-century chemical revolution and had a large influence on both the history of chemistry and the history of biology. He is widely considered in popular literature as the "father of modern chemistry".

It is generally accepted that Lavoisier's great accomplishments in chemistry largely stem from his changing the science from a qualitative to a quantitative one. Lavoisier is most noted for his discovery of the role oxygen plays in combustion. He recognized and named oxygen (1778) and hydrogen (1783) and opposed the phlogiston theory. Lavoisier helped construct the metric system, wrote the first extensive list of elements, and helped to reform chemical nomenclature. He predicted the existence of silicon (1787) and was also the first to establish that sulfur was an element (1777) rather than a compound. He discovered that, although matter may change its form or shape, its mass always remains the same.

Lavoisier was a powerful member of a number of aristocratic councils, and an administrator of the Ferme générale. The Ferme générale was one of the most hated components of the Ancien Régime because of the profits it took at the expense of the state, the secrecy of the terms of its contracts, and the violence of its armed agents. All of these political and economic activities enabled him to fund his scientific research. At the height of the French Revolution, he was accused by

Jean-Paul Marat of selling adulterated tobacco and of other crimes, and was eventually guillotined a year after Marat's death.

Lavoisier's education was filled with the ideals of the French Enlightenment of the time, and he was fascinated by Pierre Macquer's dictionary of chemistry. He attended lectures in the natural sciences. Lavoisier's devotion and passion for chemistry were largely influenced by Étienne Condillac, a prominent French scholar of the 18th century. His first chemical publication appeared in 1764. From 1763 to 1767, he studied geology under Jean-Étienne Guettard. In collaboration with Guettard, Lavoisier worked on a geological survey of Alsace-Lorraine in June 1767. In 1764 he read his first paper to the French Academy of Sciences, France's most elite scientific society, on the chemical and physical properties of gypsum (hydrated calcium sulfate), and in 1766 he was awarded a gold medal by the King for an essay on the problems of urban street lighting. In 1768 Lavoisier received a provisional appointment to the Academy of Sciences. In 1769, he worked on the first geological map of France.

During late 1772 Lavoisier turned his attention to the phenomenon of combustion, the topic on which he was to make his most significant contribution to science. He reported the results of his first experiments on combustion in a note to the Academy on 20 October, in which he reported that when phosphorus burned, it combined with a large quantity of air to produce acid spirit of phosphorus, and that the phosphorus increased in weight on burning. In a second sealed note deposited with the Academy a few weeks later (1 November) Lavoisier extended his observations and conclusions to the burning of sulfur and went on to add that "what is observed in the combustion of sulfur and phosphorus may well take place in the case of all substances that gain in weight by combustion and calcination: and I am persuaded that the increase in weight of metallic calces is due to the same cause."

TEXT 6

Henry Cavendish
10 146 п.з.

Henry Cavendish (10 October 1731 – 24 February 1810) was a British natural philosopher, scientist, and an important experimental and theoretical chemist and physicist. Cavendish is noted for his discovery of hydrogen or what he called "inflammable air". He described the density of inflammable air, which formed water on combustion, in a 1766 paper "On Factitious Airs". Antoine Lavoisier later reproduced Cavendish's experiment and gave the element its name.

A notoriously shy man (it has been postulated that he was on the autism spectrum), Cavendish was nonetheless distinguished for great accuracy and precision in his researches into the composition of atmospheric air, the properties of different gases, the synthesis of water, the law governing electrical attraction and repulsion, a mechanical theory of heat, and calculations of the density (and hence the mass) of the Earth. His experiment to measure the density of the Earth has come to be known as the Cavendish experiment.

Henry Cavendish was born on 10 October 1731 in Nice, where his family was living at the time. His mother was Lady Anne Grey, fourth daughter of Henry Grey, 1st Duke of Kent, and his father was Lord Charles Cavendish, third son of William Cavendish, 2nd Duke of Devonshire. The family traces its lineage across eight centuries to Norman times and was closely connected to many aristocratic families of Great Britain. His mother died in 1733, three months after the birth of her second son, Frederick, and shortly before Henry’s second birthday, leaving Lord Charles Cavendish to bring up his two sons.

At age 11, Henry attended Hackney Academy, a private school near London. At age 18 (on 24 November 1748) he entered the University of Cambridge in St Peter's College, now known as Peterhouse, but left three years later on 23 February 1751 without taking a degree (a common practice). He then lived with his father in London, where he soon had his own laboratory.

Lord Charles Cavendish spent his life, first, in politics and then increasingly in science, especially in the Royal Society of London. In 1758, he took Henry to meetings of the Royal Society and also to dinners of the Royal Society Club. In 1760, Henry Cavendish was elected to both these groups, and he was assiduous in his attendance thereafter. He was active in the Council of the Royal Society of London (to which he was elected in 1765).

About the time of his father's death, Cavendish began to work closely with Charles Blagden, an association that helped Blagden enter fully into London’s scientific society. In return, Blagden helped to keep the world at a distance from Cavendish. Cavendish published no books and few papers, but he achieved much. Several areas of research, including mechanics, optics, and magnetism, feature extensively in his manuscripts, but they scarcely feature in his published work. Cavendish is considered to be one of the so-called pneumatic chemists of the eighteenth and nineteenth centuries, along with, for example, Joseph Priestley, Joseph Black, and Daniel Rutherford. Cavendish found that a definite, peculiar, and highly inflammable gas, which he referred to as "Inflammable Air" was produced by the action of certain acid on certain metals. This gas was in fact hydrogen, which Cavendish correctly guessed was proportioned to two in one water.

Although others, such as Robert Boyle, had prepared hydrogen gas earlier, Cavendish is usually given the credit for recognizing its elemental nature. Also, by dissolving alkalis in acids, Cavendish made "fixed air" (carbon dioxide), which he collected, along with other gases, in bottles inverted over water or mercury. He then measured their solubility in water and their specific gravity and noted their combustibility. Cavendish was awarded the Royal Society’s Copley Medal for this paper. Gas chemistry was of increasing importance in the latter half of the 18th century and became crucial for Frenchman Antoine-Laurent Lavoisier’s reform of chemistry, generally known as the chemical revolution.

In 1783 Cavendish published a paper on eudiometry (the measurement of the goodness of gases for breathing). He described a new eudiometer of his own invention, with which he achieved the best results to date, using what in other hands had been the inexact method of measuring gases by weighing them. He next published a paper on the production of water by burning inflammable air (that is, hydrogen) in "dephlogisticated air" (now known to be oxygen), the latter a constituent of atmospheric air (phlogiston theory).

Cavendish concluded that dephlogisticated air was dephlogisticated water and that hydrogen was either pure phlogiston or phlogisticated water. He reported these findings to Joseph Priestley, an English clergyman and scientist, no later than March 1783, but did not publish them until the following year. The Scottish inventor James Watt published a paper on the composition of water in 1783; Cavendish had performed the experiments first but published second. Controversy about priority ensured.

In 1785 Cavendish carried out an investigation of the composition of common (i.e. atmospheric) air, obtaining impressively accurate results. He conducted experiments in which hydrogen and ordinary air were combined in known ratios, and then exploded with a spark of electricity. Furthermore, he also described an experiment in which he was able to remove, in modern terminology, both the oxygen and nitrogen gases from a sample of atmospheric air until only a small bubble of unreacted gas was left in the original sample. Using his observations, Cavendish observed that, when he had determined the amounts of phlogisticated air (nitrogen) and dephlogisticated air (oxygen), there remained a volume of gas amounting to 1/120 of the original volume of nitrogen.

By careful measurements he was led to conclude that "common air consists of one part of dephlogisticated air [oxygen], mixed with four of phlogisticated [nitrogen]".

In the 1890s (around 100 years later) two British physicists, William Ramsay and Lord Rayleigh, realized that their newly discovered inert gas, argon, was responsible for Cavendish's problematic residue; he had not made an error. What he had done was perform rigorous quantitative experiments, using standardized instruments and methods, aimed at reproducible results; taken the mean of the result of several experiments; and identified and allowed for sources of error. The balance that he used, made by a craftsman named Harrison, was the first of the precision balances of the 18th century, and as accurate as Lavoisier's (which has been estimated to measure one part in 400,000). Cavendish worked with his instrument makers, generally improving existing instruments rather than inventing wholly new ones.

Cavendish, as indicated above, used the language of the old phlogiston theory in chemistry. In 1787 he became one of the earliest outside France to convert to the new antiphlogistic theory of Lavoisier, though he remained skeptical about the nomenclature of the new theory. He also objected to Lavoisier's identification of heat as having a material or elementary basis. Working within the framework of

Newtonian mechanism, Cavendish had tackled the problem of the nature of heat in the 1760s, explaining heat as the result of the motion of matter.

In 1783 he published a paper on the temperature at which mercury freezes and in that paper made use of the idea of latent heat, although he did not use the term because he believed that it implied acceptance of a material theory of heat. He made his objections explicit in his 1784 paper on air. He went on to develop a general theory of heat, and the manuscript of that theory has been persuasively dated to the late 1780s. His theory was at once mathematical and mechanical: it contained the principle of the conservation of heat (later understood as an instance of conservation of energy) and even contained the concept (although not the label) of the mechanical equivalent of heat.

Cavendish's electrical and chemical experiments, like those on heat, had begun while he lived with his father in a laboratory in their London house. Lord Charles Cavendish died in 1783, leaving almost all of his very substantial estate to Henry. Like his theory of heat, Cavendish's comprehensive theory of electricity was mathematical in form and was based on precise quantitative experiments. In 1771 he published an early version of his theory, based on an expansive electrical fluid that exerted pressure. He demonstrated that if the intensity of electric force was inversely proportional to distance, then the electric fluid in excess of that needed for electrical neutrality would lie on the outer surface of an electrified sphere; then he confirmed this experimentally. Cavendish continued to work on electricity after this initial paper, but he published no more on the subject.

Cavendish wrote papers on electrical topics for the Royal Society but the bulk of his electrical experiments did not become known until they were collected and published by James Clerk Maxwell a century later, in 1879, long after other scientists had been credited with the same results. Cavendish’s electrical papers from the Philosophical Transactions of the Royal Society of London have been reprinted, together with most of his electrical manuscripts, in The Scientific Papers of the Honourable Henry Cavendish, F.R.S. (1921). According to the 1911 edition of Encyclopædia Britannica, among Cavendish's discoveries were the concept of electric potential (which he called the "degree of electrification"), an early unit of capacitance (that of a sphere one inch in diameter), the formula for the capacitance of a plate capacitor, the concept of the dielectric constant of a material, the relationship between electric potential and current (now called Ohm's Law) (1781), laws for the division of current in parallel circuits (now attributed to Charles Wheatstone), and the inverse square law of variation of electric force with distance, now called Coulomb's Law.

TEXT 7

James Clerk Maxwell
7449 п.з.

James Clerk Maxwell (13 June 1831 – 5 November 1879) was a Scottish scientist in the field of mathematical physics. His most notable achievement was to formulate the classical theory of electromagnetic radiation, bringing together for the first time electricity, magnetism, and light as manifestations of the same phenomenon. Maxwell's equations for electromagnetism have been called the "second great unification in physics" after the first one realised by Isaac Newton.

With the publication of "A Dynamical Theory of the Electromagnetic Field" in 1865, Maxwell demonstrated that electric and magnetic fields travel through space as waves moving at the speed of light. Maxwell proposed that light is an undulation in the same medium that is the cause of electric and magnetic phenomena. The unification of light and electrical phenomena led to the prediction of the existence of radio waves.

Maxwell helped develop the Maxwell–Boltzmann distribution, a statistical means of describing aspects of the kinetic theory of gases. He is also known for presenting the first durable colour photograph in 1861 and for his foundational work on analysing the rigidity of rod-and-joint frameworks (trusses) like those in many bridges.

His discoveries helped usher in the era of modern physics, laying the foundation for such fields as special relativity and quantum mechanics. Many physicists regard Maxwell as the 19th-century scientist having the greatest influence on 20th-century physics. His contributions to the science are considered by many to be of the same magnitude as those of Isaac Newton and Albert Einstein. In the millennium poll—a survey of the 100 most prominent physicists—Maxwell was voted the third greatest physicist of all time, behind only Newton and Einstein. On the centenary of Maxwell's birthday, Einstein described Maxwell's work as the "most profound and the most fruitful that physics has experienced since the time of Newton".

Maxwell had studied and commented on electricity and magnetism as early as 1855 when his paper "On Faraday's lines of force" was read to the Cambridge Philosophical Society. The paper presented a simplified model of Faraday's work and how electricity and magnetism are related. He reduced all of the current knowledge into a linked set of differential equations with 20 equations in 20 variables. This work was later published as "On Physical Lines of Force" in March 1861.

Around 1862, while lecturing at King's College, Maxwell calculated that the speed of propagation of an electromagnetic field is approximately that of the speed of light. He considered this to be more than just a coincidence, commenting, "We can scarcely avoid the conclusion that light consists in the transverse undulations of the same medium which is the cause of electric and magnetic phenomena."

Working on the problem further, Maxwell showed that the equations predict the existence of waves of oscillating electric and magnetic fields that travel through empty space at a speed that could be predicted from simple electrical experiments; using the data available at the time, Maxwell obtained a velocity of 310,740,000 meters per second (1.0195×109 ft/s). In his 1864 paper "A Dynamical Theory of the Electromagnetic Field", Maxwell wrote, "The agreement of the results seems to show that light and magnetism are affections of the same substance, and that light is an electromagnetic disturbance propagated through the field according to electromagnetic laws".

His famous twenty equations, in their modern form of four partial differential equations, first appeared in fully developed form in his textbook A Treatise on Electricity and Magnetism in 1873. Maxwell expressed electromagnetism in the algebra of quaternions and made the electromagnetic potential the centrepiece of his theory. In 1881 Oliver Heaviside replaced Maxwell's electromagnetic potential field by 'force fields' as the centrepiece of electromagnetic theory. Heaviside reduced the complexity of Maxwell's theory down to four differential equations, known now collectively as Maxwell's Laws or Maxwell's equations. According to Heaviside, the electromagnetic potential field was arbitrary and needed to be "murdered". The use of scalar and vector potentials is now standard in the solution of Maxwell's equations.

A few years later there was a debate between Heaviside and Peter Guthrie Tait about the relative merits of vector analysis and quaternions. The result was the realisation that there was no need for the greater physical insights provided by quaternions if the theory was purely local, and vector analysis became commonplace. Maxwell was proven correct, and his quantitative connection between light and electromagnetism is considered one of the great accomplishments of 19th century mathematical physics.

Maxwell also introduced the concept of the electromagnetic field in comparison to force lines that Faraday described. By understanding the propagation of electromagnetism as a field emitted by active particles, Maxwell could advance his work on light. At that time, Maxwell believed that the propagation of light required a medium for the waves, dubbed the luminiferous aether. Over time, the existence of such a medium, permeating all space and yet apparently undetectable by mechanical means, proved impossible to reconcile with experiments such as the Michelson–Morley experiment. Moreover, it seemed to require an absolute frame of reference in which the equations were valid, with the distasteful result that the equations changed form for a moving observer. These difficulties inspired Albert Einstein to formulate the theory of special relativity; in the process Einstein dispensed with the requirement of a stationary luminiferous aether.

Maxwell also investigated the kinetic theory of gases. Originating with Daniel Bernoulli, this theory was advanced by the successive labours of John Herapath, John James Waterston, James Joule, and particularly Rudolf Clausius, to such an extent as to put its general accuracy beyond a doubt; but it received enormous development from Maxwell, who in this field appeared as an experimenter (on the laws of gaseous friction) as well as a mathematician.

Between 1859 and 1866, he developed the theory of the distributions of velocities in particles of a gas, work later generalised by Ludwig Boltzmann. The formula, called the Maxwell–Boltzmann distribution, gives the fraction of gas molecules moving at a specified velocity at any given temperature. In the kinetic theory, temperatures and heat involve only molecular movement. This approach generalised the previously established laws of thermodynamics and explained existing observations and experiments in a better way than had been achieved previously. Maxwell's work on thermodynamics led him to devise the thought experiment that came to be known as Maxwell's demon, where the second law of thermodynamics is violated by an imaginary being capable of sorting particles by energy.

In 1871 he established Maxwell's thermodynamic relations, which are statements of equality among the second derivatives of the thermodynamic potentials with respect to different thermodynamic variables. In 1874, he constructed a plaster thermodynamic visualisation as a way of exploring phase transitions, based on the American scientist Josiah Willard Gibbs's graphical thermodynamics papers.

TEXT 8

Nikolay Nikolayevich Semyonov
2597 п.з.

Nikolay Nikolayevich Semyonov (or Semenov), (15 April 1896 – 25 September 1986) was a Russian/Soviet physicist and chemist. Semyonov was awarded the 1956 Nobel Prize in Chemistry for his work on the mechanism of chemical transformation.

Semyonov was born in Saratov, the son of Elena Dmitrieva and Nikolai Alex Semyonov. He graduated from the department of physics of Petrograd University (1913–1917), where he was a student of Abram Fyodorovich Ioffe. In 1918, he moved to Samara, where he was enlisted into Kolchak's White Army during Russian Civil War.

In 1920, he returned to Petrograd and took charge of the electron phenomena laboratory of the Petrograd Physico-Technical Institute. He also became the vice-director of the institute. During that difficult time, Semyonov, together with Pyotr Kapitsa, discovered a way to measure the magnetic field of an atomic nucleus (1922). Later the experimental setup was improved by Otto Stern and Walther Gerlach and became known as Stern–Gerlach experiment.

In 1925, Semyonov, together with Yakov Frenkel, studied kinetics of condensation and adsorption of vapors. In 1927, he studied ionisation in gases and published an important book, Chemistry of the Electron. In 1928, he, together with Vladimir Fock, created a theory of thermal disruptive discharge of dielectrics.

He lectured at the Petrograd Polytechnical Institute and was appointed Professor in 1928. In 1931, he organized the Institute of Chemical Physics of the USSR Academy of Sciences (which moved to Chernogolovka in 1943) and became its first director. In 1932, he became a full member of the Soviet Academy of Sciences.

Semyonov's outstanding work on the mechanism of chemical transformation includes an exhaustive analysis of the application of the chain theory to varied reactions (1934–1954) and, more significantly, to combustion processes. He proposed a theory of degenerate branching, which led to a better understanding of the phenomena associated with the induction periods of oxidation processes.

Semyonov wrote two important books outlining his work. Chemical Kinetics and Chain Reactions was published in 1934, with an English edition in 1935. It was the first book in the U.S.S.R. to develop a detailed theory of unbranched and branched chain reactions in chemistry. Some Problems of Chemical Kinetics and Reactivity, first published in 1954, was revised in 1958; there are also English, American, German, and Chinese editions. In 1956, he was awarded the Nobel Prize in Chemistry (together with Sir Cyril Norman Hinshelwood) for this work.

TEXT 9

Pyotr Leonidovich Kapitsa
4036 п.з.

Pyotr Leonidovich Kapitsa (8 July 1894 – 8 April 1984) was a leading Soviet physicist and Nobel laureate, best known for his work in low-temperature physics.

Kapitsa was born in Kronstadt, Russian Empire to Bessarabian-Volhynian-born parents Leonid Petrovich Kapitsa, a military engineer who constructed fortifications, and Olga Ieronimovna Kapitsa from the Ukrainian noble family Stebnytski. Kapitsa's studies were interrupted by the First World War, in which he served as an ambulance driver for two years on the Polish front. He graduated from the Petrograd Polytechnical Institute in 1918. He subsequently studied in Britain, working for over ten years with Ernest Rutherford in the Cavendish Laboratory at the University of Cambridge, and founding the influential Kapitza club. He was the first director (1930–34) of the Mond Laboratory in Cambridge. In the 1920s he originated techniques for creating ultrastrong magnetic fields by injecting high current for brief periods into specially constructed air-core electromagnets. In 1928 he discovered the linear dependence of resistivity on magnetic field for various metals in very strong magnetic fields.

In 1934 Kapitsa returned to Russia to visit parents but was not allowed by Stalin's government to travel back to Great Britain.

As his equipment for high magnetic field research remained in Cambridge (although later Ernest Rutherford negotiated with British government the possibility of shipping it to the USSR), he changed the direction of his research to low temperature research, beginning with a critical analysis of the existing methods for obtaining low temperatures. In 1934 he developed new and original apparatus (based on the adiabatic principle) for making significant quantities of liquid helium.

Kapitsa formed the Institute for Physical Problems, in part using equipment which the Soviet government bought from the Mond Laboratory in Cambridge (with the assistance of Rutherford, once it was clear that Kapitsa would not be permitted to return).

In Russia, Kapitsa began a series of experiments to study liquid helium, leading to the discovery in 1937 of its superfluidity (not to be confused with superconductivity). He reported the properties of this new state of matter in a series of papers, for which he was later awarded the Nobel Prize in Physics "for basic inventions and discoveries in the area of low-temperature physics". In 1939 he developed a new method for liquefaction of air with a low-pressure cycle using a special high-efficiency expansion turbine. Consequently, during World War II he was assigned to head the Department of Oxygen Industry attached to the USSR Council of Ministers, where he developed his low-pressure expansion techniques for industrial purposes. He invented high power microwave generators (1950–1955) and discovered a new kind of continuous high pressure plasma discharge with electron temperatures over 1,000,000K.

Immediately after the war, a group of prominent Soviet scientists (including Kapitsa in particular) lobbied the government to create a new technical university, the Moscow Institute of Physics and Technology. Kapitsa taught there for many years. From 1957, he was also a member of the presidium of the Soviet Academy of Sciences.

In 1978, Kapitsa won the Nobel Prize in Physics "for his basic inventions and discoveries in the area of low-temperature physics" and was also cited for his long term role as a leader in the development of this area. He shared the prize with Arno Allan Penzias and Robert Woodrow Wilson, who won for discovering the cosmic microwave background.

Kapitsa resistance is the thermal resistance (which causes a temperature discontinuity) at the interface between liquid helium and a solid. The Kapitsa–Dirac effect is a quantum mechanical effect consisting of the diffraction of electrons by a standing wave of light. In fluid dynamics, the Kapitsa number is a dimensionless number characterizing the flow of thin films of fluid down an incline.

TEXT 10

Lev Davidovich Landau
4679 п.з.

Lev Davidovich Landau (January 22, 1908 – 1 April 1968) was a Soviet physicist who made fundamental contributions to many areas of theoretical physics. His accomplishments include the independent co-discovery of the density matrix method in quantum mechanics (alongside John von Neumann), the quantum mechanical theory of diamagnetism, the theory of superfluidity, the theory of second-order phase transitions, the Ginzburg–Landau theory of superconductivity, the theory of Fermi liquid, the explanation of Landau damping in plasma physics, the Landau pole in quantum electrodynamics, the two-component theory of neutrinos, and Landau's equations for S matrix singularities. He received the 1962 Nobel Prize in Physics for his development of a mathematical theory of superfluidity that accounts for the properties of liquid helium II at a temperature below 2.17 K (−270.98 °C).

Landau was born on 22 January 1908 in Baku, Azerbaijan, in what was then the Russian Empire. Landau's father was an engineer with the local oil industry and his mother was a doctor. He learned to differentiate at age 12 and to integrate at age 13. Landau graduated in 1920 at age 13 from gymnasium. His parents considered him too young to attend university, so for a year he attended the Baku Economical Technical School. In 1922, at age 14, he matriculated at the Baku State University, studying in two departments simultaneously: the Departments of Physics and Mathematics, and the Department of Chemistry. Subsequently, he ceased studying chemistry, but remained interested in the field throughout his life.

In 1924, he moved to the main centre of Soviet physics at the time: the Physics Department of Leningrad State University. In Leningrad, he first made the acquaintance of theoretical physics and dedicated himself fully to its study, graduating in 1927. Landau subsequently enrolled for post-graduate studies at the Leningrad Institute of Physics and Technology where he eventually received a doctorate in Physical and Mathematical Sciences in 1934. Landau got his first chance to travel abroad during the period 1929–1931, on a Soviet government—People's Commissariat for Education—travelling fellowship supplemented by a Rockefeller Foundation fellowship. By that time he was fluent in German and French and could communicate in English. He later improved his English and learned Danish.

After brief stays in Göttingen and Leipzig, he went to Copenhagen on 8 April 1930 to work at the Niels Bohr's Institute for Theoretical Physics. He stayed there till 3 May of the same year. After the visit, Landau always considered himself a pupil of Niels Bohr and Landau's approach to physics was greatly influenced by Bohr. After his stay in Copenhagen, he visited Cambridge (mid-1930), where he worked with P. A. M. Dirac, Copenhagen (20 to 22 September – 22 November 1930), and Zurich (December 1930 to January 1931), where he worked with Wolfgang Pauli. From Zurich Landau went back to Copenhagen for the third time and stayed there from 25 February till 19 March 1931 before returning to Leningrad the same year.

Between 1932 and 1937 he headed the Department of Theoretical Physics at the National Scientific Center Kharkov Institute of Physics and Technology and lectured at the University of Kharkov and the Kharkov Polytechnical Institute. Apart from his theoretical accomplishments, Landau was the principal founder of a great tradition of theoretical physics in Kharkov, Soviet Union, sometimes referred to as the "Landau school". In Kharkov, he and his friend and former student, Evgeny Lifshitz, began writing the Course of Theoretical Physics, ten volumes that together span the whole of the subject and are still widely used as graduate-level physics texts.

Landau developed a famous comprehensive exam called the "Theoretical Minimum" which students were expected to pass before admission to the school. The exam covered all aspects of theoretical physics, and between 1934 and 1961 only 43 candidates passed, but those who did later became quite notable theoretical physicists.

Landau was the head of the Theoretical Division at the Institute for Physical Problems from 1937 until 1962. Landau led a team of mathematicians supporting Soviet atomic and hydrogen bomb development. Landau calculated the dynamics of the first Soviet thermonuclear bomb, including predicting the yield. For this work he received the Stalin Prize in 1949 and 1953, and was awarded the title "Hero of Socialist Labour" in 1954.

His students included Lev Pitaevskii, Alexei Abrikosov, Evgeny Lifshitz, Lev Gor'kov, Isaak Khalatnikov, Roald Sagdeev and Isaak Pomeranchuk.

TEXT 11

Germain Henri Hess
3770 п.з.

Germain Henri Hess (7 August 1802 – 30 November 1850) was a Swiss-Russian chemist and doctor who formulated Hess's law, an early principle of thermochemistry.

Hess was born on 26 July (7 August) in Geneva, Switzerland. His father was an artist and in 1805 moved the family to Russia to work as a tutor to a rich family. His Swiss-born mother was tutor as well and Hess had the benefit of learning German and French at home. In 1817, his family moved to Derpt, Russian Empire (now Tartu, Estonia), where he went to a private school for two years, and then to Derpt Gymnasium, which he finished in 1822. In autumn of the same year Hess studied medicine at the University of Derpt. During that time, Chemistry department was responsible for Chemistry courses of Medicine and Pharmacy departments and Professor Gottfried W. Osann was giving the lectures which carried in German (an obvious advance for Hess). Under Osann’s supervision, Hess made chemical analyses, but also had an interest in the lectures of Professor of Physics Georges-Frédéric Parrot and Professor of Mineralogy Moritz von Engelhardt. Hess graduated with honors from Derpt University receiving a doctor of medicine degree with his dissertation entitled *Something about Curative Waters, Especially Those in Russia*. He qualified as a physician in 1825. By application of Professors Osann and Engelhardt, Hess was sent to Sweden, to visit Swedish chemist Jöns Jakob Berzelius and after a meeting with turned once and for all to chemistry. On his return to Russia, Hess joined an expedition to study the geology of the Urals before was appointed a doctor at Irkutsk which, according to the regulations of that time, owe to practice at a Russian frontier after having graduated. Here went to Irkutsk in August 1826.

In 1830, Hess took up chemistry full-time, researching and teaching, and later became an adjunct professor of Chemistry at the St. Petersburg Academy of Sciences. His most famous paper, outlining his law on thermochemistry, was published there in 1840. His principle, a progenitor for the first law of thermodynamics, came to be called Hess's law. It states that in a series of chemical reactions, the total energy gained or lost depends only on the initial and final states, regardless of the number or path of the steps. This is also known as the law of constant heat summation.

Like most of his colleagues, Hess was primarily an experimental chemist interested in the discovery and analysis of new substances. However, he also developed a strong interest for theoretical investigations. In particular, he wondered how chemical affinity relates to heat in chemical reactions. His experiments on various hydrates of sulfuric acid showed that the heat released when they formed was always the same, whether the reactions proceeded directly or through intermediates (1840). Hess thus formulated a special case of the conservation of energy two years before Julius Robert von Mayer stated a more general principle, in 1842. Hess was fully aware of the importance of his own contribution.

In 1842, Hess proposed the law of thermoneutrality, which states that no heat is evolved in the exchange reactions of neutral salts in aqueous solution. A full explanation would only be given 45 years later, in terms of electrolytic dissociation, by the Swedish chemist Svante Arrhenius.

After these two major discoveries, Hess was influential in the development of chemistry in Russia. His book Osnovania Chistoy Khimii (Fundamentals of Pure Chemistry) went through seven editions and remained the standard Russian textbook for undergraduate chemistry until 1861. Hess was active as a teacher and mentor of young scientists, until his poor health forced him to retire, in 1848.

TEXT 12

Vladimir Vasilyevich Markovnikov
1766 п.з.

Vladimir Vasilyevich Markovnikov (December 22, 1838 – February 11, 1904), was a Russian chemist.

Markovnikov is best known for Markovnikov's rule, elucidated in 1869 to describe addition reactions of H-X to alkenes. According to this rule, the nucleophilic X- adds to the carbon atom with fewer hydrogen atoms, while the proton adds to the carbon atom with more hydrogen atoms bonded to it. Thus, hydrogen chloride (HCl) adds to propene, CH3-CH=CH2 to produce 2-chloropropane CH3CHClCH3 rather than the isomeric 1-chloropropane

$CH_3CH_2CH_2Cl$. The rule is useful in predicting the molecular structures of products of addition reactions. Why hydrogen bromide exhibited both Markovnikov as well as reversed-order, or anti-Markovnikov, addition, however, was not understood until Morris S. Kharasch offered an explanation in 1933.

Hughes has discussed the reasons for Markovnikov's lack of recognition during his lifetime. Although he published mostly in Russian which was not understood by most Western European chemists, the 1870 article in which he first stated his rule was written in German. However, the rule was included in a 4-page addendum to a 26-page article on isomeric butyric acids, and based on very slight experimental evidence even by the standards of the time. Hughes concludes that the rule was an inspired guess, unjustified by the evidence of the time, but which turned out later to be correct (in most cases).

Markovnikov also contributed to organic chemistry by finding carbon rings with more than six carbon atoms, a ring with four carbon atoms in 1879, and a ring with seven in 1889.

Markovnikov also showed that butyric and isobutyric acids have the same chemical formula ($C_4H_8O_2$) but different structures; i.e., they are isomers.

TEXT 13

Ilya Romanovich Prigogine
6386 п.з.

Ilya Romanovich Prigogine (25 January 1917 – 28 May 2003) was a Belgian physical chemist and Nobel Laureate noted for his work on dissipative structures, complex systems, and irreversibility.

Prigogine was born in Moscow a few months before the Russian Revolution of 1917. His father, Roman Prigogine, was a chemical engineer at the Imperial Moscow Technical School; his mother, Yulia Vikhman, was a pianist. Because the family was critical of the new Soviet system, they left Russia in 1921. They first went to Germany and in 1929, to Belgium, where Prigogine received Belgian nationality in 1949.

Prigogine studied chemistry at the Université Libre de Bruxelles, where in 1950, he became professor. In 1959, he was appointed director of the International Solvay Institute in Brussels, Belgium. In that year, he also started teaching at the University of Texas at Austin in the United States, where he later was appointed Regental Professor and Ashbel Smith Professor of Physics and Chemical Engineering. From 1961 until 1966 he was affiliated with the Enrico Fermi Institute at the University of Chicago. In Austin, in 1967, he co-founded the Center for Thermodynamics and Statistical Mechanics, now the Center for Complex Quantum Systems. In that year, he also returned to Belgium, where he became director of the Center for Statistical Mechanics and Thermodynamics.

He was a member of numerous scientific organizations, and received numerous awards, prizes and 53 honorary degrees. In 1955, Ilya Prigogine was awarded the

Francqui Prize for Exact Sciences. For his study in irreversible thermodynamics, he received the Rumford Medal in 1976, and in 1977, the Nobel Prize in Chemistry. Until his death, he was president of the International Academy of Science, Munich and was in 1997, one of the founders of the International Commission on Distance Education (CODE), a worldwide accreditation agency. In 1998 he was awarded an honoris causa doctorate by the UNAM in Mexico City.

Prigogine received an Honorary Doctorate from Heriot-Watt University in 1985. Prigogine is best known for his definition of dissipative structures and their role in thermodynamic systems far from equilibrium, a discovery that won him the Nobel Prize in Chemistry in 1977. In summary, Ilya Prigogine discovered that importation and dissipation of energy into chemical systems could reverse the maximization of entropy rule imposed by the second law of thermodynamics.

Dissipative structure theory led to pioneering research in self-organizing systems, as well as philosophical inquiries into the formation of complexity on biological entities and the quest for a creative and irreversible role of time in the natural sciences. With Professor Robert Herman, he also developed the basis of the two fluid model, a traffic model in traffic engineering for urban networks, analogous to the two fluid model in classical statistical mechanics.

Prigogine's formal concept of self-organization was used also as a "complementary bridge" between General Systems Theory and thermodynamics, conciliating the cloudiness of some important systems theory concepts with scientific rigour.

In his later years, his work concentrated on the fundamental role of indeterminism in nonlinear systems on both the classical and quantum level. Prigogine and coworkers proposed a Liouville space extension of quantum mechanics. A Liouville space is the vector space formed by the set of (self-adjoint) linear operators, equipped with an inner product, that act on a Hilbert space. There exists a mapping of each linear operator into Liouville space, yet not every self-adjoint operator of Liouville space has a counterpart in Hilbert space, and in this sense Liouville space has a richer structure than Hilbert space. The Liouville space extension proposal by Prigogine and co-workers aimed to solve the arrow of time problem of thermodynamics and the measurement problem of quantum mechanics.

Prigogine co-authored several books with Isabelle Stengers, including The End of Certainty and La Nouvelle Alliance (Order out of Chaos).

In his 1996 book, La Fin des certitudes, co-authored by Isabelle Stengers and published in English in 1997 as The End of Certainty: Time, Chaos, and the New Laws of Nature, Prigogine contends that determinism is no longer a viable scientific belief: "The more we know about our universe, the more difficult it becomes to believe in determinism." This is a major departure from the approach of Newton, Einstein and Schrödinger, all of whom expressed their theories in terms of deterministic equations. According to Prigogine, determinism loses its explanatory power in the face of irreversibility and instability.

Prigogine traces the dispute over determinism back to Darwin, whose attempt to explain individual variability according to evolving populations inspired Ludwig

Boltzmann to explain the behavior of gases in terms of populations of particles rather than individual particles. This led to the field of statistical mechanics and the realization that gases undergo irreversible processes. In deterministic physics, all processes are time-reversible, meaning that they can proceed backward as well as forward through time. As Prigogine explains, determinism is fundamentally a denial of the arrow of time. With no arrow of time, there is no longer a privileged moment known as the "present," which follows a determined "past" and precedes an undetermined "future." All of time is simply given, with the future as determined or as undetermined as the past. With irreversibility, the arrow of time is reintroduced to physics. Prigogine notes numerous examples of irreversibility, including diffusion, radioactive decay, solar radiation, weather and the emergence and evolution of life. Like weather systems, organisms are unstable systems existing far from thermodynamic equilibrium. Instability resists standard deterministic explanation. Instead, due to sensitivity to initial conditions, unstable systems can only be explained statistically, that is, in terms of probability.

Prigogine asserts that Newtonian physics has now been "extended" three times: first with the use of the wave function in quantum mechanics, then with the introduction of spacetime in general relativity and finally with the recognition of indeterminism in the study of unstable systems.

TEXT 14

Zhores Ivanovich Alferov
2729 п.з.

Zhores Ivanovich Alferov; born 15 March 1930 is a Soviet and Russian physicist and academician who contributed significantly to the creation of modern heterostructure physics and electronics. He is the inventor of the heterotransistor and the winner of 2000 Nobel Prize in Physics.

Alferov was born in Vitebsk, Byelorussian SSR, Soviet Union, to a Belarusian father, Ivan Karpovich Alferov, a factory manager, and Anna Vladimirovna Rosenblum. Zhores was named after French socialist Jean Jaurès while his older brother was named Marx after Karl Marx. In 1947 he completed high school 42 in Minsk and started Belarusian Polytechnic Academy. In 1952, he graduated from V. I. Ulyanov (Lenin) Institute of Electricity and Technology in Leningrad. Since 1953 he has worked in the Ioffe Institute of Physics and Technology of the USSR Academy of Sciences. From the Institute, he earned several scientific degrees: a Candidate of Sciences in Technology in 1961 and a Doctor of Sciences in Physics and Mathematics in 1970. He has been director of the Institute since 1987. He was elected a corresponding member of the USSR Academy of Sciences in 1972, and a full member in 1979. From 1989, he has been Vice-President of the USSR Academy of Sciences and President of its Saint Petersburg Scientific Center. In 2000 he received the Nobel Prize in Physics together with Herbert Kroemer, "for developing semiconductor heterostructures used in high-speed- and optoelectronics".

Alferov invented the heterotransistor. This coped with much higher frequencies than its predecessors, and apparently revolutionised the mobile phone and satellite communications. Alferov and Kroemer independently applied this technology to firing laser lights. This, in turn, revolutionised semiconductor design in a host of areas, including LEDs, barcodes readers and CDs.

Hermann Grimmeiss, of the Royal Swedish Academy of Sciences, which awards Nobel prizes, said: "Without Alferov, it would not be possible to transfer all the information from satellites down to the Earth or to have so many telephone lines between cities."

Since1962, he has been working in the area of semiconductor heterostructures. His contributions to physics and technology of semiconductor heterostructures, especially investigations of injection properties, development of lasers, solar cells, LED's, and epitaxy processes have led to the creation of modern heterostructure physics and electronics.

He has an almost messianic conception of heterostructures, writing: "Many scientists have contributed to this remarkable progress, which not only determines in large measure the future prospects of solid state physics but in a certain sense affects the future of human society as well."

TEXT 15

Andre Konstantin Geim
6065 п.з.

Andre Konstantin Geim, (born 21 October 1958) is a Soviet-born Dutch-British physicist working in the School of Physics and Astronomy at the University of Manchester.

Geim was awarded the 2010 Nobel Prize in Physics jointly with Konstantin Novoselov for his work on graphene. He is Regius Professor of Physics and Royal Society Research Professor at the Manchester Centre for Mesoscience and Nanotechnology.

Andre Geim was born to Konstantin Alekseyevich Geim and Nina Nikolayevna Bayer in Sochi on 21 October 1958. Both his parents were engineers of German origin. In 1965, the family moved to Nalchik, where he studied at a high school. After graduation, he applied to the Moscow Engineering Physics Institute. He took the entrance exams twice, but attributes his failure to qualify to discrimination on account of his German ethnicity. He then applied to the Moscow Institute of Physics and Technology (MIPT), where he was accepted. He said that at the time he would not have chosen to study solid-state physics, preferring particle physics or astrophysics, but is now happy with his choice. He received a diploma (MSc degree equivalent) from MIPT in 1982 and a Candidate of Sciences (PhD equivalent) degree in metal physics in 1987 from the Institute of Solid State Physics (ISSP) at the Russian Academy of Sciences (RAS) in Chernogolovka.

After earning his PhD with Victor Petrashov, Geim worked as a research scientist at the Institute for Microelectronics Technology (IMT) at RAS, and from 1990 as a post-doctoral fellow at the universities of Nottingham (twice), Bath, and Copenhagen. He said that while at Nottingham he could spend his time on research rather than "swimming through Soviet treacle," and determined to leave the Soviet Union.

He obtained his first tenured position in 1994, when he was appointed associate professor at Radboud University Nijmegen, where he did work on mesoscopic superconductivity. He later gained Dutch citizenship. One of his doctoral students at Nijmegen was Konstantin Novoselov, who went on to become his main research partner. However, Geim has said that he had an unpleasant time during his academic career in the Netherlands. He was offered professorships at Nijmegen and Eindhoven, but turned them down as he found the Dutch academic system too hierarchical and full of petty politicking. "This can be pretty unpleasant at times," he says. "It's not like the British system where every staff member is an equal quantity." On the other hand, Geim writes in his Nobel lecture that "In addition, the situation was a bit surreal because outside the university walls I received a warm-hearted welcome from everyone around, including Jan Kees and other academics." (Prof. Jan Kees Maan was the research boss of Geim during his time at Radboud University Nijmegen.)

In 2001 he became a professor of physics at the University of Manchester, and was appointed director of the Manchester Centre for Mesoscience and Nanotechnology in 2002. Geim's wife and long-standing co-author, Irina Grigorieva, also moved to Manchester as a lecturer in 2001. The same year, they were joined by Novoselov who moved to Manchester from Nijmegen, which awarded him a PhD in 2004. Geim served as Langworthy Professor between 2007 and 2013, leaving this endowed professorship to Dr Novoselov in 2012. Also, between 2007 and 2010 Geim was an EPSRC Senior Research Fellow before becoming one of Royal Society Research Professors. In 2010 Radboud University Nijmegen appointed him professor of innovative materials and nanoscience, extending Geim's long list of honorary professorships.

Geim's achievements include the discovery of a simple method for isolating single atomic layers of graphite, known as graphene, in collaboration with researchers at the University of Manchester and IMT. The team published their findings in October 2004 in Science.

Graphene consists of one-atom-thick layers of carbon atoms arranged in two-dimensional hexagons, and is the thinnest material in the world, as well as one of the strongest and hardest. The material has many potential applications.

Geim said one of the first applications of graphene could be in the development of flexible touch screens, and that he has not patented the material because he would need a specific application and an industrial partner. On 5 October 2010, Geim was awarded the 2010 Nobel Prize in Physics jointly with Novoselov "for groundbreaking experiments regarding the two-dimensional material graphene". Upon hearing of the award he said, "I'm fine, I slept well. I didn't expect the Nobel Prize this year» and that his plans for the day would not change. The lecture for the award took place on 8 December 2010 at Stockholm University. He said he hopes that graphene and other two-dimensional crystals will change everyday life as plastics did for humanity. A colleague of Geim said that his award shows that people can still win a Nobel by "mucking about in a lab".

Geim was involved in the development of a biomimetic adhesive which became known as gecko tape — so called because of the adhesiveness of gecko feet — research of which is still in the early stages. It is hoped that the development will eventually allow humans to scale ceilings, like Spider-Man.

Geim's research in 1997 into the possible effects of magnetism on water scaling led to the famous discovery of direct diamagnetic levitation of water, and led to a frog being levitated. For this experiment, he and Michael Berry received the 2000 Ig Nobel Prize. "We were asked first whether we dared to accept this prize, and I take pride in our sense of humor and self-deprecation that we did".

Geim has also carried out research on mesoscopic physics and superconductivity. He said of the range of subjects he has studied: "Many people choose a subject for their PhD and then continue the same subject until they retire. I despise this approach. I have changed my subject five times before I got my first tenured position and that helped me to learn different subjects."

TEXT 16

Sergei Vasiljevich Lebedev
2710 п.з.

Sergei Vasiljevich Lebedev (July 25, 1874 – May 1, 1934) was a Russian/Soviet chemist and the inventor of polybutadiene synthetic rubber, the first commercially viable and mass-produced type of synthetic rubber.

Lebedev was born in 1874 in Lublin and went to school in Warsaw. In 1900, he graduated from St. Petersburg University and found work at the Petersburg Margarine Factory.

Starting in 1902, Lebedev moved from university to university in Russia, starting at the Saint-Petersburg Institute for Railroad Engineering. In 1904, he returned to St. Petersburg University to work under Alexei Yevgrafovich Favorskii (Stalin Prize, 1941, for contributions to the manufacture of synthetic rubber).

In 1915, Lebedev was appointed Professor at the Women's Pedagogical Institute in St. Petersburg. After 1916, he was a Professor of the Saint Petersburg Academy for Military Medicine. In 1925, he became the leader of the Oil Laboratory (after 1928, the Laboratory of Synthetic Resins) at St. Petersburg University. He died in Leningrad and is interred in Tikhvin Cemetery.

Lebedev's main works are devoted to polymerisation of diene hydrocarbons. He was the first to research the polymerisation of butadiene (1910-1913). In 1910, Lebedev was the first to get synthetic rubber based on poly-butadiene. His book Research in polymerisation of by-ethylene hydrocarbons (1913) became the bible for studies of synthetic rubber.

After 1914, he studied polymerisation of ethylene monomers, leading to modern industrial methods for manufacturing of butil synthetic rubber and poly-isobutylene. Between 1926 and 1928, Lebedev developed a single-stage method for manufacturing butadiene out of ethanol.

In 1928, he developed an industrial method for producing synthetic rubber based on polymerisation of butadiene using metallic sodium as a catalyst. This method became the base for the Soviet industry of synthetic rubber. The Soviets lacked reliable access to natural rubber, making the manufacture of synthetic rubber important. The first three synthetic rubber plants were launched in 1932-33. For butadiene production they used grain or potato ethanol as a feedstock. It caused a number of jokes about "Russian method of making tires from potatoes".

By 1940, the Soviet Union had the largest synthetic rubber industry in the world, producing more than 50,000 tons per year. During World War II, Lebedev's process of obtaining butadiene from ethyl alcohol was also used by the German rubber industry. Another important contribution of Lebedev's was the study of the kinetics of hydrogenation of ethylene hydrocarbons and the development of a number of synthetic motor oils for aircraftengines.

TEXT 17

Vasily Vladimirovich Petrov
2670 п.з.

Vasily Vladimirovich Petrov (19 July 1761 – 15 August 1834) was a Russian experimental physicist, self-taught electrical technician, academician of Russian Academy of Sciences (since 1809; Corresponding member since 1802).

Vasily Petrov was born in the town of Oboyan (currently Kursk Oblast of Russia) in the family of a priest. He studied at a public school in Kharkov, and then at the St. Petersburg Teacher's College.

In 1788, he gained a position as mathematics and physics teacher at Kolyvansko-Voskresenskoe College of Mining, in the town of Barnaul. In 1791, he was transferred to Saint Petersburg to teach mathematics and Russian at the military Engineering College, in the Izmailovsky regiment. In 1793, Petrov was invited to teach mathematics and physics at the St. Petersburg Medical and Surgery School, at the military hospital. In 1795, he was promoted to the rank of 'Extraordinary Professor'. During the next few years, he built up a comprehensive physics laboratory.

His first published book, "A collection of new physical-chemical experiments and observations", was published in 1801. The bulk of this work was dedicated to the description of experiments related to combustion, as evidence against the then-popular phlogiston theory.

The chapters, describing luminosity of phosphors of mineral and organic origins have elicited vivid interest in scientific circles. Petrov was able to detect the maximum temperature when phosphorus ceases to glow in open (atmospheric) air, by his numerous experiments with fluorite he was able to prove it glows due to a different reason than phosphorus.

In 1802, Petrov discovered the electric arc effect, thanks to his building the world's largest and most powerful Voltaic pile at the time, which consisted of around 4,200 copper and zinc discs. In “News of Galvanic-Voltaic Experiments,” 1803, Petrov described experiments performed using the voltaic pile, detailing the stable arc discharge and the indication of its possible use in artificial lighting, melting metals for smelting and welding, obtaining pure metallic oxides, and reduction of metals from oxides mixed with powdered carbon and oils.

Petrov was forgotten soon after his death and his works fell into oblivion. A copy of "News of Galvanic-Voltaic Experiments" was discovered by chance in a library in the town of Vilno near the end of the 19th century. The book was the first time in world literature that a series of important physical phenomena related to electricity were described in detail. It was not until the late 1880s that technology based on Petrov's experiments was developed with the goal of industrial usage.

TEXT 18

Paul Walden
7068 п.з.

Paul Walden (26 July 1863 – 22 January 1957) was a Russian and Latvian-German chemist known for his work in stereochemistry and history of chemistry. In particular he invented the stereochemical reaction known as Walden inversion and synthesized the first room-temperature ionic liquid, ethylammonium nitrate.

Walden was born in Rozula, Latvia in a large peasant family. At the age of four, he lost his father and later his mother. Thanks to financial support from his two older brothers who lived in Riga (one was a merchant and another served as a lieutenant) Walden managed to complete his education – first graduated with honors from the district school in the town of Cēsis (1876), and then from the Riga Technical High School (1882). In December 1882, he enrolled into the Riga Technical University and became seriously interested in chemistry. In 1886, he published his first scientific study on the color evaluation of the reactions of nitric and nitrous acid with various reagents and establishing the limits of sensitivity of the color method to detection of nitric acid. In April 1887, he was appointed a member of the Russian Physics and Chemical Society. During this time, Walden started his collaboration with Wilhelm Ostwald (Nobel Prize in Chemistry 1909) that has greatly influenced his development as a scientist. Their first work together was published in 1887 and was devoted to the dependence of the electrical conductivity of aqueous solutions of salts on their molecular weight.

In 1888, Walden graduated from the University with a degree in chemical engineering and continued working at the Chemistry Department as an assistant to Professor C. Bischof. Under his guidance, Walden began compiling "Handbook of Stereochemistry" which was published in 1894. In preparation of this handbook, Walden had to perform numerous chemical syntheses and characterizations which resulted in 57 journal papers on stereochemistry alone, published between 1889 and 1900 in Russian and foreign journals. He also continued his research in the field of physical chemistry, establishing in 1889 that the ionizing power of non-aqueous solvent is directly proportional to the dielectric constant. During the summer vacations of 1890 and 1891, Walden was visiting Ostwald at the University of Leipzig and in September 1891 defended there a master thesis on the affinity values of certain organic acids. Ostwald suggested him to stay in Leipzig as a private lecturer, but Walden declined, hoping for a better career in Riga.

In the summer of 1892 he was appointed assistant professor of physical chemistry. A year later he defended his doctorate on osmotic phenomena in sedimentary layers and in September 1894 became professor of analytical and physical chemistry at the Riga Technical University. He worked there until 1911 and during 1902–1905 was rector of the University. In 1895, Walden made his most remarkable discovery which was later named Walden inversion, namely that various stereoisomers can be obtained from the same compound via certain exchange reactions involving hydrogen. This topic became the basis for his habilitation thesis defended in March 1899 at St. Petersburg University.

After that, Walden became interested in electrochemistry of nonaqueous solutions. In 1902, he proposed a theory of autodissociation of inorganic and organic solvents. In 1905, he found a relationship between the maximum molecular conductivity and viscosity of the medium and in 1906, coined the term "solvation". Together with his work on stereochemistry, these results brought him to prominence; in particular, he was considered a candidate for the Nobel Prize in Chemistry in 1913 and 1914.

Walden was also credited as a talented chemistry lecturer. In his memoirs, he wrote: "My audience usually was crowded and the feedback of sympathetic listeners gave me strength ... my lectures I was giving spontaneously, to bring freshness to the subject ... I never considered teaching as a burden".

1896 brought reforms to the Riga Technical University. Whereas previously, all teaching was conducted in German and Walden was the only professor giving some courses in Russian, from then on, Russian became the official language. This change allowed receiving subsidies from the Russian government and helped the alumni in obtaining positions in Russia. These reforms resulted in another and rather unusual collaboration of Walden with Ostwald: Walden was rebuilding the Chemistry Department and Ostwald has sent the blueprints of the chemical laboratories in Leipzig as an example. In May 1910, Walden was elected a member of the St. Petersburg Academy of Sciences and in 1911 was invited to Saint Petersburg to lead the Chemical Laboratories of the Academy founded in 1748, by Mikhail Lomonosov. He remained in that position till 1919. As an exception, he was allowed to stay in Riga where he had better research possibilities, but he was traveling, almost every week, by train, to St. Petersburg for the Academy meetings and guidance of research. In the period 1911–1915, Walden published 14 articles in the "Proceedings of the Academy of Sciences" on electrochemistry of nonaqueous solutions. In particular, in 1914 he synthesized the first room-temperature ionic liquid, namely ethylammonium nitrate (C2H5)NH+3•NO−3 with the melting point of 12 °C.

After 1915, due to the difficulties caused by the World War I, political unrest in Russia and then October Revolution, Walden had reduced his research activity and focused on teaching and administrative work, taking numerous leading positions in science. Due to the political unrest in Latvia, Walden had immigrated to Germany. He was appointed as professor of inorganic chemistry at the University of Rostock where he worked until retirement in 1934. In 1924 he was invited back to Riga, where he gave a series of lectures. He was offered leading positions in chemistry in Riga and in St. Petersburg, but declined. Despite his emigration, Walden retained his popularity in Russia, and in 1927 he was appointed as a foreign member of the Russian Academy of Sciences. Later, he also became a member of the Swedish (1928) and Finnish (1932) Academies.

In his late years, Walden focused on history of chemistry and collected a unique library of over 10,000 volumes. The library and his house were destroyed during the British bombing of Rostock in 1942. Walden moved to Berlin and then to Frankfurt where he became a visiting professor of the history of chemistry at the local university. He met the end of World War II in the French Occupation Zone, cut off the Rostock University, which was located in the Soviet Zone, and thus left without any source of income. He survived on a modest pension arranged by German chemists, giving occasional lectures in Tübingen and writing memoirs. In 1949, he published his most well known book on "History of Chemistry". He died in Gammertingen in 1957 at the age of 93. His memoirs were published only in 1974.

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