МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ
РОССИЙСКОЙ ФЕДЕРАЦИИ

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ENGLISH FOR STUDENTS OF CHEMICAL TECHNOLOGY

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Рецензенты:

канд. филол. наук, доцент ФГБОУ ВО «КГАСУ» *М. К. Гулканян*;
канд. филол. наук, доцент ФГБОУ ВО «КГЭУ» *Д. А. Демидкина*

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Пособие включает в себя тексты, поливариативные многоуровневые профессионально-ориентированные задания как для работы под руководством преподавателя, так и самостоятельной.

Предназначено для обучающихся по образовательной программе направления подготовки 18.03.01 Химическая технология.

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ВВЕДЕНИЕ

Цель пособия – помочь обучающимся овладеть навыками устной и письменной речи на английском языке в сфере нефтехимического профиля с учетом региональной специфики Республики Татарстан, усвоить лексический минимум, ознакомить обучающихся с современными материалами по предлагаемым темам, развить навыки беспереводного чтения.

При разработке пособия составители опирались на следующие основные положения:

– идею коммуникативной компетенции, т. е. адекватности речевого поведения определенной ситуации общения;

– ориентацию на высокий уровень личностных качеств специалиста, востребованных в условиях современного общества и производства;

– вариативность и поливариативность при отборе и структурировании содержания предмета «Английский язык» в зависимости от этапов обучения, многоступенчатости и уровневости подготовки специалиста.

Отбор языкового (фонетического, лексического и грамматического) материала, а также устно-речевых тем и ситуаций для формирования навыков диалогической речи осуществлен на основе функционально-ролевого подхода к содержанию производственной деятельности специалиста нефтехимического профиля.

Содержание первого модуля посвящено этапам развития казанской нефтехимической школы; в нём рассматриваются казанские учебные заведения химического профиля, а также жизненные и творческие пути известных представителей дореволюционной казанской химической школы: А.Е. Арбузова, А.М. Бутлерова, Д.И. Менделеева и Г.Х. Камая.

Модуль 2 посвящен вопросам развития химической промышленности в Австралии – одной из стран изучаемого языка, а также проблемам, возникающим вследствие развития химического производства, таким как загрязнение окружающей среды, возникновение химического смога над промышленными городами.

Модуль 3 посвящен проблемам современного развития химической промышленности в России и Татарстане на примере крупнейших региональных предприятий: «Нижнекамскнефтехим», «Казаньоргсинтез» и пр.

Модуль 4 посвящен последним достижениям мировой химической науки и перспективам ее развития.

Пособие также содержит грамматический блок, основная цель которого – систематизировать имеющиеся знания, развивать навыки и умения правильно употреблять грамматические структуры английского языка как в устной, так и письменной речи. Грамматический блок включает в себя ряд разделов, отражающих основные грамматические категории английского языка. Разделы расположены по принципу нарастания сложности, что позволяет не только хорошо усваивать материал, но и способствует его дальнейшему закреплению. Блок также включает в себя тренировочные упражнения, направленные на развитие коммуникативных навыков и автоматизацию употребления различных грамматических структур.

UNIT 1
Kazan Chemical School

Text 1

Read and translate.

Alexei Butlerov and his Contribution to Russian Science (1828–1886)

Alexei Mikhailovich Butlerov was born in Chistopol in 1828. He became a professor at Kazan and afterwards at Petersburg University and an academician.

He was one of the most remarkable of Russian scientists. Butlerov became a chemist in Kazan and developed his own school of chemistry there. His ideas and works did not repeat or develop the ideas of his predecessors but were his own.

Butlerov's theory of chemical structure laid the foundations of modern organic chemistry. Alexei Mikhailovich created and based his theory on two ideas: that properties of substances depend on the sequence in which their atoms are bound together as well as on the order of their mutual influence over one another, and atoms and molecules are bound together in a strict sequence according to their valency.

He achieved the polymerization of isobutylene and he was the first to synthesize sacharine.

In 1864–1866 Butlerov published his classic work «Introduction to organic chemistry» on the principles of which modern chemistry is based.

Vocabulary

predecessor ['pri:dɪsesə] – предшественник
to lay the foundation – положить основу
strict [strɪkt] – строгий
sequence ['sikwəns] – последовательность
valency ['veɪlənsɪ] – валентность
according to[ə'kɔ:dɪŋ tə] – в соответствии с…

Exercises

1. *Guess the meaning of the following words*.

Professor, academician, rector, atom, molecule, polymerization, isobutylene, to synthesize, saccharine.

2. *Answer the questions.*

1. Where was Alexei Butlerov born? 2. In what universities did he work? 3. What laid the foundations of modern organic chemistry? 4. What are the main ideas of Butlerov's theory? 5. Did he have any other achievements? 6. When did Butlerov publish his classic work? 7. What is the name of Butlerov's work which contains principles of which modern chemistry is based?

3. *Confirm or disprove.*

1. Alexei Butlerov was born in Kazan. 2. Alexei Butlerov was born in 1828. 3. Butlerov developed the ideas of his predecessors. 4. Butlerov's theory of chemical structure laid the foundations of modern organic chemistry. 5. The main idea of his theory is that atoms and molecules are bound together in a strict sequence according to their valency. 6. He didn't manage with saccharine synthesizing. 7. Butlerov's work «Introduction to organic chemistry» was never published.

4. *Put the sentences into the right order.*

The main ideas of Butlerov's theory; Butlerov's classic work; general information; other achievements.

5. *Translate into English.*

1. Бутлеров родился в Чистополе в 1828 году. 2. Он был одним из наиболее выдающихся ученых. 3. Теория Бутлерова о химическом строении легла в основу современной органической химии. 4. Атомы и молекулы связаны в строгой последовательности в соответствии с валентностью. 5. Бутлеров открыл полимеризацию изобутилена.

6. *Prepare the retelling of the text about Butlerov. Use plan from exercise 3.*

7. *Find in the text verbs in the Past Simple. Write 3 forms of found irregular verbs.*

8. *Discuss in pairs Butlerov's contribution into chemistry development.*

Text 2

Read and translate.

Mendeleev – Pride of Russian science

In 1999 we celebrated the 130th anniversary of the publication of the Periodic Law of Elements by Mendeleev.

Mendeleev, the outstanding Russian scientist was born in Tobolsk in 1834. In 1850 at the age of 16 he entered the Pedagogical Institute in Petersburg to study chemistry. Five years later he graduated from it as an A-student and was invited to lecture on theoretical and organic chemistry at Petersburg University.

To continue his studies and research Mendeleev was sent to Germany. In 1859 while living abroad he made a number of important investigations.

The year of 1868 was the beginning of his highly important work «Fundamentals of Chemistry». When working at the subject Mendeleev analysed an enormous amount of literature, made thousands of experiments and calculations. This tremendous work resulted in the Table of Elements consisting of vertical groups and horizontal periods. Mendeleev was the first one who suggested a system of classification in which the elements are arranged in order of increasing of properties with the increase of the atomic weights.

Arranging all the existing elements in the Table Mendeleev had to overcome great difficulties as a considerable number of elements were unknown at that time and the atomic weights of 9 elements (out of 63) we wrongly determined.

Due to these investigations Mendeleev was able to predict not only the existence of a few unknown elements but also their properties as well. Late these elements were discovered.

Mendeleev was engaged not only in the study of chemistry. His more than 350 works deal with many subjects. Combining theory with practical activity he carried out great research in coal, petroleum, iron and steel industries in Russia. He died in 1907 at the age of 73.

Time is the most severe judge in science. After 130 years of its existence, the periodic Law has preserved its full value and is being constantly developed with each new discovery.

Vocabulary

anniversary [ænı'və:sərı] – годовщина
vertical ['və:tıkəl] – вертикальный
property ['prɔpətı] – свойство
to be engaged in – заниматься
petroleum [pı'trəuljəm] – нефть

Exercises

1. *Answer the questions.*

1. Where and when Mendeleev was born? 2. What institute did he enter? 3. What subjects did he study at the institute? 4. When did he graduate from it? 5. When was he sent abroad? 6. What was the most important his discovery? 7. Were these unknown elements discovered? 8. When did Mendeleev die?

2. *Make up a dialogue using the following words:*

elements, scientist, chemistry, study, research, outstanding, investigation, work, result, important.

3. *Translate into English.*

1. Выдающийся русский химик Менделеев родился в 1834, а умер в 1907 году. 2. В 16 лет он поступил в педагогический институт в Петербурге. 3. В 1859 году Менделеев был отправлен в Германию, где сделал много важных открытий. 4. Прежде чем открыть свою периодическую таблицу, Менделеев проделал много экспериментов. 5. Менделеев сделал очень многое для угольной, нефтегазовой, металлодобывающей промышленности в России.

4. *Translate into Russian.*

To study chemistry; theoretical and organic chemistry; important investigations; fundamentals of chemistry; thousands of experiments; vertical groups and horizontal periods; system of classification; increasing atomic weights; periodic repetition of properties.

5. *Match years and events.*

1869		entered the pedagogical institute
1834		began to work on «fundamentals of chemistry»
1850	Mendeleev	died
1859		published the periodic law of elements
1868		was born
1907		lived abroad

6. *Match the adjectives with the nouns.*

atomic	elements
unknown	weights
tremendous	periods
vertical	work

horizontal	groups
considerable	number
great	amount
organic	chemistry

7. *Fill in an appropriate preposition.*

With, in, from, of, to, on, at

to consist …, to be engaged …, to graduate …, to result …, at the age…, to lecture …, to work …, to invite …, to deal ….

8. *Find pairs of synonyms.*

increase	research
enormous	complete
investigation	rise
to be engaged in	huge
carry out	to work at

9. *Make a plan on the text. Retell the text using your plan.*

10. *Imagine that two great chemists Butlerov and Mendeleev met. What would they speak about? Try to reproduce the dialogue.*

Text 3

Read and translate.

Academician A.E. Arbuzov (1877–1968)

Alexander Ermingeldovitch Arbuzov was born in the village Arbuzov-Baran, not far from Kazan on the 12th of September 1877. He spend his childhood in the village and received his first education at a regular village school.

When he was 9 Alexander entered the preparatory class of the First Kazan Gymnasium. At the gymnasium he became interested in chemistry and natural sciences.

In 1896 Arbuzov entered the Science Department of the Faculty of Physics and Mathematics of the Kazan University which he graduated from in 1900 with the Honours Degree and with the academic title Bachelor of Science.

Alexander Ermingeldovitch worked out a new perfect procedure for preparing complete esters of phosphorous acid. He was the first to make the pure esters of phosphorous acid available and to make a profound and complete study of their properties.

Later the scientist came to the conclusion that it was necessary to find a versatile reagent enabling one to tell the difference between the compounds of trivalent and pentavalent phosphorus.

The experimental discoveries were very important for the future development of the chemistry of organophosphorus compounds.

At present this transformation is known in chemistry as the Arbuzov reaction (or the Arbuzov rearrangement).

The First World War set absolutely new tasks before the chemists of Russia.

Since the war had begun the shortage of medicines imported from Germany immediately became evident, salicylic preparations being among them. The chemical section of the Military Industrial Committee entrusted A.E. to organize the production of a number of salicylic preparations in Kazan, i. e. salicylic acid, sodium salicylate, aspirin and some others. To set the production going A.E. used all his outstanding abilities of an engineer, designer, technologist and an excellent organizer and he succeeded in organizing a very technically complicated production of medicines and disinfectants. Under conditions in which no medicines could previously be produced they managed to manufacture 16 kgms of aspirin daily.

Experts considered that the effect of treatment with the aspirin produced in Kazan excelled that of the famous Bayer Firm. To the end of his life Arbuzov used only this aspirin.

In 1928 he became a Rector of Kazan University.

In 1971 a Memorial Museum was opened in the house of Arbuzov in Shkolny Street where he had lived for more than half a century.

Vocabulary

ester ['estə] – сложный эфир
phosphorous ['fɔsf(ə)rəs] – фосфористый
phosphorus ['fɔsf(ə)rəs] – фосфор
acid ['æsıd] – кислота
versatile ['və:sətaıl] – многосторонний, гибкий
reagent [rı:'eıʤ(ə)nt] – реактив

Exercises

1. *Answer the following questions.*

1. Where and when was Alexander Arbuzov born? 2. Where did he get his first education? 3. At what age did Alexander enter the preparatory class of the

First Kazan Gymnasium? 4. Where did Arbuzov study after the gymnasium? 5. Did he study well? 6. What did he work out? 7. What conclusion did he come to working with phosphorus? 8. Why was it important to organize the production of medicines in Kazan? 9. Where was Arbusov's Memorial Museum opened?

2. *Confirm or disprove.*

1. Alexander Arbuzov was born in Kazan. 2. Arbuzov received his first education at a regular village school. 3. He never interested in chemistry at the gymnasium. 4. Arbuzov had been studied at the Science Department of the Faculty of Physics and Mathematics for 7 years. 5. The scientist worked out a new perfect procedure for preparing complete esters of phosphorous acid. 6. During the World War I Arbuzov continued his experiments with phosphorous acid. 7. The production of medicines and disinfectants is very technically complicated. 8. Arbuzov succeeded in organizing production of medicines and disinfectants. 9. But famous Bayer Firm's aspirin excelled the effect of treatment of Kazan aspirin. 10. In 1928 he became a Rector of the University.

3. *Tell about scientific work of Alexander Arbuzov using the following words.*

To work out; procedure; complete ester; phosphorous acid; reagent; salicylic preparations; technically complicated production; medicines; disinfectants; effect.

4. *Change the underlined words. Choose from the words below.*

Continued, manufacturing, everyday, fifty years, before, near, well-known, get, shortfall.

1. Alexander Arbuzov was born in the village, <u>not far</u> from Kazan. 2. He <u>received</u> his first education at a village school. 3. Arbuzov is a <u>famous</u> scientist. 4. The <u>shortage</u> of medicines imported from Germany became evident. 5. He succeeded in organizing a complicated <u>production</u> of medicines. 6. No medicines could <u>previously</u> be produced under that conditions. 7. They manufactured 16 kgms of aspirin <u>daily</u>. 8. He <u>kept</u> working at the Kazan University. 9. Arbuzov had lived in Shkolny Street for more than <u>half a century</u>.

5. *Match dates and events of Arbuzov's life.*

1877	became a Rector of University
1886	entered the gymnasium

In	1896	he	graduated from the University
	1900		was born
	1928		entered the University

6. *Make sentences.*

1. Entered, A.E. Arbuzov, the Science Department, In 1896, of the Faculty of Physics and Mathematics, of the Kazan University.
2. Set, tasks, new, The First World War, absolutely, of Russia, the chemists, before.

7. a) *Make up 10 questions on the text.*

b) *Use answers as a plan for retelling.*

Text 4

Read and translate.

A Pioneer of Tatar Chemistry

The way to the science of the first Tatar professor Gilm Kamai was thorny. He was born in the family of a loader. His father wanted his son to be educated, but he died at the age of forty-two. Mother could not provide sustenance for three children that is why Gilm had to work. Fortunately, after The Soviet Revolution he obtained the opportunity to enter The Tatar Pedagogical Seminary where he was provided by scholarship and a room at the hospice. Then he entered Kazan University and after graduation took a post-graduate course on chemistry. At the University's museum favourable report of A. Arbuzov on Gilm Kamai's post-graduate work is kept.

A very exciting and important event for a young scientist became The Vth Congress named after Mendeleev. It was very responsible to report on such a conference, as it had to be listened by famous chemists. By that time two great scientific researches were completed by Gilm Kamai they were: «The Principles of Getting Phosphonacetic Ether» and «About Getting Thiophosphin Acids with Asymmetric Phosphorous».

Many foreign scientists were interested in Kamai's work. He went abroad to lecture and to share his scientific experience with foreign colleagues. On returning home Gilm Kamai was elected to be the Head of The Department of Intervening Products and Dyestuffs and in several months he became a professor of The Kazan Chemistry and Technology Institute and Kazan University.

His fundamental works in chemistry of arsenic- and phosphorous organic compounds and in nitro compounds chemistry made the Kazan Chemistry School famous.

Vocabulary

provide sustenance – прокормить

«The Principles of Getting Phosphonacetic Ether» – «К методике получения фосфонуксусного эфира»

«About Getting Thiophosphin Acids with Asymmetric Phosphorous» – «О получении тиофосфиновых кислот с асимметрическим фосфором»

chemistry of arsenic- and phosphorous organic compounds – химия мышьяк- и фосфорорганических соединений

chemistry of nitro compounds – химия нитросоединений

Exercises

1. *Make up seven questions on the text. Ask questions each other.*

2. *Find in the text sentences with the modal verb «have to» and «can» Make up 5 sentences of your own using modal verb «have to» and «can» in Present and in Past.*

3. *Translate into Russian.*

Тернистый путь; в возрасте; прокормить; получить возможность; стипендия; студенческое общежитие; аспирантура; имени Менделеева; учиться в аспирантуре; научное исследование.

4. *Translate into English.*

1. Путь к науке первого татарского профессора химии был тернист; его отец хотел, чтобы сын был образован. 3. Мать не могла прокормить троих детей, и Гильм вынужден был работать. 4. Его обеспечили общежитием и стипендией. 5. В музее университета хранится положительный отзыв Арбузова о работе Камая. 6. К этому времени два больших научных исследования были завершены. 7. Многие зарубежные коллеги интересовались работами Камая. 8. Он поехал за границу, чтобы читать лекции. 9. По возвращению домой его выбрали заведующим кафедры. 10. Его фундаментальные труды в химии прославили татарскую химическую школу.

5. *Make up a dialogue using the words from exercise 3.*

6. *Make up a plan on the text. Retell the text using your plan.*

Text 5

Read and translate.

Kazan chemistry and Technology College

Such famous chemists as Butlerov, Arbuzov and others developed their chemical researches in our city. That is why the Kazan chemical school has a strong scientific basis and a long history. Of course all scientific achievements are reflected on the development of chemical industry and we had to have worthy specialists to implement the result of a scientific work. To solve this problem many educational institutions were established in Kazan.

Kazan Chemistry and Technology College is among them. It was founded in 1964 and prepared specialists for Kazan chemical enterprises. One of such enterprises is a chemical plant Kazanorgsintez. It helps largely to the College and supports it with different types of facilities.

The college is a five-year academic institution and it has 3 departments: the Mechanical, the Technological, and the Law Department. Boys and girls enter the College at the age of 15 and study carefully a wide range of different subjects during 5 years. Besides professional subjects that are taught in well-equipped labs, computer and video halls, there are also non-professional subjects such as Psychology, Pedagogy, Esthetics and some others. Students also study Advanced Chemistry, Russian History, Russian Literature, the Tatar language, the Law, Biology, Computer programming, Physics and the English language. All these subjects are compulsory.

Because of an extensive help of the «Kazanorgsintez» many sport facilities are available for the students of the College such as swimming, tennis, track and field.

Vocabulary

achievement [ə'ʧi:vmənt] – достижение
reflect [rı'flekt] – отражать
facilities [fə'sılıtıs] – оборудование
compulsory [kəm'pʌlsərı] – обязательный

Exercises

1. *Answer the questions.*

1. What for was Kazan Chemistry and Technology College established? 2. When was the college established? 3. What enterprise supports the college? 4. How long do students study at the college? 5. How many departments does it have? 6. At what age do children usually come to enter the college? 7. What subjects do they study? 8. Are all subjects compulsory? 9. Do students have an opportunity to go in for sports?

2. *Find synonyms of the following words in the text.*

Well-known; establishment; to be founded; to help; equipment; extensively; faculty.

3. *Write out of the text sentences and replace some words by the synonyms from the exercise 2.*

4. *Translate into English.*

Обязательные предметы; научные достижения; стоящие специалисты; образовательные учреждения; готовить специалистов; широкий спектр предметов; профессиональные предметы; непрофессиональные предметы; хорошо оснащенные; доступны.

5. *Make a dialogue using the words from the exercise 4. Discuss the advantages of studying at the college.*

Text 6

Read and translate.

Kazan State Technological University

Kazan State Technological University is a large educational, research and production center. It consists of:

– KSTU (heard organisation);
– Nizhnekamsk Chemical Engineering Institute;
– Kazan Chemical Engineering College;
– Branch Institute in Bugulma;
– Planning and design institute «Sojuzkhimpromproject»;
– Research Institute «Spetskauchuk»;
– Interdisciplinary Regional Retraning Centre;
– Institute if Additional Professional Training.

Ten colleges, higher schools, departments (outside Kazan) providing different levels of higher professional education.

The University provides pre- and post-university professional training. It also performs integrated continuous education with an appropriate license for this type of activity.

The University was founded 80 years ago as Kazan Polytechnik Institute. In 1933 it was reorganised into Kazan Chemical Engineering Institute, and in 1992 it received the status of a university and was named Kazan State Technological University.

At present the University has six thousand five hundred full-time, part time extra-mural students, it offers courses in forty two specialities. More than one thousand and fifteen lectures and scientists work at the University, among them more seven hundred and fifty doctors and professors, forty five academicians. More than four hundred post graduate students specialise in forty four disciplines and forty five take doctorate courses.

In 1994 at the University was created the Faculty of Additional Training. The main mission of the faculty is providing simultaneous minor courses. Each course envisages six – eight hundred hours of classes in three years, and after the final exam students receive KSTU diploma of Additional Professional Training.

Faculty of Preparatory Training runs full-time, week-end, evening and distant preparatory colleges, evening preparatory courses.

At present the University is a State Research Centre of the RT and one of the largest scientific centres of the RF. It develops and implements scientific and technical programme «Chemistry and chemical technology in the Republic of Tatarstan» and the programme of the RT government designed till 2005 «Development of science in priority spheres». The University initiates developing of perspective schemes for cooperation of science education and industry.

The University carries out basic, applied and discovery research work of students. The University organises annual international, Russian and regional student research and scientific conventions.

The University has contracts and agreements of co-operation in the sphere of science and education with thirteen universities, colleges, organisations and companies in Great Britain, Ireland, Bulgaria, Poland and China.

Exercises

1. *Answer the following questions.*

1. What does State Technological University consist of? 2. What does the university provide? 3. When was the university founded? 4. What was its name at first? 5. When did it receive the status of a university? 6. What is the university's present name? 7. What type of education does it provide? 8. Does

the university have a professional staff? 9. Is there a post-graduate course at the university? 10. What for was the Faculty of Additional Training created?

2. *Make up a plan on the text.*

3. *Discuss in pairs what educational services State Technological University provides.*

4. *Say in English.*

Университет состоит из; высшее профессиональное образование; лицензия на какой-либо вид деятельности; студент дневного отделения; учиться заочно.

5. *Discuss in pairs what advantages State Technological University provides.*

UNIT 2
Chemical problems and realities

Text 1

Read and translate.

The polymer industry in Australia

Australia uses a large amount of polymer materials per head of population. Poly (ethylene), poly (propylene), poly (vinyl chloride), poly (vinyl acetate), and many step-growth polymers, such as urea-formaldehyde and polyester resins, are produced in Australia. The amounts of these polymers, which are imported, depend on economic factors, including tariff-levels. Polymers for special purposes are usually imported.

Production of synthetic polymers in Australia started in the early 1950's with production of nitrocellulose, urea-formaldehyde and then poly (vinyl chloride). Vinyl chloride was made from acetylene and hydrogen chloride. Now vinyl chloride is made from ethylene.

Low-density poly (ethylene) was first produced in Australia in 1957. The ethylene was produced by the dehydration of ethanol, which was made by fermentation of sugar.

Since the first petrochemical plants were constructed in Australia during the 1960's ethylene has been obtained from the cracking of distillation products from crude oil. Natural gas may replace this source in the future. Production of high-density poly (ethylene) was begun in the 1970's.

Vocabulary

polymer materials ['pɔlımə mə'tıərıəls] – полимеры
ethylene ['eθılın] – этилен
propylene [prɔpılın] – пропилен
vinyl chloride ['vaınıl 'klɔ:raıd] – винилхлорид
vinyl acetate ['vaınıl 'æsıtıt] – ацетат
urea-formaldehyde resins ['juərıə-fɔ:mældıhaıd] – карбамидо-формальдегидные смолы
polyester [‘pɔlı'estə] – полиэфир

Exercises

1. *Find in the text verbs in passive.*

2. *Answer the following questions.*

1. What polymers are produced in Australia? 2. When did production of synthetic polymers started in Australia? 3. What polymers did the production start with? 4. What was vinyl chloride made from? 5. When was low-density polyethylene first produced? 6. In what way was ethylene produced? 7. What was changed in producing ethylene, since the first petrochemical plants were constructed? 8. When was production of high-density polyethylene begun?

3. *What reaction does this formula express?*

$C_2H_2(g) + HCl(g) \rightarrow CH_2CHCl(g)$

4. *Divide your class into 2 groups and compete: which group will be able to name more products made from polymers.*

5. *Name as many polymers as possible.*

6. *Match the antonyms.*

import	finish
dependant	exclude
start	break
make	export
include	independent

7. *Find pairs of synonyms.*

make	build
obtain	produce

begin	aim
purpose	get
construction	start

8. *In which sentences of the text are the words from exercises 7 and 8 used? Find them and read.*

The polymer

Exercises

1. *Fill in the gaps using the words.*

Materials, rust, fluids, adhesive, approximately, transparent, synthetic, transported.

1. Potentially, plastics do not … or need regular re-painting. 2. These tanks are used for storing such … as oil and petrol. 3. The light weight of plastics enables them to be easily … and moved on site. 4. PVC can be manufactured in a variety of colours or can be … . 5. …, also known as glue, cement, is any non-metallic substance applied to one or both surfaces of two separate items that binds them together and resists their separation. 6. In the United Kingdom … 500,000 tonnes of PVC are produced each year. 7. Thermosets also present an increased utilisation as reinforcing and structural … . 8. Thermoplastics and thermosets are … polymers.

2. *Translate the sentences.*

1. По отношению к нагреву полимеры подразделяют на термопластичные и термореактивные. 2. Человек давно использует природные полимерные материалы в своей жизни. 3. Промышленное производство полимеров началось в начале XX века. 4. Эластомеры – это полимеры, обладающие высокоэластичными свойствами. 5. Наука о полимерах стала развиваться как самостоятельная область знания к началу Второй мировой войны. 6. Производство синтетических полимеров началось в 1906 году, когда Лео Бакеланд (Leo Baekeland) запатентовал так называемую бакелитовую (Bakelite) смолу. 7. Многие полимеры, такие как эпоксидные смолы, склонны к воспламенению.

3. *Read the extract from a leaflet sponsored by the plastics industry. Choose a heading for each paragraph. There is one you do not need.*

a) An important new use of plastic.
b) Plastic and the environment.
c) A history of plastic.
d) New life of old plastic?
e) Physical qualities.

1. Though natural rubber was used as early as 1600 BC and significant developments were made in the early nineteenth century, it was the development of plastics during the twentieth century which really revolutionized the world.

2. Its uniquely versatile properties – its strength, the fact that it can be made either flexible, as in shoes or watchstraps, or rigid, as in tables or chairs, and its lightweight and water-resistant – mean that plastic has already replaced many traditional materials such as wood, metal, ceramic. The world must have been a very different place before plastic.

3. A recent development which is likely to revolutionize manufacturing is 3D printing. Plastic is built up, layer on layer, to create complex solid objects.

4. Recycled plastic is now being used in very creative ways, too. In Taiwan, plastic bottles were used to build EcoARK exhibition centre, while in Bangalore, India, a new, longer-lasting more durable road surface has been laid using around 10 % of the city's waste plastic. This will cut the need for road repairs.

4. *Match the words in the leaflet to the definitions.*

Doesn't let water through easily; not heavy; able to bend; having many different uses; likely to last a long time; difficult to move or bend.

Text 2

Read and translate.

Controlling air pollution

Emission of substances into the air cannot be eliminated entire unless all human activity stops. However, authorities in each state place legally enforceable limits on the levels of each pollutant, depending upon its toxicity and the technology available to restrict its emission. The National Health and Medical Research Council of Australia has mode recommendations with respect to the concentrations of pollutants that can be achieved in chimney gases with good industrial practice.

The effects of air pollution could be minimized by: using materials which contain fewer potential sources of pollution, treating wasters released to the atmosphere to remove or reduce pollutant concentrations, disposing of wasters correctly so that they are rapidly diluted and dispersed in the atmosphere and do not build up to harmful levels.

Vocabulary

emission [ɪ'mɪʃ(ə)n] – выделение, распространение
substance ['sʌbstəns] – вещество
enforceable [ɪn'fɔ:səbl] – осуществимый
pollutant [pə'lu:tənt] – загрязняющий агент
chimney ['tʃɪmnɪ] – труба
dilute [daɪ'lju:t] – разжижать
disperse [dɪs'pə:s] – рассеивать
to release [rɪ'li:s] – выпускать сбрасывать
to treat [tri:t] – обрабатывать, подвергать действию
dispose [dɪs'pəuz] – располагать
dispose of – отделаться, избавиться

Exercises

1. *Find in the text forms of the modal verb «can».*

2. *Use the modal verb can in sentences of your own.*

3. *Express the main idea of the text, discuss on its name.*

4. *Comment on the following statements.*

1. Authorities in each state place legally enforceable limits on the levels of each pollutant. 2. Using materials that contain fewer potential sources of pollution can minimize the effects of air pollutant. 3. Treating wasters, released to the atmosphere, can minimize the effects of air pollution.

5. *Comment on situation in your country on the following statements.*

1. Can emission of substances into air be eliminated? 2. What do authorities really do to manage the situation with air pollution? 3. Can the effects of air pollution be minimized by using materials, which contain fewer potential sources of pollution? 4. What can we do to reduce pollutant concentration? 5. What can we do with wasters so that the pollutants are rapidly diluted and dispersed?

6. *Discuss with your partner what ways of the air pollution controlling is useful to use in our country. Use your own knowledge and information from the text.*

7. Make pairs.

chimney	activity
human	limits
available	pollution
pollutant	technology
enforceable	concentration
air	gases

Text 3

Read and translate.

Our uses of Acids and Bases

Acids and bases are two classes of chemical substances often encountered in daily living.

Part 1
Acids

Common examples of aqueous solutions of acids include the following:

– Vinegar, which is a solution of acetic acid;

– Juices of oranges, lemons and grapefruit, which contain citric acid;

– Battery acid, which is a solution of sulfuric acid;

– «Spirits of salt», used in soldering, which is a solution of hydrogen chloride. Solutions of hydrogen chloride are called hydrochloric acid.

Acids are used extensively in industry. The quantity of sulfuric acid used in industry is more than double than of any other chemical. For example, sulfuric acid is used for many purposes, including the production of the fertilizers super phosphate and ammonium sulfate, the extraction of metals, and the production of detergents and polymers. Nitric acid is used mainly to make explosives and fertilizers.

Vocabulary

aqueous solution ['eɪkweɪəs səlu:ʃən] – водный раствор
vinegar ['vɪnɪgə] – уксус
acetic acid [ə'si:tɪk 'æsɪd] – уксусная кислота
sulfuric = sulphuric acid [sʌl'fjuərɪk 'æsɪd] – серная кислота
soldering ['sɔldərɪŋ] – припой

hydrogen chloride ['haıdrıʤən 'klɔ:raıd] – хлорид водорода
hydrochloric acid ['haıdrəklɔrık 'æsıd] – соляная кислота
nitric acid ['naıtrık 'æsıd] – азотная кислота

Exercises

1. *Find in the text the following words, read and translate them.*

2. *Complete the sentences.*

1. Vinegar is a solution of … . 2. Juices of oranges contain … . 3. Battery acid is a solution of … . 4. Soldering is a solution of … . 5. Solutions of hydrogen chloride is a … .

3. *Write the following formulas in words* (прил. А).

CH_3COOOH; H_2SO_4; C_6H_8O7; HCl.

Part 2
Bases

Bases are used in a range of household cleaning agents including oven, drain and window cleaners, and washing powders. Common bases include:

– sodium hydroxide;
– sodium carbonate;
– ammonia;
– quicklime;
– hydrated lime.

In industry, more ammonia is used than any other chemical except sulfuric acid. It is used mainly to make fertilizers and explosives. Sodium hydroxide is used in large quantities for the manufacture of soaps, in the extraction of alumina from bauxite and for the removal of sulfur compounds during oil refining. Sodium carbonate is used in the manufacture of glass and to reduce the level of acidity of solutions. Lime is used mainly in bricklayers' mortars and, with Plaster of Paris, in wall and ceiling plasters. It is also used in the BOS steel making process and as an acidity control in industry.

Vocabulary

ammonia [ə'məunjə] – аммиак
quicklime ['kwıklaım] – негашеная известь
hydrated lime ['haıdreıtıd laım] – гашенная известь
hydroxide [haıd'reksaıd] – гидроокись

bauxite ['bɔ:ksaɪt] – алюминиевая руда
alumina [ə'lju:mɪnə] – окись алюминия
mortar ['mɔ:tə] – строительный раствор
plaster ['plɑ:stə] – штукатурка
Plaster of Paris – гипс

Exercises

1. *Write the following formulas in words.*

Na_2CO_3, NH_3, CaO, $Ca(OH)_2$, $NaOH$.

2. *Answer the following questions.*

1. What are the common examples of aqueous solutions of acids? 2. What acid is more than double than any other chemical used in industry? 3. What purposes is sulfuric acid used for? 4. What is nitric acid used for? 5. Where are bases used? 6. What is ammonia used for in industry? 7. What is sodium hydroxide used for? 8. What is used in the manufacture of glass and to reduce the level of acidity of solutions? 9. Where is lime used? 10. Can you say that acid and bases are commonly used in our life?

3. *Name as much as possible products of acid and bases.*

4. *Pronounce the following words.*

Ammonia, quicklime, hydrated lime, hydroxide, bauxite, alumina, mortar, plaster, Plaster of Paris, acid, aqueous solution, vinegar, acetic acid, sulfuric acid, soldering, hydrogen chloride, hydrochloric acid, nitric acid.

Text 4

Read and translate.

Part 1
Sources of Energy

We use for many purposes, ranging from such large-scale applications as the provision of electricity to a whole city down to using the small amount of energy from match to light the barbeque. Where do we get this energy from? There are many sources of energy available to us, some of which are more suited for a particular purpose than others. Our main natural sources of energy are summarized below.

Wood. Heat is evolved when wood burns. Apart from the sun and localized phenomena such as hot water springs, wood was the earliest common source of warmth.

Wind. Probably the two most common uses of the energy of moving air have been the propulsion of sailing ships and windmills.

As people have begun to realize that supplies of coal and oil will not be available forever – at least at reasonable prices – more attention is being paid to supplementing our energy usage with the energy of winds.

Rivers. Moving water in rivers has long been used to provide the energy for transporting goods in barges and in other ways.

Another important use of the energy of rivers is the production of electricity.

The sun. Our existence depends on energy that is provided daily by the sun. For example warm from the sun warms our planet and plants would not grow without light from the sun. The sun has an importance as an energy source far over and above our daily uses of heat and light reaching the earth: none of the energy sources mentioned so far could exist but for the presence of the sun.

Vocabulary

evolve [ɪ'vɔlv] – выделять (газы, теплоту)
barge [ba:ʤ] – баржа
propulsion [prə'pʌlʃən] – движение вперед
windmill ['wɪndmɪl] – ветряная мельница

Exercises

1. *Answer the questions.*

1. What was the earliest common source of warmth? 2. What are the two most common uses of the energy of moving air? 3. How can be used an energy of moving water in rivers? 4. What does our existence depend on? 5. If supplies of coal and oil will not be available, what source of energy could be used instead?

2. *Can you say what was the oldest source of energy, which was used by ancient people?*

3. a) *Find in the text adjectives in superlative.* b) *Make the following adjectives superlative:* hot, common, early, warm, reasonable.

Part 2
Sources of Energy

Crude oil. The carbon compounds comprising crude oil can provide energy by combustion. During refining of crude oil mixtures of substances suitable for particular purposes are produced. The industrialized countries of the world, including Australia, have become heavily depend on the availability of petroleum products, especially as transport fuels.

Natural gas. The main component of natural gas is methane. Natural gas can provide energy by combustion of the methane and other carbon compounds. This energy source is becoming increasingly important in Australia.

Coal. Heat energy is obtained by burning coal in air. Before petroleum became freely available, coal was used as the source of energy for the engines in trains and ships. Petroleum products have replaced coal for this purpose although, as the limitations of crude oil supplies have recognized, some coal-fired ships been built recently. Coal is the main energy source used for production of electricity in many countries.

Vocabulary

crude oil [kru:d ɔɪl] – непереработанная нефть
combustion [kəm'bʌstʃən] – сгорание
fuel [fjuəl] – топливо
methane ['mi:θeɪn] – метан
carbon ['kɑ:bən] – углерод; уголь

Exercises

1. *Answer the questions.*

1. What compounds of crude oil can provide energy? What way? 2. What substances are produced during oil refining? 3. What way is heat energy obtained from coal? 4. What was used as the source of energy for the engines in trains and ships? 5. What is the main energy source used for production of electricity?

2. *Can you say that there is something general in these sources of energy?*

Part 3
Sources of Energy

Other sources of energy. The above list of energy sources is by no means complete. Some natural sources which have not been important in the past, but which may be used more in future include the following:

– Ocean waves could supply a continuous supply of energy;

– Ocean tides could be a source of much energy if engineers can develop methods to obtain it economically;

– Ethanol, produced by fermentation of cane sugar, potatoes and other vegetable matter can be used as a supplement for petrol in cars;

– Vegetable oils, such as linseed oil and safflower oil can be used instead of diesel fuel in tractors.

Any chemical reaction that releases heat or light is potential source of energy.

Vocabulary

tide [taıd] – морской прилив, отлив
ethanol ['eθənɔl] – этиловый спирт
fermentation [¸fə:men'teıʃən] – брожение, ферментация
cane [keın] – тростник
linseed oil ['lınsi:d ɔıl] – льняное масло

Exercises

1. *What do you think about these sources of energy? Express your opinion on each future source of energy.*

2. *Try to remind what sources of energy are not mentioned in these texts.*

3. *Pronounce the following words correctly. Translate them.*

Phenomena, propulsion, available, reasonable, barge, electricity, crude, carbon, combustion, industrialized, methane, engine, petroleum, although, exist.

4. *Make up a dialogue.*

Student A: a man from the Future tells about sources of energy, which they use.

Student B: a man who tells about sources of energy, which we use now.

5. *Find seven sources of energy.*

o	w	e	c	w	c	d	a
n	i	r	o	s	r	g	o
a	n	s	c	s	u	n	c
t	d	w	o	o	d	l	o
u	v	s	a	u	e	r	a
r	i	n	l	n	o	i	l
a	a	r	i	v	e	r	s
l	g	a	s	r	t	u	i

Text 5

Read and translate.

The quality of water from different sources

The quality of water from various sources is different. Water that accumulates in the atmosphere as a result of evaporation or transpiration is relatively pure. After this water returns to the earth as rain or snow and migrates over or through the ground towards the sea, the concentration of dissolved impurities generally increases. The concentration of impurities in water at each stage of the water cycle is discussed below.

Although relatively pure, rainwater contains dissolved atmospheric gases. Some of these dissolved gases cause the water to be acidic. As result of contact with airborne particles, rainwater may also contain variable concentrations of dissolved salts and insoluble solid matter.

Rainwater that flows over the surface of the ground may become even more acidic as carboxylic acids and carbon dioxide produced by decaying vegetation dissolve in it. This acidic water dissolves salts and minerals as it runs over the ground. The impurities dissolved in run-off water depend on the nature of the soil.

Run-off water, which percolates deep into the soil to become groundwater, may contain relatively high concentrations of dissolved ions.

At deep levels, a long way from the oxygen-rich surface, groundwater is usually in a strongly reducing environment. In deep groundwater, elements may be in lower oxidation states than those common in surface water. Most of the iron salts in bore water are iron salts. In air, the iron ions are oxidized to brown iron ions, which are responsible for the brown stain on many buildings alongside gardens irrigated with bore water.

Some run-off water eventually returns to the sea either over or through the ground. The concentrations of dissolved ions in seawater are many times greater than those typically found in inland surface water or groundwater.

All of the chemical elements are present to some extent in the oceans, which can be regarded as the world's largest ore body. Water in the ocean contains about 40 million tones of solids dissolved in every cubic kilometer of water. The dissolved matter is mostly sodium ions and chloride ions, but significant quantities of valuable elements are present.

Vocabulary

evaporation [ɪˌvæpə'reɪʃən] – выпаривание
transpiration [ˌtrænpə'reɪn] – испарение
impurity [ɪm'pjuərɪtɪ] – загрязнение, примесь
airborne ['ɛəbɔ:n] – находиться в воздухе
insoluble [ɪn'sɔljubl] – нерастворимый
decay [dɪ'keɪ] – распад, разложение
vegetation [ˌveʤɪ'teɪʃən] – растительность
percolate – просачиваться, проникать сквозь

Exercises

1. *Answer the following questions.*

1. What causes the water to be acidic? 2. What is the result of water contact with air borne particles? 3. Why rain water that flows over the surface of the ground may become more acidic? 4. What do the impurities dissolved in run-off water depend on? 5. What is the difference between elements in deep groundwater and in surface water? 6. What happens to iron ions in air? 7. Is concentration of dissolved ions in seawater and in inland water equal? 8. Does the ocean water contain dissolved solids? 9. What concentration do solids reach in the ocean? 10. What are the dissolved matters?

2. *Tell about the quality of rainwater, groundwater, surface water, inland water, bore water, seawater, ocean water.*

3. *Write out of the text 10 key sentences.*

4. *Prepare the retelling of the text.*

5. *Match adjectives and nouns.*

significant	gases
dissolved	water
acidic	quantities
valuable	levels
deep	matters
atmospheric	elements

6. *Write out of the text all adjectives in comparative and superlative degrees.*

7. *Make complete lines.*

large	larger	the largest
great		the greatest
	deeper	
		the richest
poor		
big		
white		
long		

8. *Make the following adjectives comparative and superlative as in example.*

Example: acidic – more acidic – the most acidic

various, common, valuable, different, difficult, comparable, beautiful, significant, important.

Remember!

good	better	the best
bad	worse	the worst
little	less	the least
much, many	more	the most

Text 6

Read and translate.

Photochemical smog

Often there are a number of pollutants present in the atmosphere at the same time. Evidence suggests that the combined effects of a number of pollutants are often worse than the effects of each substance acting separately. An example is photochemical smog, which is formed by reactions of oxides of nitrogen and hydrocarbons.

Hydrocarbons and oxides of nitrogen are emitted into the air during fossil fuel combustion.

Some aromatic hydrocarbons can irritate mucous membranes in the respiratory systems and some can induce various forms of cancer and blood abnormalities. Nitric oxide and nitrogen dioxide are potentially harmful to plant and animal life and both contribute to the production of acid rain. When the air contains hydrocarbons as well as oxides of nitrogen, reactions can occur on sunny days to produce a photochemical smog, which contains very harmful substances.

Severe photochemical smog may often occur in cities located in valleys or shallow basins. In the troposphere the temperature normally decreases with increasing altitude. Air warmed by the earth expands, becomes less dense and rises. Cooler air moves in to replace it. Air currents created in this way help to disperse the pollutants.

Under certain weather conditions, a layer of warm air may lie above a cooler air mass. This layer is termed an inversion layer. The denser cool air cannot rise through this inversion layer, and vertical atmospheric circulation is prevented.

Pollutants are then trapped in the lower layer, increasing the opportunity for reaction between primary pollutants. Situation such as this may remain unchanged for days until weather conditions change and the inversion layer breaks up.

Vocabulary

oxide ['ɔksaıd] – окись
nitrogen ['naıtrəʤən] – азот
hydrocarbon ['haıdrəu'kɑ:bən] – углеводород
fossil ['fɔsl] – окаменелый
combustion [kəm'bstʃən] – сгорание
mucous membrane ['mju:kəs 'membreın] – слизистая оболочка
dioxide [daı'ɔksaıd] – двуокись

Exercises

1. *Pronounce correctly the following words:*

oxide, nitrogen, fuel, hydrocarbon, dioxide, troposphere, temperature, atmospheric, circulation, inversion.

2. *Answer the following questions.*

1. What is photochemical smog formed by? 2. When do hydrocarbons and oxides of nitrogen are emitted into the air? 3. How do hydrocarbons can influence our health? 4. Where is photochemical smog more likely to occur? 5. What air is less dense warm or cold? 6. What can break up the inversion layer? 7. What is the inversion layer?

3. *Say in English.*

1. Смог формируется посредством реакций окисей азота и углеводорода. 2. Некоторые углеводороды могут раздражать слизистые оболочки дыхательной системы. 3. Окись азота и двуокись азота вносят свой вклад в возникновение кислотного дождя. 4. Воздух, нагретый землей, расширяется, становится менее плотным и поднимается. 5. Вертикальная атмосферная циркуляция прекращается.

4. *Match antonyms. What part of speech does each pair represent?*

worse	jointly
separately	useful
form	more
harmful	horizontal
decrease	break
less	better
vertical	increase

5. *Replace the underlined words by the synonyms below:*

cause, frequently, usually, matters, rising, is called, height, situated.

1. Some hydrocarbons can <u>induce</u> various forms of cancer and blood abnormalities. 2. Reactions can occur on sunny days to produce a photochemical smog which contains very harmful <u>substances</u>. 3. Severe photochemical smog may <u>often</u> occur in cities <u>located</u> in valleys or shallow basins. 4. In the troposphere the temperature <u>normally</u> decreases with <u>increasing altitude</u>. 5. This <u>is termed</u> an <u>inversion</u> layer.

6. *Confirm or disprove.*

1. Combined effect of a number of pollutants is often worse than the effects of each substance acting separately. 2. Hydrocarbons are not harmful for human health. 3. Nitric oxide and nitrogen dioxide have no influence to the acid rains. 4. Photochemical smog usually occurs in mountain regions.

5. The situation when pollutants are trapped in the lower layer, increase the opportunity for reaction between primary pollutants.

7. *Make a plan for the text. Retell the text.*

8. *Discuss with your partner the ways of photochemical smog appearance.*

UNIT 3
Russia and Tatarstan chemical industry outlook

Text 1

Read and translate.

General development of industry branch

Chemical and petrochemical industry is a basic branch of industry in the national economy of Russian Federation. It is a major supplier of raw materials, semi-processed materials and various products to all branches of industry, agriculture, service sector, trade, science, culture and education, defense complex. The enterprises of chemical and petrochemical industry provide about 3,5 % of tax revenues to the income part of the state budget.

In 1998 it was not possible to secure the trend to the stabilization and certain growth of petrochemical production, which had been marked in 1994–1997. Volumes of production of synthetic rubber, polystyrene, truck tires, etc. decreased in 1998 as compared with 1997. Indices of physical volumes of production in the branch of industry decreased by 7,5 %. Absence of centralized investments and difficult financial conditions of the enterprises dramatically slowed down the rate of technical reconstruction and reequipment of the branch.

The most stable enterprises of this branch of industry were operating in following regions: in North-west region – Novgorod area; in Central region – Kostroma area; in Volga region – Republic of Tatarstan, Volgograd area; in East Siberia region – Krasnoyarsk territory, where the output of products was more than 100 % as compared with 1997. Significant increase in commercial output was marked in the Republic of Tatarstan as far as the production of polyethylene and car tires is concerned.

The volume of chemical and petrochemical production in 1998 was mostly defined by the demand on the domestic market. Export share in the total production volume was 32 % and decreased by 0,4 % in comparison with 1997.

Steady trend to the decrease in volumes of export shipments to far abroad countries was marked from January till June 1998. In general, in the 3rd quarter 1998 the volume of export deliveries increased by 1,7 % in comparison with pre-crisis period and in the 4th quarter it again increased by 20,3 %.

Vocabulary

raw materials [rɔ: mə'tɪərɪəl] – сырье
output ['autput] – выпуск
revenue ['revɪnju:] – годовой доход
indices ['ɪndɪsi:z] pl. от index – индекс
domestic market [dəu'mestɪk 'mɑ:kɪt] – внутренний рынок
quarter ['kwɔ:tə] – квартал
tire = tyre ['taɪə] – шина, покрышка
demand [dɪmɑ:nd] – спрос
acceleration [ək¸seəreɪʃən] – ускорение, убыстрение

Exercises

1. *Answer the following questions.*

1. In what spheres are products of chemical industry used? 2. Why did volumes of production decrease in 1998? 3. What did the absence of centralized investments cause? 4. In what regions are the most stable enterprises operating? 5. What was the volume of chemical and petrochemical production defined? 6. What was the export share in the total production volume? 7. When was steady trend to the decrease of exporting shipments marked? 8. What happened to volume of export in the 3rd quarter 1998? In the 4th quarter?

2. *Put the sentences into the right order.*

1. Production volumes. 2. Stable enterprises. 3. Volumes of export. 4. General information of RF chemical industry.

3. *Write out of the dictionary the transcription of the following words:*

Semi-processed, revenue, budget, synthetic, polystyrene, polyethylene, quarter.

4. *Translate the sentences paying attention to the prepositions.*

Remember!
Повысился *на* 10 % – Increased *by* 10 %
Повысился *до* 50 % – Increased *to* 50 %

Use the following words. Stood at – был на уровне; leveled off – установился на уровне; to rise, to increase – повышаться; to fall, to decrease – падать, снижаться

1. В 1994 году объем производства был на уровне 2 млрд руб. 2. В 1995 он повысился на 1 млрд руб. 3. С 1995 по 1996 объем произведенных: товаров оставался на уровне 3 млрд руб. 4. В 1996 – 1998 он повысился до 6 млрд руб. 5. А в 1998 стал резко снижаться и достиг 3 млрд руб. к началу 1999 года. 6. В 1998 году объем химического производства понизился на 3 млрд руб.

5. a) *Discuss with your partner what consequences the crises of 1998 entailed.* b) *Make a dialogue.*

6. *Prepare the retelling of the text.*

Text 2

Read and translate.

Joint Stock Company «Nizhnekamskneftekhim»

The Headquarters of Joint Stock Company (JSC) «Nizhnekamskneftekhim» are located in the vicinity of its main production complex and 5 km far from the dwelling zone of Nizhnekamsk. Nizhnekamsk is the third city in the Republic of Tatarstan after Kazan and Naberezhny Chelny in terms of its size and population.

Headquarters premises of JSC «Nizhnekamskneftekhim» take a 11-storey building. Total area of the premises is equal to 16.8 thousand sqm. The premises were put in operation in 1992. Number of personnel working in the Headquarters amounts to about 500, i. e. 2.72 % of the total number of employees of JSC «Nizhnekamskneftekhim» (which is 18.4 thousand persons).

In the Headquarters there are the Board of Directors of the Company and the office of Director General of JSC «Nizhnekamskneftekhim». There are also the main management departments of the Director General in the premises.

1. Department of the First Deputy Director General – Director for Production and Development (production management, raw materials and

equipment supplies); 2. Some departments of the First Deputy Director General – Chief Engineer (technical management, department of the Chief Engineer for Power Supply); 3. Department of the Deputy Director General – Director for Economics and Finances as well as that of the Chief Accountant (accounting department, financial administration, economic planning and forecasting department, labour and payroll department, economic analysis department); 4. Some departments of the Deputy Director General – Director for Marketing and Sales (sales management, export management, transport department). Besides the services and departments listed above, in the Headquarters of JSC «Nizhnekamskneftekhim» there are the Property, Stock Market and Investments Department, Administration for Information and General Issues and Legal Department.

Further, in the Headquarters there are Scientific and Technical Library, Museum of JSC «Nizhnekamskneftekhim», Assembly Hall and the Telecasting Studio of JSC «Nizhnekamskneftekhim».

Vocabulary

Headquarters ['hed'wɔ:təz] – главное управление
in the vicinity [ın ðə vı'sınıtı] – поблизости
dwelling zone ['dwelıŋ zəun] – жилая зона
premise ['premıs] – постройки
First Deputy Director General – первый заместитель директора
Board of Directors – совет директоров

Exercises

1. *Study the table below.*

Board of Directors	
Director General	
First Deputy Director General	Deputy Director General
Director for Production and Development	Director for Economics and Finances
Chief Engineer	Chief Accountant
Chief Engineer for Power Supply	Director for Marketing and Sales

2. *Match functions with personnel.*

Director for production and development	Technical management, power supply
Chief engineer	Accounting department
Chief accountant	Production management, raw materials and equipment supplies
Director for Economics and Finances	Sales, export management
Director for Marketing and Sales	Economic Planning and Forecasting Financial Administration

3. *Name all the departments of the Headquarters of «Nizhnekamskneftekhim».*

4. *Remember!*

How to read decimal fractions?
2.75 – two point seven five
0.7 – point seven
500 – five hundred
7000 – seven thousand
675 – six hundred and seventy five
2649 – two thousand six hundred and forty nine

5. *Write in words.*

2000 –
400 –
4.5 –
6.78 –
5783 –
952 –

Text 3

Read and translate.

From Nizhnekamsk oil refinery to «Nizhnekamskneftekhim»

The Nizhnekamsk Oil Refinery has been acting as an independent legal entity since January 1961 when construction of its works started. In July 1967 the first works of the Oil Refinery, the Central Gas Cut Plant, was put in operation. In December 1967 the company got its present name: Nizhnekamsk Oil Refinery. Production of isoprene-monomer and isoprene rubber started in 1970. In 1973 production of butyl rubber and divinyl started. In 1976 the ethylene plant was put in operation and a 286 km long ethylene pipeline from Niznekamsk to Kazan was finished.

In 1977 the company was renamed as «Nizhnekamskneftekhim» Production Association an that year its plant producing ethylbenzol and styrene was put in operation and a 520 km long ethylene pipeline from Niznekamsk to Salavat via Ufa and Sterlitamak was finished. In 1979 a new oil processing plant ELOU-AVT started working; in 1980 ethylene oxide plant; in 1983 production of propylene oxide and polyethers started. In 1993 «Nizhnekamskneftekhim» Production Association was denationalized and transformed into «Nizhnekamskneftekhim» Open Joint-Stock Company, registered with the Ministry of Finances of the Republic of Tatarstan on August 18, 1993, register entry No. 388.

JSC «Nizhnekamskneftekhim» is located in the area of the Nizhnekamsk Industrial Aggregation, 5 km far from the City of Nizhnekamsk, the third major city in the Republic of Tatarstan being a part of the Russian Federation.

The company has got an access to the railroad system via the station of Biklian, 4 km far from its industrial site. JSC Tatneft, Almetievsk delivers oil, ethylene and a part of diesel fuel for JSC «Nizhnekamskneftekhim» through its pipelines. Total length of its ethylene pipeline is 806 km. JSC «Nizhnekamskneftekhim» uses it to supply industry of Kazan, Ufa and Sterlitamak with ethylene. Capacity of this ethylene pipeline exceeds 300 thousand ton a year.

The company also owns a loading dock, for a part of the products is shipped by water. Wheeled transport is also in broad use. There is a possibility to ship the products by air, for Begishevo Airport has obtained the international status.

Vocabulary

legal entity ['li:gəl 'entıtı] – юридическое лицо
works [wə:ks] – завод, фабрика
isoprene-monomer [ızɔ'prın'məunəmə] – изопрен-мономер
isoprene rubber [ızɔ'prın 'rʌbə] – изопреновый каучук
butyl rubber ['bju:tıl 'rʌbə] – бутилкаучук
divinyl [dı'vaınıl] – дивинил
ethylbenzol ['eθil'benzɔl] – этилбензол
styrene ['staırın] – стирол (этиленбензол, винилбензол)
oxide ['ɔksaıd] – окисел, окись, оксид
polyether [polı'i:θə] – простой полиэфир

Exercises

1. *Answer the following questions.*

1. When did The Nizhnekamsk Oil Refinery become an independent legal entity? 2. When was it renamed? 3. Where is «Nizhnekamskneftekhim» located? 4. Is Nizhnekamsk the second biggest city in Tatarstan? 5. Does the Company have an access to railroad system? 6. What is the total length of the company's ethylene pipeline? 7. What for this pipeline is used? 8. What is ethylene pipeline's capacity? 9. Does the Company use shipping by water? 10. Through what airport does the company ship its products by air?

2. *Match synonyms.*

legal entity	building
start	output
construction	petroleum
works	mill
plant	begin
operate	juridical person
production	factory
finish	through
producing	get
via	widely used
oil processing	posses
obtain	complete
in broad use	oil refining
own	manufacturing
oil	work

3. *Replace the underlined words by synonyms. See exercise 2.*

1. The Nizhnekamsk Oil Refinery is an independent <u>legal entity</u> since January 1961 when <u>construction</u> of its works started. 2. In 1970 <u>production</u> of isoprene-monomer and isoprene rubber <u>started</u>. 3. The plant <u>producing</u> ethylbenzol and styrene was put in operation and a 520 km long ethylene pipeline from Niznekamsk to Salavat <u>via</u> Ufa and Sterlitamak <u>was finished</u>. 4. In 1979 a new <u>oil processing</u> plant started working. 5. The company also <u>owns</u> a loading dock. 6. Airport has <u>obtained</u> the international status.

4. *Match years and events.*

1961	A new oil processing plant started working
1967	A company was renamed
1970	The ethylene plant was put in operation
1973	The first works of the Oil Refinery was put in operation
1976	Production of butyl rubber and divinyl started
1977	«Nizhnekamskneftekhim» registered with the Ministry of Finances of the Republic of Tatarstan
1979	Production of propylene oxide and polyethers started
1980	Constructions of first works started
1983	Production of isoprene-monomer and isoprene rubber started
1993	Ethylene oxide plant started to operate

Text 4

Read and translate.

Joint Stock Company «Kazanorgsintez»

Joint Stock Company (JSC) «Kazanorgsintez» is one of the biggest enterprises of chemical industry in the CIS. The Company comprises 8 productions plants that manufacture a wide range of chemical products and their derivatives. The main products of the Company are:

– high and low density polyethylene which takes 56 percent of the Company's total production output; the produced amount is 340 thousand tons per year;

– polyethylene pipes which takes 9 percent of the Company's total production output; the produced amount is about 35 thousand tons per year;

– ethylene oxide and its derivatives which take 28 percent of the Company's total production output;

– organic peroxides being the initiators of polymerization process – the Company is the only manufacturer of the product in the CIS.

The total assortment of the Company's products makes over 100 items. The Company is constantly mastering new products, such as newest composite materials obtained from high and low density polyethylene, catalysts and emulsifiers for oil dehydration.

The Company exports its production to more than 20 highly developed countries of the world such as the USA, Germany, Finland, Belgium, England, etc. It has become possible because of high quality of the products and their correspondence with the world standards.

With the aim to solve the problems of upgrading of the existing production facilities, to expand the range of products and to raise the competitive capacity, the Company works in close cooperation with leading foreign companies such as Union Carbide, John Brown, Lummus Crest, Ciba, BASF, Hochst etc.

One of today's principal tasks of the Company is trying to solve the problems of environmental pollution problems. This implies utilization of industrial waste, treatment of industrial waste gases by means of efficient technologies, and perfection of various methods of analysis.

The financial position of the Company is stable; its production has a great demand on both domestic and foreign markets.

Vocabulary

high density polyethylene [haı 'desıtı ˌpɔlı'eθıli:n] – полиэтилен высокого давления.

derivative [dı'rıvətıv] – производное

amount [ə'maunt] – количество

polymerization [pəˌlımәraızeıʃәn] process – процесс полимеризации

catalyst ['kætəlist] – катализатор

emulsifier [e'mʌlsıfaә] – эмульгатор

oil dehydration [ɔıl ˌdi:haı'dreıʃәn] – обезвоживание нефти

peroxide [pә'rɔksaıd] – перекись

Exercises

1. *Make up 10 questions on the text. Ask these questions each other.*

2. *Name the main products of JSC «Kazanorgsintez».*

3. *Put the sentences into the right order.*

The main products of the company; the company’s export; close cooperation with foreign companies; the main task of the company; the financial position of the Company.

4. *Replace the underlined words by the words below.*

Include, factory, overall, more, satisfy increase, main, means, through, solid, overseas.

1. «Kazanorgsintez» is one of the <u>biggest</u> enterprises of chemical industry in the CIS. 2. The Company <u>comprises</u> 8 productions plants which manufacture a wide range of chemical products and their derivatives. 3. The <u>total</u> assortment

of the Company's products makes over 100 items. 4. It has become possible because of high quality of the products and their compliance with the world standards. 5. With the aim to solve the problems of upgrading the existing production facilities, to expand the range of products and to rise the competitive ness, the Company works in close cooperation with leading foreign companies such as Union Carbide, John Brown, Lummus Crest, Ciba, BASF, Hochst etc. 6. One of today's principal tasks of the Company is trying to solve the problems of environment pollution. 7. This implies utilization of industrial waste. 8. Treatment of industrial waste gases by means of efficient technologies, and perfection of various methods of analysis. 9. The financial position of the Company is stable. 10. Its production has a great demand on both domestic and foreign markets.

5. *Match the adjectives with the nouns.*

close	technologies
principle	waste
industrial	task
efficient	cooperation
nigh	range
chemical	quality
wide	products

6. *Write in words the following abbreviations.*

the CIS –
the RF –
the USA –
the UK –

7. *Make up a dialogue. Discuss your Company's output and problems your companies face.*

Student A is a BASF company representative.
Student B works at «Kazanorgsintez» plant.

Text 5

Read and translate.

JSC Chemical Plant named after L.Y. Karpov

The Karpov chemical plant from the town of Mendeleevsk, founded in 1868 is elder one of the chemical industry of Russia and the Tatarstan

Republic. In 1998 the plant celebrated the 130th anniversary. More than 130 years ago the output of chemical products in Bondjug (Mendeleevsk) permitted the plant to refuse the import of expensive chromium, sulphiric and hydrochloric acid, copper vitriol. In Bondjug there was an experimental base of national and universal chemical science.

Today the plant produces 47 types of chemical products for different branches of industry, 9 types of consumer goods. The main specialization is the output of inorganic salt, household chemical goods, reagents, and ceramics. Primary ranges of products manufactured by the plant are: barium, sulphite and calcium chloride. The chemical plant has 12 types of guaranteed high quality chemical products.

The plant management works out long-term tasks based on the marketing results. Today the main task is the output of 18 new products types, which are at present purchased for currency; among them aluminium sulphate used as water cleaning coagulant. Mastering the production of harmless reagent against ice for needs of civil and combat aviation is in the nearest future plans. The question about establishment of a joint venture for injections manufacture such as calcium chloride is under consideration.

Under difficult economic conditions the chemical plant has found the right place in the marketing area and has raised its rating. The plant has everything required to materialize its great future plans.

Vocabulary

sulphite ['sʌlfaɪt] – сернистокислый, сульфитный
barium ['bɛərɪəm] – барий
calcium chloride ['kælsɪəm 'klɔ:raɪd] – хлорид кальция
aluminium sulphate [ˌælju'mɪnjəm 'sʌlfeɪt] – сернокислый алюминий
coagulant [kəu'ægjulənt] – коагулянт, сгущающее вещество
reagent [rɪ'eɪʤənt] – реактив, реагент

Exercises

1. *Answer the following question.*

1. When was the chemical plant in Mendeleevsk founded? 2. What for was this plant established? 3. What is the amount of production of chemicals? 4. Does the plant produce any consumer goods? 5. What does the plant produce? 6. How many new product types they are going to manufacture?

2. *Replace the underlined words by the synonyms below.*

Jubilee, to establish, factory, implement, purpose, civic, amid, buy, innocuous, elevate, requirements, long-dated, sort, manufacture, assure, allow, production.

1. The Karpov chemical plant from the town of Mendeleevsk, was founded in 1868. 2. In 1998 the plant celebrated the 130th anniversary. 3. More than 130 years ago the output of chemical products in Mendeleevsk permitted the plant to refuse the import of expensive materials. 4. The chemical plant has 12 types of guaranteed high quality chemical products. 5. Today the main task is the output of 18 new products types, which are at present purchased for currency. 6. The plant management works out long-term tasks based on the marketing results. 7. Among them aluminium sulphate used as water cleaning coagulant. 8. Mastering the production of harmless reagent against ice for needs of civil and combat aviation is in the nearest future plans. 9. Under difficult economic conditions the chemical plant has found the right place in the marketing area and has raised its rating. 10. The plant has everything required to materialize its great future plans.

3. *Translate into English.*

1. Сто тридцатая годовщина. 2. Восемнадцатый новый продукт. 3. Первый в области химической промышленности. 4. Второй год. 5. Пятидесятый юбилей.

4. *Make up phrases.*

long-term	plant
chemical	task
marketing	reagent
household	aviation
joint	good
civil	venture
harmless	area

Remember! Cardinal numbers

First	Первый
Second	Второй
Third	Третий
Fourth	Четвертый
Fifth	Пятый
Sixth	Шестой
…	…
Ninety ninth	Девяносто девятый
etc.	

5. *Write the following numbers in words. Make them cardinal.*

130 –
47 –
12 –
18 –
9 –

6. *Tell about the plant named after Karpov using the following words:*

Was founded, 130th anniversary, 47 types of chemical products, consumer goods, primary range of products, main task, right place in the marketing area.

7. *Find in the text examples of Participle 2.*

8. *Use them in the sentences of your own.*

Text 6

Read and translate.

Closed joint stock company «Sirazin and Co»

It's Director Mr. Sirazin and its employees created it. Nevertheless, in 1996 it became a Joint Stock Company. Only those who work for the company are its holders.

For 15 years it has been actively developing as a construction-industrial enterprise with wide range of activities. Now it is one of the biggest in Russian, with high level of profitability, reliable and highly qualified staff.

«Sirazin and Co» runs wholesale and retail trade outlets; railway facilities; gas filling stations; park of heavy weight tracks; warehouses; container storage area; varnish and paint production; drying oil and roof mastic production shops; foam plastic production; filling line for varnishes, paints, and chemical liquids; packing facility for dry materials; carpenter shop; restaurant «Kurkachi».

Exercises

1. *Name products which the company sales.*

2. *Imagine that you are a businessman. Discuss with your partner what kind of chemical products would you sell to be profitable.*

3. *What kind of business would you start? Ground your opinion.*

4. *Do you know that company? What do you think about advertisement? Is it an important thing in business?*

UNIT 4
Chemical achievements review

Text 1

Read and translate.

World chemical outlook

The situation in the chemical industry round the world was expected to improve. Chemical industry in US resumed its growth despite the fact that there were a few surprises. One was the foreign trade situation and restraints where the interest rates and raw materials cost were increased. The chemical economy is driven by these two factors.

Expectations were also outperformed by Canada. This year its chemical shipments are being increased.

It wasn't expected much in Europe. Economists there were worried about exports because of the Asian crises, despite the expectations Asia-Pacific region especially South Korea's chemical industry rised dramatically.

If say about the forecast for the next year the situation in US chemical industry will be improved if no unexpected economic slowdown happens.

Canada should continue to grow gradually next year especially if oil prices remain high. Europe is also ready for rapid growth as the European chemical producers take advantage of the expanding global economy. Asia-Pacific should also see better times next year South Korea should continue its rebus growth.

Vocabulary

to resume [rı'zju:m] – продолжать
to drive [draıv] – руководить
restraint [rıs'treınt] – ограничение
interest rate – процентная ставка
shipment ['ʃıpmənt] – погрузка
to outperform [ˌautpə'fɔ:m] – перевыполнять
economic slowdown – замедленный экономический рост
growth [grəuθ] – рост, развитие
chemical shipments ['kemıkəl 'ʃıpmənts] – отгрузка химических товаров

Exercises

1. *Write out of the text verbs in Present Simple, Past Simple Passive, Future Simple Passive and Present Continuous Passive. Make the following sentences negative and interrogative.*

Example: Expectations were outperformed by Canada.

Expectations were not outperformed by Canada.

Were expectations outperformed by Canada?

1. The chemical industry was expected to improve. 2. The interest rates were increased. 3. The chemical economy is driven by two factors. 4. The growth was expected in Europe. 5. This year chemical shipments are being increased. 6. The US chemical industry will be improved.

3. *Make sentences Passive.*

1. We improved the situation. 2. The state interest increased rates and raw materials cost. 3. South Korea improved its chemical industry. 4. Canada outperformed expectations. 5. These two factors drive the chemical economy. 6. Experts expected the improvement in the chemical industry.

4. *Match the verbs with the nouns.*

resume	shipments
increase	advantage
decrease	growth
expand	slowdown
see	interest rates
take	better times
have	economy

5. *Answer the following questions.*

1. What was expected in the chemical industry round the world? 2. Did chemical industry in the US resume its growth? 3. What 2 factors drive the chemical economy? 4. Why did Canada outperformed expectations? 5. What were economists in Europe worried about? 6. South Korea chemical industry was improved, wasn't it? 7. What is expected in US chemical industry next year? 8. What Forecast do they give about Europe and Asia-Pacific chemical industry?

6. a) *Read the text and follow the figure 1.*

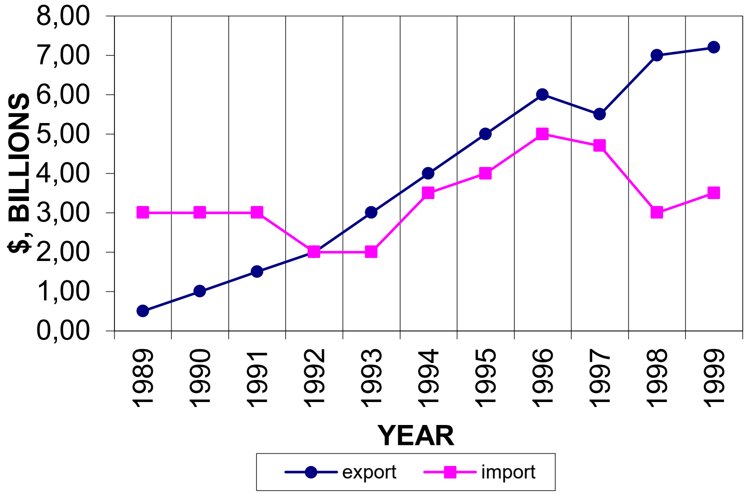


Fig. 1. S. Korean industry petrochemicals up

On the graph in front of you the horizontal axis represents the years from 1989 to 99. The vertical axis shows quantity of exports and imports expressed in billions of dollars. You can see that in 1989 the imports leveled off at 3 billion dollars. And had a slight fall in 1991 and again leveled off at 2 billion from the middle of 1992 till the mid. of 1993. From that time it rised gradually until it reached a peak of 5 billion dollars in the middle of 1996. Imports had a slight fall during 1996-1997 and decreased dramatically in 1998 to 3 billion dollars. There was a slight rise of imports level during 1998–1999.

b) *Write out of the text words and phrases, which will help you to describe the graph.*

c) *Describe the levels of exports during 1989-1999 like it is shown in the text before with imports.*

7. *Find pairs of antonyms.*

improve	boom
growth	fall
crises	slow
rise	suddenly
increase	reduce
gradually	make worse
rapid	decline
expand	slightly
dramatically	decrease

8. *Make up a dialogue.*

Student A is an expert who can forecast the situation in the chemical industry. Student A wants to know the opinion of Student B about the present situation.

Student B is a person who works in chemical industry and knows the present situation in it. Student B wants to know experts forecast for the next year.

Text 2

Read and translate.

Laboratory on Wheels

Public high school that has to put up with substandard teaching laboratories or have no labs at all will soon be able to make use of a new self-contained mobile chemistry lab. The mobile lab will hit the road full time next fall, filled with lab equipment, running water, fume hoods and other safety equipment, and facilities for the handicapped.

About 10 refined faculty members will take turns accompanying the lab on the road. This king of project will serve as phase of Virginia Tech's chemistry outreach program, expenses for such a lab will run about $ 150000 per year, including suppliers, repairs, maintenance, salary for drivers and other personnel.

A committee composed of high-school teachers is collecting and modifying experiments suitable for the mobile lab. Teachers will be able to access information about the experiments via the Internet. Pre- and post lab exercises will also be available on the web site.

This month, the lab will begin touring schools to familiarize teachers with its operation and instruments.

Eventually, the lab will be available to call public schools at the primary-, middle-, and high school levels and at community colleges.

Vocabulary

self-contained [self-kən'teınd] – снабженный всем необходимым
fume [fju:m] – пар с сильным запахом
facilities [fə'sılıtıs] – оборудование, аппаратура
hit [hıt] – колесить
put up – обходиться
substandard ['sʌb'stændəd] – несоответствующий стандартам
hood [hud] – крышка, чехол

Exercises

1. *Find in the text verbs in Future Simple.*

2. a) *Make up seven questions on the text (2 «yes-no» questions, 3 special questions, 2 tag questions).*

Example: will public High School be able to make use of a new mobile chemistry lab? – *yes-no*

Who will be able to make use of new self-contained mobile chemistry lab? – *special*

Public High School will be able to make of a new self-contained mobile chemistry lab, won't it? – *tag.*

b) *Ask these questions each other.*

3. *Find pairs of synonyms.*

disabled	hood
equipment	through
servemake	acquainted
familiarize	autumn
accompany	work for
bonnet	handicapped
fall	facilities
via	go with

4. *Match the antonyms.*

substandard	healthy
handicapped	profit
expense	to finish
suitable	standard
to begin	private
public	inappropriate

5. *Use proper prepositions: about, as, of, with, for, to*.

Run …, serve …, make use …, fill …, suitable …, available … .

6. *Make sentences.*

1. Public high school, soon, be able, will, to make use of, a new chemistry lab.
2. The lab, this month, begin, touring, schools, will.

7. *Write out of the text sentences, which contain the basic information. Use these sentences as a plan. Try to reproduce the text.*

Text 3

Read and translate.

Astrobiology Institute

NASA is aiming to create what it calls a virtual institute by using the most up-to-date. Internet and videoconferencing technologies it will join 11 institutes and Universities, at Ames Research Center (one of the members) chemists search for clues to life.

Jason P. Dworkin a chemist in the astro-chemical laboratory made the cell-like structures by simulating in the laboratory the kinds of chemical reaction he thinks are constantly taking place in much of interstellar space. Dworkin took a mixture of water, methanol, carbon monoxide and ammonia – the simple molecules found in the icy clouds far out in space where comets form – and irrigated it with an ultraviolet lamp, simulating the intense UV radiation. The result is a sticky film rich in complex and unidentified organic molecules. Disperse the film in water and it spontaneously forms tiny slightly leaky vesicles.

Andrew Ponerille head of the biomolecular and cellular modeling program at Ames said that those vesicles were essentially envelopes for a cell. They could stand on the pathway from inanimate to animate matter. Tracing that pathway is one focus at the astrobiology research going on at Ames. Other parts of the program investigate some of the most primitive microbial systems still surviving on Earth to learn how these systems interact with their environment. In particular the scientists want to know what characteristic signatures the microbes live behind in rocks and in the atmosphere that might serve as pointers to the presence of life elsewhere in the Universe.

Vocabulary

clues to life – разгадка возникновения жизни
cell-like – похожий на клетку
interstellar space ['ınte'stelə speıs] – межзвездное пространство
sticky ['stıkı] – липкий, клейкий
disperse [dıs'pə:s] – распрыскивать, погружать
vesicle ['vesıkl] – пузырек

cellular ['seljulə] – клеточный, клеточного строения
inanimate matter [ın'ænımıt 'mætə] – неорганический
animate ['ænımıt] – живой, органический

Exercises

1. *Answer the following questions.*

1. What is Nasa aiming to create? 2. How many members will virtual institute join? 3. How did Jason P. Dworkin a chemist in the astrochemical laboratory make a cell-like structure? 4. What did he do to make a sticky film rich in complex and unidentified organic molecules. 5. What does film form if we disperse it in water? 6. What did Andrew Pohorille said about vesicles? 7. What is the other part of the astrobiology research going on at Ames? 8. What do scientists in particular want to know?

2. *Put the sentences into right order.*

1. The part of the program investigates some of the most primitive microbial systems. 2. Virtual institute will join 11 institutes and universities. 3. The result is a sticky film rich in complex and unidentified organic molecules. 4. Dworkin made the cell-like structures by simulating in the laboratory the kinds of chemical reaction. 5. The scientists want to know characteristic signatures the microbes that might serve as pointers to the presence of life else where in the Universe.

3. *Imagine that you are Jason P. Dworkin – a chemist in the astrochemical laboratory. Tell about your experience: what you made first, what then to get the vesicles – envelops for cells.*

4. *Give the English equivalents.*

Исследовательский центр; структура похожая на клетку; межзвездное пространство; смесь воды, одноокиси углерода и аммиака; ультрафиолетовое излучение; липкая пленка; на пути от не органических к органическим соединениям; где-нибудь во вселенной.

5. *Find and write out of the text all adverbs. How can you make an adverb from an adjective?*

6. *Make adverbs from the following adjectives.*

Virtual, constant, simple, spontaneous, slight, essential, primitive.

Text 4

Read and translate.

Biotech's Promise clouded by Consumer Fear

Biotechnology is the molecular, fundamentally chemical, approach to understanding and manipulating life. Will it provide the spearhead combating the scourges of hunger, disease, human deprivation, and environmental degradation? Will biotechnology be the cutting edge of science-based progress in the 21st century – just as chemistry and physics have been in the 20th?

This method of genetic modification differs in three significant ways from the tradition method of cross-pollination that goes back to the beginnings of agriculture. It is more precise and predictable. It is faster. And it gives breeders, for the first time, the power to cross biological barriers. Despite all this potential genetically engineering plants and food are generation in the scientific community, they have run into serious problems in Europe. The major supermarket chains there won't carry products containing the, because they are afraid of its unhealthy nature. But specialists speak about substantial equivalence comes from Eric Millstone. Millstone says: «Substantial equivalence is a pseudoscientific concept because it was created primarily to provide an excuse for not requiring biochemical or toxicological tests».

He points to what he sees as the anomaly. The chemical composition of glyphosfate – resistant soybeans is different from antecedent varieties.

The second opinion reports findings that a genetically engineered potato fed to rats causes a thickening at the wall of part of their digestive tract.

Gerald C. Nelson, who coordinated the study of the politics and economics of agricultural biotech, says the technology's future can't be predicted at this time. However he tells that the most likely scenario includes another five or ten years of continued debate.

Vocabulary

spearhead ['spɪəhed] – начало
combat ['kɔmbət] – война
scourge [skə:ʤ] – бич
deprivation [ˌdeprɪ'veɪʃən] – лишение
cross–pollination [krɔs–ˌpɔlɪ'neɪ ʃən] – перекрестное опыление
digestive tract [dɪ'ʤestɪv trækt] – пищеварительный тракт

Exercises

1. *Answer the following questions.*

1. What are the advantages of biotechnological method of making food? 2. Are there any problems with engineered food? 3. Why do supermarket chains don’t want to carry them? 4. What do they mean saying that genetic food has a substantial equivalence? 5. Why Eric Miller says that the concept of substantial equivalence is pseudoscientific? 6. What chemical composition differs in new kind of product? 7. What did an engineered potato cause in experiments with rats? 8. Who is Gerald Nelson? 9. What did he say on that problem?

2. *Find in the text sentences with the following words. Read and translate them.*

Начало войны с …; человеческие лишения; перекрестное опыление; преодолевать биологические барьеры; псевдонаучная концепция; предыдущие виды; наиболее вероятный сценарий.

3. *Put the plan into the right order.*

1. Cheerful projects of biotechnologies. 2. Differences from previous method of getting food. 3. Substantial equivalence. 4. Laboratory reports. 5. Opinion about the future of such a products.

4. *Discuss in pairs.*

Student A likes the idea of engineering food.
Student B is against of using biotechnological food.

5. Imagine that your group is at the conference where the advantages and disadvantages of engineered food are discussed. Argue with each other.

6. *Write out of the text the most important sentences.*

7. *Retell the text. Use the plan from exercise 3 and sentences from exercise 6.*

Text 5

Read and translate.

The Dendritic Rod Emits Blue Light

Chemists in Japan have synthesized a dendritic macromolecular rod that harvests light over a wide range of wavelength and converts it into blue light with high efficiency.

The rod consists of a right poly conjugated backbone wrapped with a flexible poly dendritic envelope. The backbone collects photons of visible light in the wavelength while the envelope collects photons of ultraviolet light and channels the energy to the backbone, which then fluoresces blue.

The work was carried out at the University of Tokyo by chemistry professor Takuzo Aida who says: «We have obtained a new blue luminescence quantum yield as high as 100 % over a wide range of concentration. The efficiency of the energy transfer from the light harvesting antennae at the dendritic envelope to the chromo phone units is also about 100 %». The research is an important step toward applications of dendrimers in optoelectronic devices.

Vocabulary

dendritic [den'drıtık] – древовидный, дендрический
conjugate ['kɔʤugət] – соединенный, сопряженный
wrap [ræp] – обертывать, сворачивать
photon ['fəutɔn] – фотон
fluoresce [flɔ:'res] – флуоресцировать
quantum ['kwɔntəm] – доля, часть
yield [ji:ld] – количество произведенного

Exercises

1. *Think over where this invention could be used.*

2. *Find the following words in dictionary; write out their transcriptions.*

To synthesize, to harvest, wavelength, to convert, efficiency, conjugated, flexible, photon, ultraviolet, fluoresce, yield.

3. a) *Explain what is the meaning of prefixes: poly-, macro-.*
b) *Make examples.*

4. *Find in the text words that sound like their Russian equivalents.*

5. *Explain the main idea of the text in one sentence.*

6. *If you were an author of this article would you name your article differently? What names of that text are also possible?*

7. *Make up five different types of questions on the text.*

Text 6

Read and translate.

A Revolution in Treating Disease

The American Chemical Society designated the discovery of penicillin as an International Historic Chemical Landmark at ceremony at St. Mary's Hospital, London.

In 1928 at that hospital Alexander Fleming discovered penicillin. This discovery let to the introduction of antibiotics that greatly reduced the number of deaths from infection.

Fleming discovered the antibiotic when he returned to his laboratory from avocation on September 3, 1928. He had been investigating Staphylococcus, bacteria, that cause infections such as boils and abscesses. He noticed that one of the dishes containing colonies of the bacteria was contaminated with a mold that had inhibited the growth of the bacteria.

Fleming initially called the contaminating substance «mold juice» and only later did he name it «penicillin» after the mold.

He published his discovery the following year. He wrote in the opening paragraph of the paper. While working with staphylococcal variants, a number of culture plates were set a side on the laboratory bench and examined from time to time. In the examinations, these plates were necessary exposed to the air and they became contaminated with various microorganisms. It was noticed that around a large colony at a contaminating mould, the staphylococcal colonies became transparent and were obviously undergoing lysis.

Vocabulary

investigate [ɪn'vestigeɪt] – исследовать
boil [bɔɪl] – нарыв, чирей
abscess ['æbsɪs] – абсцесс
mold [məuld] – плесень
inhibit [ɪn'hɪbɪt] – сдерживать, подавлять
contaminate [kən'tæmɪneɪt] – заражать
culture ['kʌlʧə] – культура, выращивание бактерий

Exercises

1. *Answer the following questions.*

1. What did the American Chemical Society designated as an International Historic Chemical Landmark? 2. When and where did Alexander Fleming discover penicillin? 3. What did this discovery let to the introduction? 4. Did he discover the antibiotic accidentally? 5. What was the first name of contaminating substance? 6. What did Flaming write about his discovery when published it?

2. *Put sentences into the right order.*

1. He had been investigating Staphylococcus, bacteria, that cause infections such as boils and abscesses. 2. He published his discovery the following year. 3. He noticed that one of the dishes containing colonies of the bacteria was contaminated with a mold that had inhibited the growth of the bacteria. 4. Fleming discovered the antibiotic when he returned to his laboratory from avocation on September 3, 1928. 5. The American Chemical Society designated the discovery of penicillin as an International Historic Chemical Landmark at ceremony at St. Mary's Hospital, London. 6. Fleming initially called the contaminating substance «mold juice» and only later did he name it «penicillin» after the mold.

3. *Find pairs of synonyms.*

designate	rite
let	come back
return	allow
following	restrain
antibiotic	development
ceremony	inserting
introduction	next
inhibit	denote
to name	penicillin
growth	to call

4. *Name as more as possible discoveries that are of great importance.*

Texts for additional reading and translation

The periodic table

In 1863 there were 56 known elements with a new element being discovered at a rate of approximately one per year.

Other scientists had previously identified periodicity of elements. John Newlands described a Law of Octaves, noting their periodicity according to relative atomic weight in 1864, publishing it in 1865. His proposal identified the potential for new elements such as germanium. The concept was criticized and his innovation was not recognised by the Society of Chemists until 1887.

Another person to propose a periodic table was Lothar Meyer, who published a paper in 1864 describing 28 elements classified by their valence, but with no prediction of new elements.

After becoming a teacher, Mendeleev wrote the definitive textbook of his time: Principles of Chemistry (two volumes, 1868 – 1870). As he attempted to classify the elements according to their chemical properties, he too noticed patterns that led him to postulate his periodic table. Mendeleev was unaware of the earlier work on periodic tables going on in the 1860s. He made the following table, and by adding additional elements following this pattern, developed his extended version of the periodic table.

On 6 March 1869, Mendeleev made a formal presentation to the Russian Chemical Society, entitled 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:

– the elements, if arranged according to their atomic weight, exhibit an apparent periodicity of properties;

– elements which are similar regarding their chemical properties have atomic weights which are either of nearly the same value (e. g., Pt, Ir, Os) or which increase regularly (e. g., K, Rb, Cs);

– 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;

– the elements which are the most widely diffused have small atomic weights;

– 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;

– 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;

– the atomic weight of an element may sometimes be amended by knowledge of those of its contiguous elements;

– 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. Only a few months after, Meyer published a virtually identical table.

They both constructed their tables in a similar manner by listing the elements in a row or column in order of atomic weight and starting a new row or column when the characteristics of the elements began to repeat. The success of Mendeleev's table came from two decisions he made: The first was to leave empty spaces in the table when it seemed that the corresponding element had not yet been discovered. Mendeleev was not the first chemist to do so, but he was the first to be recognized as using the trends in his periodic table to predict the properties of those missing elements, such as gallium and germanium.

The second decision was to ignore the order suggested by the atomic weights and switch adjacent elements, such as cobalt and nickel, to better classify them into chemical families. With the development of theories of atomic structure, it became apparent that Mendeleev had listed the elements in order of increasing atomic number.

There are many ways the Periodic Table can be used. The table can be used to find the atomic number. The atomic weight is also indicated in the table. The orbital arrangement of electrons is shown for each of the elements.

The common oxidation states are given. For most elements these numbers are the same as the valence numbers.

The table enables us to recognize families of elements. And at last the table can be used to predict the properties of the elements. The fact that the Periodic Table can assist in predicting properties of elements has helped in the discovery of missing elements.

Historical background of elements

One meet the idea of an element very early in our study of chemistry. The ancients suspected that there must be some very simple substances from which more complicated ones were built. At one time they thought that everything might be made up of earth, air and water; these got the name «element» which comes from the same word as «elementary» or simple.

This idea, though wrong, is still a rather important one. The first man to recognize the modern type of element was Robert Boyle in the middle of seventeenth century. His idea was that an element was just something which could not be broken down chemically into anything simpler. He knew of metals like iron, copper, tin, lead, gold and silver and non-metals like carbon and sulphur, all the gases being called «air». In the years since Boyle first defined an element in the modern sense over one hundred different ones have been defined. Some of these are rather common and well-known but quite a lot are man-made. Examples are mendeleyevium, nobelium and laurencium. One of the first distinctions between elements was the division into metals and nonmetals.

One may be able to devise other ways of distinguishing metals from nonmetals. We have seen that a dull-red mercuric oxide is decomposed into mercury and oxygen. The weights of oxygen and mercury obtained are together equal to the weight of mercuric oxide. Similarly, water is decomposed by electrolysis into oxygen and hydrogen. No chemist, however, has been able to separate any other substances from mercury, oxygen or hydrogen: these three substances are known, therefore, as elements. An element is a substance which, so far as is known, contains only one kind of atom. It has been found possible to resolve all known substances into about 117 elements: many of these elements are rare, and relatively few are common in nature.

Astronomers have found that the same elements which are common on Earth, e. g. nitrogen, carbon and hydrogen, are also the commonest in the Sun and other stars. Thus elements are the primary building materials of the Universe.

Questions on chemistry

What is an atom?

An atom is made up of a dense central nucleus that consists of positive protons and neutral neutrons bound together by an electromagnetic force. This nucleus is enveloped in a cloud of negatively charged electrons. When a group of atoms bind with each other they form a molecule.

Where do you find an atom?

All elements are made out of atoms. What's more all the atoms of an element are completely identical. However you should note that atoms of different elements are completely different. Atoms of different elements can come together to form compounds. What is interesting is when there is a chemical reaction, atoms are not made, destroyed or changed. You are always left with the same number of atoms that you had at the beginning of the reaction.

How much do they weigh?

You may wonder how heavy these building blocks weigh. An Italian chemist called Amadeo Avogadro did. While doing research on gases, Avogadro realised that it was possible to measure the ratio of the atomic masses.What this meant was that if he measured a litre of oxygen and found that it was 16 times more than that of hydrogen, then it could be assumed that the atomic mass of oxygen was 16 times more than hydrogen.

Based on atomic weight, and using carbon as a standard atomic weight a relative scale of elements could be created by Avogadro. Yet it was Dimitri Mendeleev, a Russian chemist who invented the first periodic table which lists out elements by increasing atomic mass.

What is the relation between the number of protons and the number of electrons in an atom?

All atoms are electrically neutral. Since protons are positively charged and electrons are negatively charged they must equal each other if the atom is to remain neutral.

Therefore, in any atom the number of protons must equal the number of electrons. Thus a hydrogen atom has one proton and one electron.

What is meant by the atomic weight of an element?

The number of protons in any atom equals the number of electrons in that atom. This number is used to identify an element and is called the atomic number of the element. For example, the atomic number of hydrogen, which has one proton, is 1. The atomic number of helium, which contains two protons, is 2, and so on.

Although all atoms have weight, the weights, in usual terms, are very, very small. Therefore, to avoid using minute quantities, numbers expressing the comparative weights of atoms are used. These numbers are called the atomic weights of elements. They are not actual weights of atoms but are comparisons of actual weights with the weight of the standard atom set at arbitrary number. Atomic weights were based on a standard which is 12 oC.

Can the same element have different atomic weights? Atoms of the same element often have different atomic weights. These differences are due to differences in the number of neutrons in their nuclei. When atoms of the same element have different weights they are called isotopes of the element. This difference in atomic weight does not change the chemical properties but it does have an effect upon the nuclear properties of the atom or its radioactivity.

Molecules

As an atom is the smallest part of an element, and as a compound must contain at least two elements, it follows that the smallest part of a compound that can exist must contain at least two different atoms. This is called a molecule. Although the atoms of elements take part in chemical reactions, they very often do not normally exist as single atoms when they are free. The atoms of such gases as oxygen, hydrogen, nitrogen and chlorine may be considered as very friendly ones, as they almost always occur in pairs, each pair forming a molecule, the smallest particle able to exist alone. On the other hand, the atoms of such gases as argon, helium and neon seem to prefer to remain alone. As the molecules of these gases contain only one atom, they are said to be monoatomic in contrast to the former which are diatomic.

Some compounds are so complex that a single molecule may contain several hundreds of atoms and be quite large in comparison with a molecule of hydrogen, the smallest of all. It is possible to take photographs showing the way in which such large molecules are made up by means of a special type of microscope called an electron microscope, but these molecules are still too small to be seen through the most powerful of optical microscopes.

The theories of periodic table

During the nineteenth century, many chemists tried to arrange the elements in an order which related to the size of their atoms and also showed regular repeating patterns in their behaviour or properties. The most successful attempt was published by the Russian, Dimitri Mendeleev, in 1869, and still forms the basis of the modern periodic table.

Periodic table

Both the physical properties and chemical properties of an element and its compounds are related to the position of the element in the periodic table. This relationship has led to the table being divided into groups and periods. The arrangement of the elements starts on the left of period 1 with hydrogen and moves in order of increasing atomic number from left to right across each period in turn.

Period is a horizontal row of elements in the periodic table. There are seven periods in all. Period 1 has only two elements – hydrogen and helium. Periods 2 and 3 each contain eight elements and are called the short periods. Periods 4, 5, 6 and 7 each contain between 18 and 32 elements. They are called the long periods. Moving from left to right across a period, the atomic number increases by one from one element to the next. Each successive element has one more electron in the outer shell of its atoms. All elements in the same period have the same number of shells, and the regular change in the number of electrons from one element to the next leads to a fairly regular pattern of change in the chemical properties of the elements across a period.

Atomic structure

Matter is composed of tiny particles called atoms. The atom is a complex unit of various particles, the most important of which are electrons, protons, and neutrons. These particles have different properties. Electrons are tiny, very light particles that have a negative electrical charge (-). Protons are much larger and heavier than electrons and have the opposite charge, protons have a positive charge. Neutrons are large and heavy like protons, however neutrons have no electrical charge. Each atom is made up of a combination of these particles.

The difference between atoms of different elements are due to1 differences in the number of protons and neutrons in the nucleus and to differences in the arrangement of the electrons surrounding the nucleus. The mass of the atom is concentrated almost entirely in the nucleus.

The chemical properties of different elements can be explained by the structure of the atom. Chemical changes involve a shifting of outer (valence) electrons so that a shell is achieved. The activity of metals and non-metals is related to the size of the atom and to the number of electrons in the external orbit.

The valence or combining capacity of an atom is determined by the number of electrons it gains, loses or shares in chemical combinations with atoms of other elements. Atoms also may be joined to other atoms by sharing pairs of electrons. This process produces covalent compounds. These are generally gases or liquids with low boiling points. Oxidation involves the loss of electrons by the element. The process is accompanied by an algebraic increase 2 in valence. Reduction, on the other hand, 3 involves a gain of electrons by the substance reduced. This process is accompanied by an algebraic decrease in valence.

Silicon

The element silicon is second to oxygen in abundance in the crust of the earth, of which it constitutes about 28 per cent. It never occurs free, but only in combination with oxygen or with oxygen and metals in the silicate minerals, which compose most of the earth's crust.

Quartz is a crystalline form of silicon dioxide, SiO_2, commonly called silica. On forming by slow deposition from solution in water during centuries, it is crystallized. At other times the silica by separating from solution as a colourless gel is gradually dried and compacted into flint. Flint is found in clay beds in all parts of the world.

Living organisms sometimes employ calcium carbonate and sometimes silica as a skeleton or supporting structure. Silica is plentiful, too, in most grasses and cereals. The fibers of bamboo have much silica, and the feathers of certain birds may have about 40 percent silica. Even the human body contains minute amounts of silica.

Dmitri Mendeleev

Born: 8 February 1834, Verkhnie Aremzyani, Russian Empire.

Died: 2 February 1907 (aged 72), St. Petersburg, Russian Empire.

Nationality: Russian.

Fields: chemistry, physics and adjacent fields.

Alma mater: Saint Petersburg University.

Notable students: Dmitri Petrovich Konovalov, Valery Gemilian, Alexander Baykov.

Known for: inventing the Periodic table of chemical elements.

Dmitri Ivanovich Mendeleev was a Russian chemist and inventor. He created the first version of the periodic table of elements. Using the table, he predicted the properties of elements yet to be discovered. 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 hydro-dynamics, 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 transformed Saint Petersburg into an internationally recognized center for chemistry research. Mendeleev worked on the theory and practice of protectionist trade and on agriculture. Also he is given credit for the introduction of the metric system to the Russian Empire.

Though Mendeleev was widely honored by scientific organizations all over Europe, he resigned from Saint Petersburg University on 17 August 1890. 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. However, he was not awarded it because of the argument that the periodic system was too old to acknowledge its discovery in 1906. In 1907, Mendeleev died at the age of 72 in Saint Petersburg from influenza.

Commemoration

A number of places and objects are associated with the name and achievements of Dmitri Mendeleev. In Saint Petersburg his name was given to the National Metrology Institute dealing with establishing and supporting national and worldwide standards for precise measurements. In the Twelve Collegia building, now being the centre of Saint Petersburg State University and in Mendeleev's time – Head Pedagogical Institute – there is Dmitri Mendeleev's Memorial Museum Apartment with his archives. The street in front of these is named after him as Mendeleevskaya liniya (Mendeleev Line).

In Moscow there is D. Mendeleyev University of Chemical Technology of Russia. After him was also named mendelevium, which is a synthetic chemical element with the symbol Md (formerly Mv) and the atomic number 101. It is a metallic radioactive transuranic element in the actinide series, usually synthesized by bombarding einsteinium with alpha particles.

A large lunar impact crater Mendeleev that is located on the far side of the Moon, as seen from the Earth, also bears the name of the scientist. Russian Academy of Sciences yearly awards since 1998 Mendeleev Golden Medal (originally started by USSR Academy of Sciences in 1962) for achievements in chemical science and technology.

Mendeleev university of chemical technology of Russia

In 1898 Moscow Industrial School was founded. It was a new type of an educational institution at that time. In 1902, when the construction of the specially designed building was completed, the Industrial School moved to Miusskaya Square. The Mendeleev Institute was founded in 1920 on the basis of Moscow Industrial School. Since that time it has grown into a famous university. There are 13 faculties and several colleges: Higher College of Chemical Engineering, Russian Academy of Science Higher Chemical

College and International Higher College of Information Computer Systems. About 6000 students (including foreign) and 400 postgraduates and trainees are studying at the Mendeleev University now. Its graduates are outstanding scientists, politicians, leaders of research centres and industrial enterprises, famous businessmen, showmen and bankers.

A lot of Members and Associate Members of the Russian Academy of Science, professors work at the Mendeleev University. It is acknowledged as an international centre of chemistry and chemical technology. Its main recent scientific developments are new environmentally safe chemical processes, composite and engineering materials based on polymers and silicates and materials applicable in various branches of science and industry.

Major courses are:

– Chemical Technology of Carbonaceous Materials;
– Chemical Technology of plastics;
– Chemistry and Technology of Polymeric Film-Forming Materials;
– Petrochemical Synthesis;
– Chemical Technology of Organic Dyes;
– Chemical Technology of Ceramics and Refractories;
– Chemical Technology of Glass and Glassceramics;
– Technology of Inorganic Substances;
– Technology of Electrochemical Productions;
– Chemical Physics and Technology of Nitrogen Compounds;
– Chemistry and Technology of Macromolecular Compounds;
– Chemistry and Technology of Organic Synthesis;
– Technology of Isotopes and Pure Substances;
– Radioecology and Chemistry of High Energy;
– Technology of Rare and Dispersed Elements;
– Chemical Technology of Materials for Quantum;
– Electronics and Electronic Devices;
– Cybernetics of Chemical Processes;
– Production Automatics;
– Computer Systems in Chemistry and Chemical Technology;
– Industrial Ecology;
– Technology of Biosphere Protection;
– Industrial Biotechnology;
– Material Technology and Production Engineering of New Materials;
– Membrane Technology;
– Chemistry Teaching;
– Marketing;
– Management;
– Sociology.

Scientific work in Mendeleev University of Chemical Technology of Russia

The research carried out in Mendeleev University of Chemical Technology of Russia (MUCTR) involves just about all branches of chemistry, chemical technology, biotechnology, as well as a lot of divisions of knowledge having nothing with chemistry. One of the priority lines is energy resource saving and chemical technology safety.

Creating inorganic materials of the new generation is given priority as well. The scientists of Mendeleev University develop modern technologies of construction materials. One of them is synthetic granite sygran. It is highly competitive with the natural materials in its mechanical properties. Glass ceramics are used for decorating in constructing. The scientists were awarded the State Prize for advances in making the materials.

The research works in the field of making materials for nuclear energy industry have been carried out in the University since 1949. The first work in this direction includes that of academicians Kurchatov and Zhavoronkov.

Nowadays the scientists of the University keep on dealing with the problems of nuclear power engineering safety. The achievements in the field of rare-earth and dissimilar metals are particularly concerned with rhenium, zirconium, and hafnium.

The scope of zirconium application is wide enough. It is used in the power engineering for making fuel elements of nuclear power plants and for making modern kinds of ceramics. It is going to be applied in making ceramics for cylinders of internal-combustion engines as well as for making jewellery finets.

More than 300 textbooks have been published. Mendeleev University carries out research works under the programs designed in the Department of education of the Russian Federation. MUCTR has been assigned to be at the head of the major Chemical Technologies program.

The scientists of Mendeleev University solve the problems of removing organic and inorganic compounds and heavy metal components from wastewater. They also solve the questions of nuclear power plant sewage purification and water treatment for thermoelectric power stations as well as drinking water purification. Advantages of the method are evident. Power inputs are the lowest, chemical reagents are not used in this case. It makes possible to reuse the purified water. The wastewater purification techniques have been applied in more than 60 Russian and foreign enterprises.

Mendeleev University of Chemical Technology of Russia has been directing the work of chemistry and applied chemistry Head Council attached to Ministry of Education of Russia. It involves 101 universities from all regions of our country. Conferences on an exchange of experience, seminars of young scientists take place regularly. There are joint publications. Head Council is a coordinator of the fundamental research work of the University.

More than 15 research schools of scientists being up to world standard work in MUCTR to date. Among them there are: theory of chemistry; theory of applied chemistry; inorganic materials of new generation; polymeric materials; new industrial processes and devices for environmental protection; inorganic substances and electrochemical processes; organic substance synthesis; materials for nuclear power engineering; energy-saturated materials and goods.

Priority lines of research work at the university: Energy and resource-saving technologies; Inorganic materials of the new generation; Chemistry and technology of Polymers; Varnishes and paints, film-forming materials; Composite and structural materials; Petrochemistry and oil refining; Membrane technologies; Materials and technologies for atomic industry; Construction materials, finishing and decorative materials; Materials for medicine and health protection; Biotechnology; environmental protection; Nanotechnologies; Technology of inorganic substances and electrochemical changes; Energy saturated materials and compositions; Materials for electronic engineering; Sustainable development problems; Industrial safety; Information technologies.

What is chemistry?

Chemistry is the study and manipulation of molecules or matter, its structure, properties, and composition, and the changes that matter undergoes.

Chemists routinely create new matter that finds applications in computing, nanotechnology, biotechnology, drug discovery, biology and medicine.

Chemists are environmentally friendly, working to find new sources of energy and to minimize waste. For decades chemists have been finding applications for renewable matter which is important because oil is not an infinite re-source. They are contributing to a new area – Chemical Biology – which is the study of the chemistry of life and medicine. It is envisaged that this area will lead to the next generation of medicines. Chemistry provides an important part of the solution to needs in society and can provide opportunities and the knowledge for economic development. There is a need for the broadly educated chemist who can work on the core topics as well as those who can work and communicate with biologists, physicists, clinicians and engineers.

The science of chemistry is of prime importance to nanotechnology, biotechnology, drug discovery, the environment, energy, biology and medicine. The work of chemists is all about you. The toothpaste you use in the morning is the work of chemists. Chemists had much to do with the clothing you wear. They may have made the fiber or created the dye that gives it color. From the test tubes of chemists have come modern medicines and many kinds of vitamins. It is the chemist who deserves thanks for many of the materials you find in your home, at school, and in cars, buses, planes, and trains.

Chemistry disciplines

There is a vast literature on chemistry. It covers their structure, how they combine to create other substances and how they react under various conditions, etc. Chemistry is divided into a lot of sections. There are more than thirty branches (disciplines) of chemistry today. The areas are covered by these sections are explained below.

General chemistry examines the structure of matter and the reaction between matter and energy. It is the basis for the other branches of chemistry.

Physical chemistry covers the structures, properties and behavior of substances, includes the basic laws of chemistry.

Inorganic chemistry looks at the groups of elements in the periodic table, their properties, uses and compounds (excepting carbon compounds).

Organic chemistry covers the carbon-chain compounds, examines their structures and various groups into which they fall. This branch of chemistry deals with the chemistry of carbon and living things.

Environmental chemistry explains the interaction of naturally occurring chemicals, and the effect of pollution. General chemistry information is a section of charts and tables of properties, symbols and means of identification, plus information on apparatus, preparations, tests and forms of chemical analysis.

Agrochemistry. This branch of chemistry may also be called agricultural chemistry. It deals with the application of chemistry for agricultural production, food processing, and environmental remediation as a result of agriculture.

Analytical chemistry. Analytical chemistry is the branch of chemistry involved with studying the properties of materials or developing tools to analyze materials.

Astrochemistry. Astrochemistry is the study of the composition and reactions of the chemical elements and molecules found in the stars and in space and of the interactions between this matter and radiation.

Biochemistry. Biochemistry is the branch of chemistry concerned with the chemical reactions that occur inside living organisms.

Chemical engineering. Chemical engineering involves the practical application of chemistry to solve problems.

Chemistry history. Chemistry history is the branch of chemistry and history that traces the evolution over time of chemistry as a science. To some extent, alchemy is included as a topic of chemistry history.

Cluster chemistry. This branch of chemistry involves the study of clusters of bound atoms, intermediate in size between single molecules and bulk solids.

Combinatorial chemistry. Combinatorial chemistry involves computer simulation of molecules and reactions between molecules.

Electrochemistry. Electrochemistry is the branch of chemistry that involves the study of chemical reactions in a solution at the interface between an ionic conductor and an electrical conductor. Electrochemistry may be considered to be the study of electron transfer, particularly within an electrolytic solution.

Food Chemistry. Food chemistry is the branch of chemistry associated with the chemical processes of all aspects of food. Many aspects of food chemistry rely on biochemistry, but it incorporates other disciplines as well.

Geochemistry. Geochemistry is the study of chemical composition and chemical processes associated with the Earth and other planets.

Green Chemistry. Green chemistry is concerned with processes and products that eliminate or reduce the use or release of hazardous substances. Remediation may be considered part of green chemistry.

Kinetics. Kinetics examines the rate at which chemical reactions occur and the factors that affect the rate of chemical processes.

Pharmaceutical (Medicinal) Chemistry – Pharmaceutical chemistry is chemistry as it applies to pharmacology and medicine.

Nanochemistry. Nanochemistry is concerned with the assembly and properties of nanoscale assemblies of atoms or molecules.

Nuclear Chemistry. Nuclear chemistry is the branch of chemistry associated with nuclear reactions and isotopes.

Photochemistry. Photochemistry is the branch of chemistry concerned with interactions between light and matter.

Polymer Chemistry. Polymer chemistry or acromolecular chemistry is the branch of chemistry the examines the structure and properties of macromolecules and polymers and finds new ways to synthesize these molecules.

Solid State Chemistry. Solid state chemistry is the branch of chemistry that is focused on the structure, properties, and chemical processes that occur in the solid phase. Much of solid state chemistry deals with the synthesis and characterization of new solid state materials.

Thermochemistry. Thermochemistry may be considered a type of Physical Chemistry. Thermochemistry involves the study of thermal effects of chemical reactions and the thermal energy exchange between processes.

Theoretical Chemistry. Theoretical chemistry applies chemistry and physics calculations to explain or make predictions about chemical phenomena.

Materials Science and Technology, the study of materials, nonmetallic as well as metallic, and how they can be adapted and fabricated to meet the needs of modern technology. Using the laboratory techniques and research tools of physics, chemistry, and metallurgy, scientists are finding new ways of using plastics, ceramics, and other nonmetals in applications formerly reserved for metals.

General chemistry. General chemistry examines the structure of matter and the reaction between matter and energy. General chemistry is the science of matter, especially its chemical reactions, but also its composition, structure and properties.

Chemistry is concerned with atoms and their interactions with other atoms, and particularly with the properties of chemical bonds. It is the basis for the other branches of chemistry. Chemistry studies experimentally and theoretically the composition of matter and the changes that take place in matter. A chemical change involves changes in composition and in properties. A physical change involves only changes in properties with no change in composition.

Chemical changes are usually accompanied by the liberation or the absorption of energy in the form of light, heat or electricity. All forms of matter consist of either pure substances or mixtures of two or more pure substances.

Elements are the building blocks of matter. Compounds are combinations of elements. Most of the elements are metals and most of them will unite with other elements and form compounds. The formation of a compound from simpler substances is known as synthesis. Analysis is the process of breaking down a compound into simpler substances or its elements and thus is the determination of its composition. The composition of a pure substance never changes.

Every substance has physical and chemical properties. Physical properties include colour, smell, solubility, density, hardness and boiling and melting points. Chemical properties include the behaviour with other materials. Matter exists in three states: the solid, the liquid and the gaseous state. A substance can be transformed from one state to another under the changes of its temperature.

Organic chemistry. Organic chemistry is that branch of chemistry that deals with the structure, properties, and reactions of compounds that contain carbon. It is a highly creative science. Organic chemists can create new molecules never before proposed which, if carefully designed, may have important properties for the betterment of the human experience. Organic chemistry is the largest chemistry discipline. Beyond our bodies' DNA, peptides, proteins, and enzymes, organic compounds are all around us. They are central to the economic growth of the U.S., in industries such as the rubber, plastics, fuel, pharmaceutical, cosmetics, detergent, coatings, dyestuffs, and agrichemicals industries. The very foundations of biochemistry, biotechnology, and medicine are built on organic compounds and their role in life processes. Most of all the modern, high tech materials are composed, at least in part, of organic compounds. Clearly, organic chemistry is critically important to our high standard of living.

Organic chemists at all degree levels are found in all those industries, working on projects from fundamental discovery to highly applied product development. The foundation of the pharmaceutical industry is the large pool of highly skilled organic chemists. For example, nature may provide a molecule such as a complex antibiotic, an antitumor agent, or a replacement for a hormone such as insulin; organic chemists determine the structure of this newly discovered molecule and then modify it to enhance the desired activity and specificity of action, while decreasing undesired side effects. Indeed, organic chemists have produced a wonderful myriad of highly successful products to fight human diseases.

There is tremendous excitement and challenge in synthesizing a molecule never before made synthetically or found in nature. Tailoring the properties of that molecule via chemical synthesis to produce beneficial effects to meet the needs of the present and future human existence is both challenging and rewarding.

Biochemistry. Biochemistry is the science of the molecular basis of life. It involves the study of the rich variety of molecules found in living cells and organisms. The objective of biochemistry is to understand how these molecules work by observing how they operate and interact. The scope of biochemistry is as wide as life itself. Biochemists study the molecular processes going on in all types of organisms from bacteria to plants, and from yeasts to fish, birds and animals. The exciting revolting underway with the sequencing of the human and other genomes, along with many new nano-scale technologies, is allowing biochemists to study life in ever more detail.

This new insight into life is rapidly advancing our understanding of the molecular choreography underlying growth and development. It also provides new openings for applying our knowledge of the molecules of life in the diagnosis and treatment of many diseases. Graduates in biochemistry find jobs in the biotechnology and pharmaceutical industries, biomedical laboratories, the agribusiness sector, scientific policy making, and also go on to further research for Masters and PhD degrees, or other postgraduate qualifications.

Inorganic chemistry. Inorganic chemistry is the study of the synthesis and behavior of inorganic and organometallic compounds. This field covers all chemical compounds except the myriad organic compounds (carbon based compounds, usually containing C-H bonds), which are the subjects of organic chemistry.

The distinction between the two disciplines is far from absolute, most importantly in the sub-discipline of organometallic chemistry. It has applications in every aspect of the chemical industry including catalysis, materials science, pigments, surfactants, coatings, medicine, fuel, and agriculture. Many inorganic compounds are ionic compounds, consisting of cations and anions joined by ionic bonding. Important classes of inorganic salts are the oxides, the carbonates, the sulfates and the halides. Many inorganic compounds are characterized by high melting points. Inorganic salts typically are poor conductors in the solid state. Other important features include their solubility in water ease of crystallization. Where some salts (e. g., NaCl) are very soluble in water, others (e. g., SiO2) are not.

The simplest inorganic reaction is double displacement when in mixing of two salts the ions are swapped without a change in oxidation state. When one reactant contains hydrogen atoms, a reaction can take place by exchanging protons in acid-base chemistry. Inorganic compounds are found in nature as minerals. Soil may contain iron sulfide as pyrite or calcium sulfate as gypsum. The first important man-made inorganic compound was ammonium nitrate for soil fertilization.

Subdivisions of inorganic chemistry are organometallic chemistry, cluster chemistry and bioinorganic chemistry. These fields are active areas of research in inorganic chemistry, aimed toward new catalysts, superconductors, and therapies.

Modern rules

The International Union of Pure and Applied Chemistry (IUPAC) main responsibility is to decide how chemicals are to be named, and also to assign credit to the chemists who found them first. It publishes them in books, coded by colour.

The Gold Book is for all the jargon that chemists use. The Green Book is about symbols and units of measurement. The Red Book is for elements and inorganic compounds. The Blue Book is for organic chemicals like benzene and alcohol.

IUPAC also puts together books that all chemists need as reference material, like lists of melting points, solubility of different things in water, standard methods for doing experiments and a lot more. Many of these books take a lot of hard work over many years.

Chemistry and matter

Science plays such an important part in the modern world that no one can now feel that he understands the world in which he lives unless he has an understanding of science. The science of chemistry deals with substances. At this point in the study of chemistry we shall not define the word substance in its scientific sense, but shall assume that you have a general idea of what the word means. Common examples of substances are water, sugar, salt, copper, iron oxygen – you can think of many others.

Nearly two centuries ago it was discovered by an English chemist, Sir Humphry Davy (1778–1827), that common salt can be separated, by passing electricity through it, into a soft, silvery metal, to which he gave the name sodium, and a greenish-yellow gas, which had been discovered some time earlier, and named chlorine. Chlorine is a corrosive gas, which attacks many metals, and irritates the mucous membranes of the nose and throat if inhaled. The discovery that the properties of common salt are quite different from those of sodium or chlorine is one of the many surprising facts about the nature of substances that chemists have found out.

A sodium wire will burn in chlorine, producing salt, the process of combination of sodium and chlorine to form salt being called a chemical reaction. When a mixture of gasoline and air explodes in the cylinders of an automobile a chemical reaction takes place, and at the same time the energy is released to move the automobile. Both carbon dioxide and carbon monoxide are compounds of carbon and oxygen, and water being a compound of hydrogen and oxygen.

Chemists study substances to learn as much as they can about their properties (their characteristic qualities) and about the reactions that change them into other substances. Knowledge obtained in this way has been found to be extremely valuable. Since some substances (like morphine and cocaine), may have undesirable properties along with the positive ones, we should test such substances for their powers of deadening pain and of producing addiction very thoroughly.

In the beginning, some methods carried out in laboratories were really dangerous, e. g. a young investigator, H. Davy tested many gases on himself by inhaling them. He discovered that one gas (named laughing gas), produced a state of hysteria when inhaled, and that people seemed not to suffer pain when they fell down or bumped into an object. It is rather surprising, but that gas was not suggested to be used in surgical operations right after its discovery. No one seems to have had this idea, and the use of anesthetics was delayed for nearly half a century. Then another investigator in the United States noticed that the chemical substance ether, when inhaled, produces unconsciousness, and another one noticed the same effect with chloroform. These substances were soon brought into general use. The discovery of anesthesia was a great discovery, not only because it relieves pain, but also because it permits delicate surgical operations to be carried out that would be impossible if the patients remained conscious. No doubt that the twentieth century may be called the chemical age.

Chemical and physical changes

Chemical change is a change that takes place in a substance, during which it breaks up into simpler substances or it combines with other substances to make a new one with different properties or characteristics. For example, mercuric oxide may be changed to mercury and oxygen by heating it; the burning of wood is an example of a chemical change in which the elements carbon and oxygen are combined to form the gas, carbon dioxide.

A physical change is one in which the identifying characteristics or properties of the substance are not changed, although a change in form or state may occur. The melting of ice, the breaking of glass, or the dissolving of sugar in water are examples of physical changes.

In a chemical change where there is a chemical reaction, a new substance is formed and energy is either given off or absorbed. For example, if a piece of paper is cut up into small pieces it still is paper. This would be a physical change in the shape and size of the paper. If the same piece of paper is burned, it is broken up into different substances that are not paper. Physical changes can be reversed; chemical changes cannot be reversed with the substance changed back without extraordinary means, if at all. For example, a cup of water can be frozen when cooled and then can be returned to a liquid form when heated.

The 1860 conference

The 19th century was a time when there was a new chemical discovery almost every day. Sometimes, the same chemical would be found in labs in different countries, and get different names. For example, what was called phenol in Europe was called carbolic acid in England; the word alcohol may refer to a class of compounds or just ethyl alcohol. Is the chemical with symbol S spelt sulphur or sulfur? Because of this, it was decided that a committee of eminent chemists would help create some rules for giving chemicals their names.

The committee was headed by August Kekule, and called for a conference in 1860. They also decided to form a permanent association of chemists, where they could discuss all issues, not just names.

Geneva rules

In 1892, the first set of rules was finally agreed upon. They were adopted at Geneva, the venue for the meeting of the International Union of Chemistry. As more and more chemicals were being discovered (there are more than 50 million now), these Geneva Rules were not enough.

In 1911, chemists from around the world formed the International Association of Chemical Societies (IACS) at a meeting in Paris. This became the International Union of Pure and Applied Chemistry (IUPAC) in 1919.

Science and scientific methods

Scientists search for facts about the world around them. They try to find logical explanations for what they observe. For some scientists, discovery and explanation are ends in themselves. The work of these scientists is called pure science. Pure science is the search for a better understanding of our physical and natural world for its own sake. Pure scientists are not concerned with finding uses for their discoveries. Pure scientists get satisfaction from simply knowing why things are as they are and why they happen as they do. Most of us have some of this type of curiosity. The study of science can give you the satisfaction that comes with understanding. Science also has a practical side, called applied science. Applied science, or technology, is the practical application of scientific discoveries.

Applied scientists put scientific discoveries to work. The technology produced by applied scientists has made possible the current state of our civilization. As a result of technology, many people today have easier lives and live longer. But technology has been a mixed blessing. At the very time that it has solved some of our problems, it has created others. It has given us faster and more comfortable ways to travel but has led to the atmospheric pollution caused by the burning of gasoline. Most of the problems created by technology have arisen as side effects of otherwise beneficial technology. The goal of scientists is to achieve only beneficial results from their work. Therefore, much time, energy, and money is being spent to find ways to decrease or eliminate the harmful side effects without lowering the high standard of living that technology has made possible.

The Scientific Method

The way in which a scientist goes about solving a problem is called the scientific method. Although the scientific method varies in some details from one branch of science to another, certain steps are common to all science, including chemistry. These steps are: *Stating a problem*. In any scientific investigation, it is necessary to know just what you are trying to find out. Often, the problem can be stated in the form of a question.

Collecting observations. Someone investigating a scientific problem begins by setting up experiments. Experiments are carefully devised plans and procedures that enable researchers to make observations and gather facts that shed light on a problem.

Searching for scientific laws. Many scientists carry out experiments. They collect much data. By studying these data, scientists are able to state a scientific law. A scientific law states a relationship between observed facts. It often takes a mathematical form. Scientific laws describe natural events but do not explain them.

Forming hypotheses. A scientist tries to find out why things obey an observed law. Often, the scientist will make an educated guess (a tentative explanation) about the reasons for the law. For example, the scientist may suggest that heat is an invisible fluid. When a gas is heated, the heat fluid enters the gas, thus causing it to take up more space. Such an educated guess, based on observed facts, is called a hypothesis.

Forming theories. Scientific observations and laws are like the pieces in a jigsaw puzzle. When enough pieces have fallen into place, a meaningful pattern emerges. This pattern is a theory. A theory provides a general explanation for the observations made by many scientists working in different areas of research over a long period of time. A theory shows a relationship between observations that at first seemed totally unrelated. A theory, therefore, unifies many pieces of information to produce a grand design.

Modifying theories. A theory can never be established beyond all about. There is always the chance that someone will make a new observation or discover a new law that the theory should be able to explain but cannot. When this happens, it might be possible to modify the theory to fit the new facts.

Properties of Plastics as a Construction Material.

Each plastic material has its own peculiar properties to suit its particular uses. The success of plastic as an engineering material will depends up on the selection of variety of plastic. Following are the general properties of plastic.

1. *Appearance of Plastics.* In the market there are so many types of models of plastics are available such as transparent, colored etc. suitable pigments are added in the process of manufacturing of plastic material to get these different properties. So, these will give good appearance to the structure and makes it attractive.

2. *Chemical Resistance of Plastics.* Plastics offer great resistance against chemicals and solvents. Chemical composition of plastics during manufacturing will decide the degree of chemical resistance. Most of the plastics available in the market offer great corrosion resistance. So, corrosive metals are replaced by plastic in the case of water carrying pipes, etc.

3. *Dimensional Stability.* Thermo-plastic types of plastics can be easily reshaped and reused. But in the case of thermo-setting type plastics, it is not possible to reshape or remold the material.

4. *Ductility of Plastics.* Ductile nature of plastic is very low. When tensile stress are acting on plastic member they may fail without any prior indication.

5. *Durability of Plastics.* Plastics with sufficient surface hardness are having good durability. Sometimes, plastics may affected by termites and rodents especially in the case of thermo-plastic types, however it is not a serious problem because of no nutrition values in plastic.

6. *Electric Insulation.* Plastics are good electric insulators. So they are used as linings for electric cables and for electronics tools.

7. *Finishing.* Any type of finishing treatment van be given to the plastics. Mass production of plastic particles with uniformity of surface finish is done by having technical control during manufacturing.

8. Fire Resistance. The resistance to temperature or fire for varieties of plastics considerably varies depending upon the structure. Plastics made of cellulose acetate are burnt slowly. PVC made plastics do not catch fire easily. Plastics made of phenol formaldehyde and urea formaldehyde are fire proof materials.

9. *Fixing.* Fixing of plastic materials is so easy. We can bolt, drill or glued to fix plastic material position.

10. *Humidity.* The plastics made up of cellulosic materials are affected by the presence of moisture. The plastics made of poly vinyl chloride (PVC pipes) offers great resistance against moisture.

11. *Maintenance.* Maintaining of plastics are so simple. Because they do not need any surface finishing coats or paints etc.

12. *Melting Point.* Generally plastics have very low melting point. Some plastics may melt at just 50 oC. So, they cannot be used in the positions of high temperature. Thermo setting type of plastics are having high melting point than thermo plastic type plastics. However, thermo setting types are cannot used for recycling. To improve the heat resistance of the plastics, glass fiber reinforcement is provided in its structure.

13. *Optical Property.* There are so many types of plastics. Some plastics are transparent which allows light in its original direction and some are translucent nothing but semi-transparent which allows light but changes light rays direction.

14. *Recycling of Plastics.* Disposal of plastics in the environment causes severe pollution. But it is not a serious problem because of its recycling property. We can use plastic waste disposal conveniently to produce drainage pipes, fencing, hand rails, carpets, benches etc.

15. *Sound Absorption.* By the saturation of phenolic resins we can produce acoustic boards. These acoustic boards are sound absorbents and provide sound insulation. Generally for theatres, seminar halls this type of acoustic ceilings are used.

16. *Strength.* Practically we can say that plastic is strong material but ideal section of plastic which is useful for structural component is not designed yet. Generally by reinforcing fibrous material into plastic improves its strength. If the strength to weight ratio of plastic is same as metals, then also we cannot give preference to plastics because of various reasons like, heavy cost, creep failure may occur, poor stiffness and sensitive against temperature.

17. *Thermal Property.* The thermal conductivity of plastics is very low and is similar to wood. So, foamed and expanded plastics are used as thermal insulators.

18. *Weather Resistance.* Most of the plastics except some limited varieties are capable of resistance against weathering. But, major problem is plastics when the plastics are exposed to sunlight, they are seriously affected by ultra violet rays and gets brittle. To prevent this, plastics are incorporated by fillers and pigments which helps to absorb or reflect the UV rays to surface.

19. *Weight of Plastics.* The Plastics have low specific gravity generally ranges from 1.3 to 1.4. So they are light in weight and easily transportable to any place in a large quantity.

Uses of Plastics in Building Construction

Plastics are manufactured in different forms such as moulding pipes, sheets and films. They are formed or expanded to produce materials of low density. Dissolved in solvents or dispersed as emulsions, they are used in paints, varnishes and adhesives. At present, plastics find use in buildings mainly in thin coverings, panels, sheets, foams, pipes etc. Skilful use of plastics will expand the usefulness and life of conventional building materials and help them to function more efficiently and economically.

Controlled experiments

When scientists do an experiment, they set up a situation in which they can control certain factors, or variables. A variable is something whose value can be made to change. For example, when you are driving a car, your speed is a variable. You can go faster or slower by depressing the accelerator or letting up on it. During a controlled experiment, scientists change the variables one at a time, and after each variable is changed, note what effect that particular variable is having on the results of the experiment. The results of an experiment, which often include a collection of measurements, are called observations, or data.

Sample problem. You turn on the switch to an electric lamp, but the light does not go on. Conduct a controlled experiment to determine why.

Solution. As a start to solving this problem, you should form a mental list of what factors might be causing it. Some possible causes are:

– the light bulb is burned out;

– the switch is warn out;

– the electric circuit that supplies electricity to the lamp is not working.

Perhaps the circuit was overloaded, and the fuse blew out or the circuit breaker tripped, one of the wires in the lamp cord broke. This could happen either in the plug, in the lamp, or somewhere between them. In effect, the possible causes are hypotheses, they being educated guesses concerning why the lamp does not work. Now for the experiment itself. For it to be a controlled experiment, you should test one possible cause at a time. To make it easier, you should first test the possible cause that is easiest to test. Proceeding on this basis, you can turn on another lamp to see whether the bulb in that lamp works. If it does, you then can replace the bulb in the lamp that is not working with the good bulb. If the light still does not go on, you can test the other possible causes.

Practice problem. As the head chef of a company that sells baked goods, you baked a cake according to the recipe, but you did not like the texture of the cake. You decided to try again, and as a second attempt, you used less flour and one more egg than the recipe called for, which produced a better cake. Explain why your second attempt was or was not a controlled experiment. If you were to make a third attempt, how would you proceed?

False theories

Only in 17th century chemists began to base their conclusions on precise experiments. Robert Boyle (1627–1691) was the first to apply a new method of investigation based on the generalization of experimental data and the laws of nature. Robert Boyle thought that the task of the chemist is to perform experiments, accumulate observations, and not to put forth a theory without a thorough investigation. Boyle‘s theoretical works, and especially his method of investigation influenced the progress of chemistry. However, it took chemistry another 100 years to free itself from the wrong conception of matter. This period is marked by the reign in chemistry so-called phlogiston theory founded towards the end of the 17th century by the German chemist Stahl.

The phlogiston theory owed its origin to the need to explain the combustion, oxidation and reduction of metals. Chemists were greatly interested in these processes in connection with the progress of metallurgy during the 17th century. According to Stahl‘s theory, all combustible substances, including metals, contained a common inflammable principle or materia ignea, which he called phlogiston. When combustible substances were burned, or metals calcined, the phlogiston volatilized, leaving an earthy residue – calx.

Hence, combustion was the decomposition of a substance into phlogiston and an earthy residue. For example: zinc = phlogiston + zinc calx.

Substances such as coal, which left a very small earthy residue upon combustion, were considered to be almost pure phlogiston.

The phlogiston theory was universally recognized for a long time. However, like any other false theory, it retarded the progress of chemistry. Chemistry was freed from the phlogiston theory in the latter half of the 18th century as a result of the precise methods of investigation introduced by the Russian scientist Mikhail Lomonosov (1711–1765). Lomonosov laid the foundation to the development of the chemical science and to the modern atomic theory.

Forming and modifying theories

A scientist tries to find out why things obey an observed law. Often, the scientist will make an educated guess (a tentative explanation) about the reasons for the law. For example, the scientist may suggest that heat is an invisible fluid. When a gas is heated, the heat fluid enters the gas, thus causing it to take up more space. Such an educated guess, based on observed facts, is called a hypothesis. It may seem to be a good explanation of the facts, but it must be tested by new and different experiments. The above heat hypothesis was accepted by scientists for a long time. But it had to be given up because it did not agree with later experiments. Scientific observations and laws are like the pieces in a jigsaw puzzle.

When enough pieces have fallen into place, a meaningful pattern emerges. This pattern is a theory. A theory provides a general explanation for the observations made by many scientists working in different areas of research over a long period of time. A theory shows a relationship between observations that at first seemed totally unrelated. A theory, therefore, unifies many pieces of information to produce a grand design.

One of the most useful theories of science is called the kinetic theory of gases, it being highly successful in explaining and predicting the behavior of all kinds of gases under all sorts of conditions.

A theory can never be established beyond all doubt. There is always the chance that someone will make a new observation or discover a new law that the theory should be able to explain but cannot. When this happens, it might be possible to modify the theory to fit the new facts. For example, the molecular theory of gases, in its original form, did not accurately predict the behavior of gases under great pressure or at very low temperatures. Only after a while it was possible to modify the theory to make it agree with these new observations.

A thoroughly tested theory seldom has to be thrown out completely. But sometimes a theory may be widely accepted for a time and later disproved, the phlogiston theory of burning being an example. According to the theory, when burnt materials give off phlogiston. Burning stops, when the air is filled with phlogiston. The phlogiston theory seemed to explain why a candle would burn for only a short period of time in a closed container. The theory was even used to explain why substances burn even more vigorously in oxygen than in ordinary air. Oxygen was supposed to be a kind of air containing less phlogiston compared to ordinary air. But in 1778, French chemist Antoine Lavoisier demonstrated that a burning substance, rather than giving off something to the air, actually removed something from it – oxygen. Lavoisier‘s work became the basis of our modern theory of burning, the phlogiston theory being gradually discarded.

The research paper

The general aim of research is to answer questions by giving fair consideration to the best available evidence. Research can be conducted in a laboratory, by a field investigation, or in many other ways; but the research for a freshman paper is usually confined to printed material, either collected in a source-book or waiting to be discovered in the college library. The job may be broken down into the following five steps: finding a good question; locating the best printed evidence in this question; considering this evidence until you reach a reasonable conclusion; organizing your findings; presenting these findings in such a way that one can easily check their accuracy and completeness.

A good many students concentrate too much and too early on the fifth step. The mechanics of a term paper – physical organization, footnotes, bibliography, and so forth – are certainly important, and will be explained in this chapter at some length. But these things are only means to an end. If you understand how and why they work you should be able to get them straight and use them reasonably and accurately. If you do not you may well blunder along, trying to get two footnotes on a page (whether it needs ten or none),oppressed of a sense of futility and feeling extremely vague about what you are trying to do.

Some of the material that you need has probably been published in periodicals rather than in book form. Such material may be located through various periodical indexes.

The Reader’s Guide to Periodical Literature, for instance, is the index that freshmen are most likely to find useful (and also the one that nearly all college libraries have). It covers popular magazines that contain the least serious information or at least some serious one – roughly, the range from Look to Scientific American. If your subject is of contemporary interest, be sure that you examine the latest issues available.

The entries in the indexes are highly condensed to save space, and may not always be clear at the first glance. The best way to master them is to examine the explanations at the front of the volume, then check out a couple of magazines covered by the index you are using. Every item in an entry means something. Examine the magazine until you are sure just what it does mean and you should have no further trouble. If there is anything you cannot make out after a fair try, ask your instructor to help you; but do not expect him to explain it all before you start.

In addition to the mentioned above, there are several other indexes which you may find to be helpful. They vary considerably in both the quality of the editing and the periods covered; and your library may not have them all. But since any one of them may save your hours of looking for needles in haystacks, it is worth while looking for any that seem appropriate.

The chemical information system

We live in the information age. In the past few decades, there has been an information explosion' in most fields. Scientific knowledge, especially, has been increasing very rapidly. When a chemist, for example, develops a new substance, it takes time to get it into scientific reference books. The books are not updated and reprinted fast enough to keep up with current developments.

To answer a chemistry-related question, it can take weeks to search through these books. And even then, the answer may be out of date. To deal with these information problems, chemists use computers. Computers can give chemists access to chemical data banks, can answer chemistry questions in minutes rather than weeks. The Chemical Information System (CIS) is the largest of these data banks. It consists of more than thirty data bases, each dealing with a particular aspect of chemistry. The CIS is used by government agencies, colleges and universities, private industry, hospitals, poison-control centers, and emergency-response teams.

The CIS has information on more than 350 000 chemicals. Someone using the system can find out a chemical's structure, molecular formula, chemical name, and other names by which the chemical is known in commerce and manufacturing. A user also can use the system to do searches. For example, the system can be searched for all compounds containing a specific structural fragment as well as on the basis of name, molecular formula, molecular mass, and atom count. And when given some of this information about an unknown chemical, the system can come up with a list of what the chemical might be.

Searches of these kinds would take weeks of monotonous research without such a computer system. The CIS includes many more-specialized data bases, as well. The Mass Spectral Search System can search for a chemical‘s mass spectrum. It also can list chemicals with similar mass spectra. The Oil and Hazardous Materials/Technical Assistance Data System provides information to emergency-response-team personnel. This information can include methods of disposing of a hazardous material and recommended limits of certain chemicals in drinking water. The Physicians Desk Reference data base contains essential information on major drugs. This information includes descriptions of drugs, do sages, and side effects. Data bases are essential in this information age and save chemists and other professionals much valuable time.

The difference between scientific law and theories

A scientific law is a statement of the regularity, a uniformity of the behaviour of matter and energy. A theory is the most acceptable explanation of facts which are known or observed. Theories are tentative explanations and are changed or discarded as new facts or knowledge become available.

What is meant by the scientific method? The scientific method is a general way of thinking used by scientists in solving problems. This process includes: clearly defining the problem, collecting all of the evidence that is available, setting up a possible answer (hypothesis), conducting an experiment to see if the hypothesis is correct, arriving at a conclusion based on the information gathered in the experiment, and testing the conclusion.

Discoveries of the past, progress of inorganic chemisty

We shall define inorganic chemistry today as the study of formation, composition, structure, and reactions of the chemical elements and their compounds, except those of carbon. Many will say that this is not the definition of inorganic chemistry alone, but chemistry itself.

Indeed, the earlier divisions of chemistry have practically disappeared and the subject is becoming an intergrated whole. Two facts helped the development of inorganic chemistry: the growth of the theoretical techniques of quantum mechanics and new optical, electrical and magnetic techniques of physical measurement by which structure can be investigated. For a full understanding of the way in which these achievements affected the development of inorganic chemistry, let's make a short survey of the history of the subject.

We may start with 1828, the year in which Wohler the pioneer of organic synthesis, showed the interrelationship between inorganic and organic chemistry. For the next fifty years inorganic and organic chemistry progressed side by side. The main work in inorganic chemistry dealt with the preparation of new compounds and the development of methods of analysis. Great numbers of new compounds were being described and important work was being car-ried out on the determination of atomic weights. The year 1887 may be accepted as the date of appearance of physical chemistry as another branch of the subject.

Many research workers were now interested in physical chemistry because it offered the precision which was lacking in inorganic chemistry. At the same time, organic chemistry developed into a system in which structure could be determined. Without the technique for such stereochemical investigations inorganic chemistry lagged behind. Thus we find that by this time organic chemistry, because of its system, and physical chemistry, because of its precision, were constantly attracting workers of inorganic chemistry. People say that facts give a science its substance, but it is the theory which provides its strengths. It is owing to the development of the theory that inorganic chemistry has before it such exciting prospects at the same time.

The origin of plastic

The plastics industry started because ivory was scare and ivory billiard balls were very expensive. That was the reason the firm of Phelan & Collander in New York soon after the Civil War offered a prize of $ 10, 000 for a substitute for ivory that could be used to make billiard balls. Many inventors were attracted by this prize. One of them was John Wesley Hyatt, who succeeded not in making a billiard ball, but in producing the first satisfactory man-made plastic. He did this by mixing camphor with cotton which had been treated with nitric acid and pressing the mixture in a hot mold. When the mold had cooled, the material in it retained the precise shape of the mold even to the tiniest detail. That was the beginning of celluloid.

Update. John Wesley Hyatt did not invent celluloid, he acquired the patent from British inventor who couldn’t find an application for his discovery. After winning the $ 10,000 prize in 1872, Hyatt used it to make billiard balls in Newark, New Jersey.

The history of chemistry science

Many years ago people already knew how to obtain many useful materials. They could smelt metals from their ores, produce and utilize various alloys, as well as manufacture glass and glassware. Long before our era the

Egyptians smelted iron from its ores, produced stained glass, and extracted medicines, dyes, and perfumes from plants. Chemical production in India and China dates from still earlier times.

More than two thousand five hundred years ago man first arrived at the thought that the universe is composed of atoms. This idea was most perfectly expressed by Democritus, the great Greek philosopher. According to Democritus, all bodies in nature are built up of minute, indivisible particles – atoms. Atoms are so small that they cannot be seen. They may be different in shape and size. The differences between substances depend on differences in the number, shape and arrangement of the atoms they consist of. Atoms are in eternal motion.

The materialistic teachings of Democritus were far in advance of the views of his contemporaries, but did not receive general recognition. According to the opinion prevailing today, chemistry as a science arose at the beginning of our era in Alexandria, a city on the Nile. Alexandria was an immense commercial and cultural centre. It concentrated the practical knowledge of Egypt and developed the philosophical ideas of ancient Greece. Treatises written in Alexandria in the first century of our era contained a great deal of chemical information, many illustrations showing chemical apparatus, and descriptions of calcining, volatilizing, filtering, dissolving, and crystallizing. Here also arose the idea of transmuting base metals into gold. This idea diverted chemistry for a long time from the path of fruitful searchings, thus retarding its progress. After the Arabian conquest of Egypt and other Eastern countries in the 7th century, part of the knowledge accumulated in Alexandria still remained intact. The Arabs made use of this knowledge and subsequently discovered and investigated many substances, including nitric acid, and various salts. The word «chemo» which had been used by Alexandrian scientists got the Arabian prefix al and became «alchemy». The Arabian scientists left a number of books containing descriptions of different chemical experiments and practical information. The conquest of Southern Spain by the Arabs promoted the penetration of practical knowledge into Western Europe. With the Arabs came the idea of transmuting base metals into gold.

In the history of chemistry the Middle Ages are known as the period of alchemy. Contrary to Arabian alchemy, which had played a positive part in the development of science, West-European alchemy was an antiscientific, reactionary trend. It was under the control of the catholic church. All the efforts of the alchemists were directed towards the search of the mysterious philosophers «stone» which might restore youth, prolong life and change base metals into gold.

Alchemy was never widespread in Russia. Until the 17th century Russian practical chemistry developed independently of Western Europe. Chemical information in Russia was exchanged mainly with the Near East Byzantium, Armenia, etc.). During the Renaissance chemistry really began to progress, and chemists started to solve practical problems. A new trend of chemistry known as iatrochemistry (medical chemistry) developed. It was founded by Paracelsus, a Swiss physician who thought that the main object of chemistry is the preparation of medicines. Many physicians engaged in chemical research. The new trend forced back the problems of alchemists and placed the study of chemical change on a sound footing. About that time the works of Agricola laid the foundation of metallurgy and opened up a new sphere of the application of chemistry.

Metric system and its origin

The idea of a universal system of measures and weights dates from long ago, but it was realized only two centuries ago. The metric or decimal system was worked out by the French Academy of Sciences in 1791. How were the units for length and weight defined? Two French scientists who were given the task to define these units took one fourth of the distance from the North Pole to the Equator on the geographical meridian which is running through Paris (the distance from Dunkirk in France to Barcelone in Spain) and divided it into ten million equal parts. One of these parts was called a metre or – measure. For shorter measurements the metre was divided by ten, for longer things the metre was multiplied by tens. It was easy to use the same metre for volume. The weight of one cubic centimeter of water was called a gramme. Thus the metric system was created. Russian scientists played a great part in the spreading of the metric system in Russia as well as in other countries.

As far as in 1867 D. I. Mendeleyev addressed Russian scientists to help to spread the decimal system. The project of the law about the use of the metric system in Russia was also worked out by D. I. Mendeleyev. It should be said, however, that up till the end of the 19th century different units of measurement were used in various countries. In the Soviet Union the metric system was adopted in 1918, soon after the Great October Socialist Revolution. Now it is adopted by most of the countries. None of the systems of the past can be compared in implicity to that of our days. Wine cooler From Japan came the aluminum can that chilled itself. Gekkeikan Co. of Kyoto began selling sake in a can with a special lower compartment filled with ammonium nitrate and a plastic container of water. When one pushed the bottom of the can, the plastic container burst and the water mixed with the ammonium nitrate causing a chemical reaction that could lower the temperature of the sake by 15 °C within three minutes.

Basic laws of chemistry

Three laws of chemistry were put forward in late eighteenth and early nineteenth centuries. Two pre-date Dalton`s atomic theory and the third (the law of multiple proportions) was developed from it. These laws were of great importance in the development of the atomic theory.

Law of constant composition States that all pure samples of the same chemical compound contain the same elements combined in the same proportions by mass. It was developed by a Frenchman, Joseph Proust, in 1799.

Law of conservation of mass States that matter can neither be created nor destroyed during a chemical reaction. It was developed by a Frenchman, Antoine Lavoisier, in 1774. Law of multiple proportions States that if two elements, A and B, can combine to form more than one compound, then the different masses of A which combine with a fixed mass of B in each compound are in a simple ratio. It is an extension of Dalton`s atomic theory.

The history of polymers

Today the market is flooded with different materials. Modern life would be incomparably different without synthetic chemicals which are called as polymers. Man-made fibres are used in clothing, carpets and curtains while plastics are used in innumerable domestic and industrial applications and artificial joints, and paints and cleaning materials, are all different forms of this important discovery. What is often forgotten is that at the beginning of the 20th century the chemistry of large molecules was unknown and their synthesis was definitely unthinkable. Large Molecules. When a German scientist named Hermann Staudinger proposed in the 1920s that it was possible to have large molecules which were made up of many thousands of atoms, he was ridiculed by many other scientists. The common wisdom was that the structures of such materials as rubber and Bakelite were actually many small molecules which were held together by an unknown force.

Organic Synthesis

Hermann Staudinger stuck to his guns and, with his colleagues, he synthesised a series of organic molecules which were called poly (methanals).

These compounds were long chains of repeating units, the units being -CH20-. They are made by joining lots of methanal molecules together. The German scientists made chains of different lengths and showed that their properties changed depending on the length of the chains that were prepared. Following this, the chemists working for Imperial Chemical Industries (ICI), soon discovered a polymer that reacted to organic molecules, ethylene which is now known as ethene and benzaldehyde, at very high temperature and pressure. The reaction failed to impress, but there was a small amount of a white, waxy substance on the wall of the reaction vessel. This was poly (ethene) or polythene, and soon ICI realised that they had a potentially useful compound.

The new material had many properties which made it unique. It was easy to form into different items and was tough and hard wearing and was impermeable to water and insulating to electricity. It was discovered in the 1930s and was soon being used in the Second World War to insulate the many metres of cables that were needed for the vital radar equipment that was used by the British.

The first plastics

The first plastic was a result of mixing phenol and formaldehyde together. This resulted in a gooey substance called bakelite, the predecessor of plastic. The first plastic dates back to 1910, when Dr. Leo H. Baekeland produced 25 barrels of 'phenolic' plastic. Plastics are polymers that have a high molecular mass. The word plastic comes from Greek and means to fit or to mould. Today the world produces more than 500 million pounds of plastics every year. The reason why plastic is so popular is because the raw materials that are required to make this product are easily available. The basic plastic requires water, air, and coal. Other forms of plastic may also require petroleum or natural gas, salt and limestone. Though plastic is a very popular material to use for making cost effective products, it does have its negative effects on the environment. Plastic is insoluble in water, is chemically inert and have toxic additives. Plastics degrade very slowly making it problematic to dispose of.

Will the human race survive the twenty first century?

Sir Martin Rees, the Astronomer Royal, is a worried man. He fears that our species cannot survive the present century, so great are the legions of things that might go wrong. He imagines extraterrestrial watching our solar system for aeons and witnessing a sudden spasm of activity as humanity begins to emit radio waves and sends vessels into space. If they continue to watch, what will these hypothetical aliens witness in the next 100 years? Rees's gloom stands in a long tradition of dyspeptic futurology. From Huxley's Brave New World and H.G. Wells to the modern environmental movement, almost everybody has painted the future as a dismal place, and almost everybody has so far been wrong. Steam engines, nuclear war, the population explosion, chemicals, social dislocation and genetically modified food have come and gone without leaving us worse off: in fact, the more technology we invent, the healthier, wealthier and wiser we become.

So why should Jeremiah Rees be right where so many past prophets have been wrong? This is of course conceivable, that the chemical industry will tomorrow invent a kind of ice that turns all water into itself, or the nuclear industry will invent a bomb hot enough to ignite the atmosphere's nitrogen. But all sorts of things are conceivable without being plausible or even possible. It was conceivable that invention of fire by Stone Age man would lead to disaster for our species.

There is undoubtedly a risk in innovation but there is also a risk in a lack of innovation, and stopping all invention at any point in our previous history would have resulted in humanitarian and ecological catastrophes on a vast scale. Consider what would have happened, for instance, if we had somehow waved a magic wand and prevented the invention of agriculture. Evidence suggests that increasingly efficient hunter-gatherers would have continued their extinction of prey species – they had already devastated the fauna of Australia, the Americas and many islands – stopping only when the last tree in the last rain forest was felled. The greatest risk of all is the risk of doing nothing.

The chemistry of tomorrow

Addressing global challenges means advancing fundamental scientific knowledge, supporting excellence in chemical science research and maximising the number of future breakthroughs. It will require an interdisciplinary approach to build bridges between chemisty‘s subisciplines, and with other sciences and engineering.

Over 150 experts were brought together to discuss issues facing today‘s society, identifying seven prioriry areas. Within these seven areas, 41 challenges were defined and the role that chemistry will play in providing solutions was examined. In addition, the expertise, attitudes and opinions of the wider community were incorporated via web based consultation.

These seven priority areas have many areas of overlap, with strong links between associated challenges. The themes of sustainable development and climate change underpin the majority of the challenges.

The seven priority areas are summarised here

– Energy. Creating and securing environmentally sustainable energy supplies, and improving efficiency of power generation, transmission and use.

– Food. Creating and securing a safe, environmentally friendly, diverse and affordable food supply.

– Future cities. Developing and adapting cities to meet the emerging needs of citizens.

– Human health. Improving and maintaining accessible health, including disease prevention.

– Lifestyle & recreation. Providing a sustainable route for people to live richer and more varied lives.

– Raw materials & feedstock. Creating and sustaining a supply of sustainable feedstock, by desighning processes and products that preserve resources.

– Water & air. Ensuring the sustainable management of water and air quality, and addressing societal impact on water resources (quality and availability).

Top-ten challenges for the chemical sciences

To ensure progress is made where it matters most, we have identified 10 of the 41 challenges as priorities for the next 5–10 years, following consultation with the chemical science community.

Listed alphabetically, these are:

– agricultural productivity: significantly and sustainably increase agricultural productivity to provide food, feed, fibre and fuel;

– conservation of scarce natural resources: develop altrenative materials to conserve precious resources and new processes to extract valuable materials from untapped sources;

– conversion of biomass feedstocks: develop biorefineries using different types of biomass to provide energy, fuel and a range of chemicals with zero waste;

– diagnostics for human health: enable earlier diagnosis and develop improved methods to monitor diseases;

– drinking water quality: use new technologies to help provide clean, accessible drinking water for all;

– drugs & therapies: harness and enhance basic sciences to transform drug discovery, development and healthcare, delivering new therapies more

– efficiently and effectively;

– energy conversion and storage: improve the performance of energy conversion and storage technologies, such as batteries, and develop sustainable transport systems;

– nuclear energy: ensure the safe and efficient harnessing of nuclear energy, through the development of fission and investigation into fusion technologies;

– solar energy: develop existing technologies into more cost efficient processes and develop the next generation of solar cells to realise the potential of solar energy;

– sustainable product design: take into account the entire life cycle of a product during initial design decisions to preserve valuable resources.

Make it happen

Chemistry has great capacity to solve many of the global challenges that society is facing. These challenges can only be addressed if we provide for an excellent, diverse and well-maintained science base, a good supply of well-trained individuals, and an innovative climate from which good ideas can flourish, be exploited and be communicated around the world. There are also exciting opportunities to develop new projects that will enable us to tackle each of the key challenges. No country can afford a skills shortage, which could leave the next generation ill-equipped to tackle major scientific and technological challenges. A diverse and technically innovative workforce is fundamental to developing and applying new technologies. To maintain the flow of future breakthroughs, it is critical to advance fundamental knowledge and to support curiosity driven research.

There also needs to be a sustainable commitment to innovation from the leaders of key organisations to establish a culture where investment in research and innovation can thrive. Let us ensure that future generations enjoy a life of quality and beauty by the intelligent application of chemical knowledge.

Superconductors

Imagine you're an electron on a motorcycle, zooming along on a smooth, empty road. No speed breakers or potholes to stop you. In an instant, you've reached your destination. Well, for an electron, such a road is called a superconductor.

How superconductivity works? When electrons move through a metal wire, we get electricity. But the path is not smooth. The metal resists the flow of electrons, as the metal atoms may absorb a few electrons instead of letting them through. This lowers the current that passes through the wire.

If you lower the temperature of the wire, it allows more current to pass through. When you reach a really low temperature, the resistance of the metal suddenly drops to zero. This is called the critical temperature (Tc), and it is different for different metals. This phenomenon is called superconductivity.

High Temperature Superconductors. For most metals, the Tc is very close to absolute zero (–273.15 °C). For example, mercury has a Tc of –277.35 °C. But there are some materials which become superconductors at much warmer temperatures. These are called high-temperatures superconductors (HTSs). But don't be fooled by the name, these materials still need to be cooled below –138 °C to work as superconductors. Luckily you can do that with liquid nitrogen, which has a temperature of about –196 °C.

So what kind of materials are these? They are not pure metals, but mixtures of metal oxides. One such is «Bisco», or Bismuth-strontium-calcium-copper-oxide (Tc –165.15 °C). Another is «Yibco» (Yttrium-barium- copper oxide, Tc –83.15 °C), and yet another is «Tibco» (Thalium-barium-calcium-copper oxide, Tc –146.15 °C). In fact, many superconductors have one or the other rare earth metal, which you can see in the periodic table as the Lanthanide series. But materials like Yibco, Tibco and Bisco are quite difficult to make, and quite expensive too.

Future fuel: from your septic tank

Today, almost all the petrol and diesel we use come from petroleum. But petroleum sources are harder and harder to find. By making sewage into oil, we can avoid both problems.

Sewage is rich in organic matter like proteins, fats and carbohydrates (think unused or spoiled food, vegetable peels and other waste). When it is treated at municipal plants, the sewage is separated into water and sludge. The water is purified and released into nature. The sludge is detoxified and placed in landfills.

Instead, the sludge can be used for making fuel. This is just like how gobar gas is made in India. Special kinds of bacteria eat up the sludge, and release methane gas. The gas can be collected and compressed into cylinders, like the ones we use for cooking gas. Some kinds of algae produce oil instead of gas. This oil can be distilled and used as a fuel for cars, pumps, and trucks.

Right now, this fuel is not cheap. But scientists are breeding different kind of algae that will make even more oil. Right now 30 % of the sludge is converted to oil.

Technology

Technology is the making, modification, usage, and knowledge of tools, machines, techniques, crafts, systems, methods of organization, in order to solve a problem, improve a preexisting solution to a problem, achieve a goal, handle an applied input/output relation or perform a specific function. It can also refer to the collection of such tools, machinery, modifications, arrangements and procedures. Technologies significantly affect human as well as other animal species' ability to control and adapt to their natural environments.

The human species' use of technology began with the conversation of natural resources into simple tools. The prehistorical discovery of the ability to control fire increased the available sources of food and the invention of the wheel helped humans in travelling in and controlling their environment. Recent technological developments, including the printing press, the telephone, and the Internet, have lessened physical barriers to communication and allowed humans to interact freely on a global scale. However, not all technology has been used for peaceful purposes; the development of weapons of ever increasing destructive power has progressed throughout history, from clubs to nuclear weapons. Philosophical debates have arisen over the present and future use of technology in society, with disagreements over whether technology improves the human condition or worsens it. Neo – Luddism, anarcho-primitivism, and similar movements criticize the pervasiveness of technology in the modern world, opining that it harms the environment and alienates people; proponents of ideologies such as transhumanism and techno-progressivism view continued technological progress as beneficial to society and the human condition. Indeed, until recently, it was believed that the development of technology was restricted only to human beings, but recent scientific studies indicate that other primates and certain dolphin communities have developed simple tools and learned to pass their knowledge to other generations.

The use of term technology has changed significantly over the last 200 years. Before the 20th century, the term was uncommon in English, and usually referred to the description or study of the useful arts. The term was often connected to technical education. Technology rose to prominence in the

20th century in connection with the Second Industrial Revolution. The meanings of technology changed in the early 20th century when American social scientists, beginning with Thorstein Veblen, translated ideas from German concept of Technik into – technology.

In German and other European languages, a distinction exists between Technik and Technology that is absent in English, as both terms are usually translated as technology. Today, technology can be most broadly defined as the entities, both material and immaterial, created by the application of mental and physical effort in order to achieve some value. In this usage, technology refers to tools and machines that may be used to solve real-world problems. The word – technology can also be used to refer to a collection of techniques. In this context, it is the current state of humanity's knowledge of how to combine resources to produce desired products, to solve problems, fulfill needs, or satisfy wants; it includes technical methods, skills, processes, techniques, tools and raw materials. The distinction between science, engineering and technology is not always clear. Science is the reasoned investigation or study of phenomena, aimed at discovering enduring principles among elements of the phenomenal world by employing formal techniques such as the scientific method. Technologies are not usually exclusively products of science, because they have to satisfy requirements such as utility, usability and safety.

Engineering is the goal-oriented process of designing and making tools and systems to exploit natural phenomena for practical human means, often (but not always) using results and techniques from science. The development of technology may draw upon many fields of knowledge, including scientific, engineering, mathematical, linguistic, and historical knowledge, to achieve some practical result.

Technology is often a consequence of science and engineering although technology as a human activity precedes the two fields. For example, science might study the flow of electrons in electrical conductors, by using already existing tools and knowledge. This new-found knowledge may then be used by engineers to create new tools and machines, such as semiconductors, computers, and other forms of advanced technology. In this sense, scientists and engineers may both be considered technologists; the three fields are often considered as one for the purposes of research and reference. The exact relations between science and technology in particular have been debated by scientists, historians, and policymakers since the late 20th century. The issue remains contentious – though most analysts resist the model that technology simply is a result of scientific research.

Nanotechnology

Nanotechnology is manipulation of matter on an atomic and molecular scale. Generally, nanotechnology works with materials, devices, and other structures with at least one dimension sized from 1 to 100 nanometres. With a variety of potential applications, nanotechnology is a key technology for the future and governments have invested billions of dollars in its research.

Nanotechnology is very diverse, ranging from extensions of conventional device physics to completely new approaches based upon molecular selfassembly, from developing new material with dimensions on the atomic scale. Nanotechnology entails application of fields of science as diverse as surface science, organic chemistry, molecular biology, semiconductor physics, microfabrication,etc. Scientists currently debate the future implications of nanotechnology. Nanotechnology may be able to create many new materials and devices with a vast range of applications, such as medicine, electronics, biomaterials and energy production. On the other hand, nanotechnology raises many of the same issues as any new technology, including concerns about the toxicity and environmental impact of nanomaterials, and their potential effects on global economics, as well as speculation about various doomsday scenarios. These concerns have led to a debate among advocacy groups and governments on whether special regulation of nanotechnology is warranted.

Materials reduced to the nanoscale can show different properties compared to what they exhibit on a macroscale, enabling unique applications. For instance, opaque substances become transparent (copper); stable materials turn combustible (aluminum); insoluble materials become soluble (gold). A material such as gold, which is chemically inert at normal scales, can serve as a potent chemical catalyst at nanoscales. Much of the fascination with nano-technology stems from these quantum and surface phenomena that matter exhibits at the nanoscale.

Current research. Nanomaterials

The nanomaterials field includes subfields which develop or study materials having unique properties arising from their nanoscale dimensions.

Interface and colloid science has given rise to many materials which may be useful in nanotechnology, such as carbon nanotubes and other fullerenes, and various nanoparticles and nanorods. Nanomaterials with fast ion transport are related also to nanoionics and nanoelectronics.

– Nanoscale materials can also be used for bulk applications; most present commercial applications of nanotechnology are of this flavor.

– Progress has been made in using these materials for medical applications.

– Nanoscale materials are sometimes used in solar cells which combats the cost of traditional Silicon solar cells.

– Development of applications incorporating semiconductor nanoparticles to be used in the next generation of products, such as display technology, lighting, solar cells and biological imaging.

Nanorobots

Nanorobots are just the adapted machine version of bacteria. Nanorobots measure six atoms across and are complicated to be designed and need to be engineered in such a way that they are autonomous in nature.

Nanorobots are small microscopic devices measured on the scale of nanometers. They are designed to function like bacteria or any normal virus. Nanorobots are small particles that have a small solar cell or some kind of battery. The nanorobots are made of tiny silicon pieces called as transducers. These transducers take in energy that is generated by the robot`s solar cell and turns the energy into mechanical power.

Nanorobots are the most useful objects that humans have invented. They are capable to rebuild the tissue molecules in order to close an open wound, rebuild the walls of ruptured veins and arteries and also find their way to the heart by travelling through your blood stream and perform important surgeries like heart molecular surgery without causing any discomfort to you. Scientists are also of the opinion that nanorobots will help in brain research, cancer research and finding remedies for difficult ailments like AIDS, leukaemia and other major diseases.

Nanovehicles

Today, when you have an illness, you have to take medicine in several doses, as pills or syrups. Imagine a day when you have to take the drug only once, and it works a whole lot better. Nanotechnology can help do that. Nanotechnology is the science of making devices that are very tiny, on the scale of one-millionth of a millimeter. This is the right size to build the vehicles that can deliver medicines to the right place in your body.

Chemists are searching for the ideal nanovehicle. This is one that would:
– dramatically reduce the drug dosage;
– deliver the drug to the right place;
– increase the local concentration of the drug there;
– and limit or eliminate side effects.

The uses of plasmas

Micro-plasma welding is a method used to join paper thin sheets of metals. The joint becomes invisible after polishing. Stainless steel water storage tanks and other kitchen implements are made this way. Plasma spray process is a most magical use of thermal plasmas, it is the only coating process that can apply any material on to any material.

– Metal on to metal: Titanium on to mild steel, to prevent corrosion of steel.

– Non-metal on to metal: alumina on to stainless steel. Alumina reduces the wear and tear on the stainless steel vessel due to industrial processes.

– Metal on to non-metal: copper on to porcelain used in capacitors. Plasma-spraying copper onto the porcelain makes it «solderable», so that electric wires can be attached to it.

– Non-metal on to non-metal: Teflon on to magnesia (ceramic). Some chemicals like hydrofluoric acid can corrode the ceramic vessels they are kept in; coating them with Teflon prevents corrosion.

Safety – a primary concern

Chemical technology has brought us many useful products. They insulate our homes, make transportation safer and less expensive, help clothe and feed us, and enable us to enjoy better health. And yet with each product comes some potential risk. While many chemicals pose no special hazard, some can have harmful effects on our health or on our environment.

Sometimes we are not even aware of chemical hazards until a product has been used for some time. For example, parents with young children wanted sleepwear that would not burn easily. The chemical industry responded by producing a flame-retardant chemical called TRIS used to treat children‘s pajamas. After TRIS had been in use for some time, it was discovered that it could cause cancer, and its use was discontinued.

In other instances, we may be aware of a risk but use a product anyway because its benefits outweigh its risks. Penicillin, for example, has saved many lives, but it also can kill people who are allergic to it. Doctors have been able to minimize the risk of using penicillin by carefully monitoring how patients react to it. In spite of these precautions, even today people occasionally die from a bad reaction to this antibiotic. But, as is true of penicillin, most people are usually willing to use a product if its risks are small and its benefits are potentially great.

The chemical industry in the United States has become increasingly concerned about eliminating chemical hazards. As a result of this concern, the industry steadily has improved its safety record. For the past decade, it has ranked either first or second among American industries in having the lowest frequency of job-related accidents.

The accidents that have occurred have been consistently among the least severe of all industries. The chemical industry, in fact, is so safe that its employees are nearly ten times more likely to have an accident while away from work than while on the job. In accordance to the above mentioned, major chemical companies are developing safety programs to protect workers during non-working hours. These programs focus on providing workers with information on how to avoid accidents. The improving record of the chemical industry shows that when people are well-informed and determined, they can live and work in a safe environment. When concern for safety is a high priority, many accidents can be avoided and the severity of those accidents that do occur can be lessened.

Industrial production of oxygen

Oxygen is so important in many ways that it is made in large quantities in industry. Manufacturers have an abundant free supply of it in the air, and it is obtained by cooling the air until it becomes a liquid (just as steam condenses to water). This liquid air contains both liquid oxygen and liquid nitrogen, and when the temperature of the mixture is allowed gradually to rise it boils and the oxygen and nitrogen change back to gases. They do this, however, at different temperatures and can therefore be collected separately. Oxygen is stored under considerable pressure in steel cylinders painted black. Its release from the cylinder is controlled by a valve, and the gas can easily be obtained whenever it is required.

Laboratory of the analytical chemistry

The chemical laboratory usually consists of one large room with a weighing room, a reagent room, and sometimes a dark room off it. The reagent room is used for storing chemicals and apparatus, and contains shelves of reagent bottles, winchesters and carboys of acid.

The weighing room is specially constructed so as to be free from external disturbances. The balances usually stand on firm stone shelves. For weighing accurately small quantities of materials a microbalance is used, and for some physical purposes, a spring balance. The laboratory itself is fitted with benches, sinks, fume cupboards or hoods, electric drying ovens, and steam ovens.

The laboratory usually has facilities for glass blowing. Heating in the laboratory is generally done directly by the Bunsen burner. Micro-burners are used where a small flame is required, and Meker burners – where a large hot flame is necessary. Test tubes stand in a test-tube rack; they are held above the flame in wooden holder and washed out with the help of a test-tube brush. Solutions are heated in glass apparatus, such as beakers and flasks. Solids are usually heated in crucibles. Crucibles are fitted with lids. The laboratory glassware includes: tubes, test-tubes, evaporating dishes, funnels, weighing bottles, beakers, flasks of different shape, bulbs, glass rods, stoppers for closing bottles, pipettes which are employed for removing measured quantities of liquids from other vessels. The lower end is contracted to a narrow opening. The glass vessels also include cylinders and burettes. A burette is a graduated glass tube, from which the liquid may be run by means of a tap at the bottom. All glass things are kept in special racks.

The laboratory is provided with different apparatus and devices. One of them, the desiccator, is used for drying materials. The condenser serves for cooling liquids and vapour. Every working place in the laboratory is supplied with a gas burner which serves for producing flames of different intensity. The burners are connected with the main gas line by a rubber tube. The flame of the burner can be regulated by a tap. Crucibles are used for igniting materials. They are made of different materials: iron, quartz, porcelian, clay, platinum, gold, etc.

Everything in the laboratory has a definite place. Near each bench there is a sink with running water and a stand with a towel and soap for washing hands. A large bottle with distilled water is placed on every bench since distilled water is necessary in almost every experiment. Powerful ventilators serve for purifying the air. They carry away harmful vapour and pungent odours, the ventilating hood also serves for carrying away laboratory fumes and disagreeable odours.

Every laboratory is provided with the most commonly used organic and inorganic reagents. Materials that occur in large crystals are ground to a more or less fine state in a mortar. The mortars are made of porcelain, iron, steel, or agate.

From chemical science to the lab

Profiles: Government agencies

Name: Paul Smith

Age: 35

Job: Separation scientist

I studied Maths, Physics and Chemistry at A Level, then went on to do a BSc course in Chemistry with Physics at Plymouth Polytechnic. After graduating I moved to the University of Leeds to carry on my scientific studies with a PhD in Physical Chemistry. First job was a postdoctoral research position, also in Leeds. I was then offered a role as Head of the Analysis Laboratory at BHR Group Ltd, an independent group of technology companies specializing in fluid flow (e. g. water purification and waste disposal).

Finally, I moved to my current role as a Separation Scientist at the Laboratory of the Government Chemist (LGC), Europe‘s largest independent analytical and diagnostic laboratory. LGC carry out chemical, biochemical and forensic analysis, DNA testing and genetic screening, research, method validation and consultancy.

As a Separation Scientist I separate a range of different types of compounds (pharmaceuticals, environmental contaminants, illegal drugs, etc.) from mixtures using several techniques, but mainly chromatography. I then have to identify the compounds, usually by using a spectroscopic technique such as mass spectrometry or ultra violet detection.

The job involves developing different assays or methods for separating and extracting the compound I am interested in. For example, I have recently been working on a procedure for detecting cannabis in hair. Hair acts like a memory stick that stores information about everything a human has been doing. So, if somebody has been taking drugs on a regular basis then both the newest and the oldest bits of hair will contain traces of the drug. This is useful for Forensic scientists as it tells them if somebody has been using drugs for a long time or has just taken them once. LGC is a contract research organisation so it looks to find work from larger companies. Our sales staff visit other companies and sometimes invite a laboratory person, such as myself, along to answer some of the more technical questions. This is interesting as it allows me to see how other laboratories operate. I enjoy working in a relaxed, friendly environment. The job is challenging and it is very rewarding when I am able to solve some quite tricky problems.

Although LGC does recruit some people with A Levels, all the staff at management level have a science degree. Having a science degree is a major benefit and allows quicker career progression as you already have a good deal of practical knowledge and are ready to apply it.

Chemical Engineering

A chemical plant is an industrial process plant that manufactures (or otherwise processes) chemicals, usually on a large scale. The general objective of a chemical plant is to create new material wealth via the chemical or biological transformation and or separation of materials. Chemical plants use special equipment, units, and technology in the processes. Other kinds of plants, such as polymer, pharmaceutical, food, and some beverage production facilities, power plants, oil refineries or other refineries, natural gas processing and biochemical plants, water and wastewater treatment, and pollution control equipment use many technologies that have similarities to chemical plant technology such as fluid systems. Some would consider an oil refinery or a pharmaceutical or polymer manufacturer to be effectively a chemical plant. Petrochemical plants (plants using petroleum as a raw material) are usually located adjacent to an oil refinery to minimize transportation costs for the feedstocks produced by the refinery. Specialty chemical plants are usually much smaller and not as sensitive to location. Nowadays, sorts of tools were developed for converting a base project cost from one geographic location to another. Chemical plants typically use chemical processes, which are detailed industrial-scale methods, to produce the chemicals. The same chemical process can be used at more than one chemical plant, with possibly differently scaled capacities at each plant. Also, a chemical plant at a site may be constructed to utilize more than one chemical process.

Chemical processes may be run in continuous or batch operation. Batch operation is commonly used in smaller scale plants such as pharmaceutical or specialty chemicals production.

In continuous operation, all steps are ongoing continuously in time. During usual continuous operation, the feeding and product removal are ongoing streams of moving material, which together with the process itself, all take place simultaneously and continuously. Chemical plants or units in continuous operation are usually in a steady state or approximate steady state. Steady state means that quantities related to the process do not change as time passes during operation. Such constant quantities include stream flow rates, heating or cooling rates, temperatures, pressures, and chemical compositions at every point (location). Continuous operation is more efficient in many large scale operations like petroleum refineries. It is possible for some units to operate continuously and others be in batch operation in a chemical plant.

Today, the fundamental aspects of designing chemical plants are done by chemical engineers, although historically this was not always the case and many chemical plants were constructed in a haphazard way before the discipline of Chemical Engineering became established. In plant design, typically less than 1 per cent of ideas for new designs ever become commercialized. During this solution process, typically, cost studies are used as an initial screening to eliminate unprofitable designs. If a process appears to be profitable, then other factors are considered, such as safety, environmental constraints, controllability, etc. The general goal in plant design is to construct or synthesize optimum designs in the neighborhood of the desired constraints.

Plant facilities

The actual production or process part of a plant may be indoors, outdoors, or a combination of the two. The actual production section of a facility usually has the appearance of a rather industrial environment. Hard hats and work shoes are commonly worn. Floors and stairs are often made of metal grating, and there is practically no decoration. There may also be pollution control or waste treatment facilities or equipment. Sometimes existing plants may be expanded or modified based on changing economics, feedstock, or product needs. As in other production facilities, there may be shipping and receiving, and storage facilities. In addition, there are usually certain other facilities, typically indoors, to support production at the site.

Although some simple sample analysis may be able to be done by operations technicians in the plant area, a chemical plant typically has a laboratory where chemists analyze samples taken from the plant. Such analysis can include chemical analysis or determination of physical properties. Sample analysis can include routine quality control on feedstock coming into the plant, intermediate and final products to ensure quality specifications are met. Nonroutine samples may be taken and analyzed for investigating plant process problems also. A larger chemical company often has a research laboratory for developing and testing products and processes where there may be pilot plants, but such a laboratory may be located at a site separate from the production plants.

A plant may also have a workshop or maintenance facility for repairs or keeping maintenance equipment. There is also typically some office space for engineers, management or administration, and perhaps for receiving visitors. The decorum there is commonly more typical of an office environment.

The arrangment of the chemical plant

A mathematical model is constructed on the basis of the process knowhow and then stored in the computer for basic references. The system includes an optimizing arrangement for quality control; the computer accepts information from the sensors about the quality of the product and then gives instructions to the actuators to change conditions on the plant in order to obtain a better product. The whole system consists of feed forward and negative feedback parts; in the former the computer refers the automatically measured input variables to a mathematical model and takes corrective action if necessary, while in the latter the computer receives data about the quality of the products from the quality sensor and then instructs the actuators to alter variables in the process in order to obtain a product of the desired quality. The complex arrangement is necessary, since no negative feedback can by itself deal with very complex situations, because it is difficult in advanced industrial operations to store all the information required to forecast the quality of products with great accuracy.

Purifiying water

The methods used to purify water depend on the use to which the water is to be put: Addition of chemicals, such as chlorine – helps to remove bacteria and other harmful organisms.

Boiling – helps to kill harmful organisms. Addition of chemicals, such as alum – helps to lump together (coagulate) small particles of suspended matter making them heavy enough to settle to the bottom and be removed.

Filtration – water is permitted to flow through layers of sand and gravel which remove solid matter suspended in the water.

Aeration – water is sprayed into the air. The sunlight kills some of the bacteria and the oxygen in the air tends to remove unpleasant odours.

Distillation – water can be freed from dissolved minerals by this process consisting of evaporation followed by condensation of the vapours in a separate vessel. Water is placed in the distilling flask and boiled to convert it into a vapour. The vapour then passes through the inner of two concentric tubes which together make up the condenser.

Process control

In process control, information gathered automatically from various sensors or other devices in the plant is used to control various equipment for running the plant, thereby controlling operation of the plant. Instruments receiving such information signals and sending out control signals to perform this function automatically are process controllers. Previously, pneumatic controls were sometimes used. Electrical controls are now common. A plant often has a control room with displays of parameters such as key temperatures, pressures, fluid flow rates and levels, operating positions of key valves, pumps and other equipment, etc. In addition, operators in the control room can control various aspects of the plant operation, often including overriding automatic control. Process control with a computer represents more modern technology. Based on possible changing feedstock composition, changing products requirements or economics, or other changes in constraints, operating conditions may be re-optimized to maximize profit.

Transport

Large quantities of fluid feedstock or product may enter or leave a plant by pipeline, railroad tank car, or tanker truck. For example, petroleum commonly comes to a refinery by pipeline. Pipelines can also carry petrochemical feedstock from a refinery to a nearby petrochemical plant. Natural gas is a product which comes all the way from a natural gas processing plant to final consumers by pipeline or tubing. Large quantities of liquid feedstock are typically pumped into process units.

Corrosion and use of new materials

Corrosion in chemical process plants is a big issue that consumes billions of dollars yearly. Electrochemical corrosion of metals is pronounced in chemical process plants due to the presence of acid fumes and other electrolytic interactions. Recently, FRP (Fibre-reinforced plastic) is used as a material of construction. The British standard specification BS4994 is widely used for design and construction of the vessels, tanks, etc.

What is the pilot plant?

Do you know the stages a full-scale chemical plant has to pass through before it gets into being? There exist the following periods: research, process development, pilot plant operation, design construction and at last manufacturing itself. Now let us consider what is meant by pilot plant operation. Pilot or prototype plants are supposed to be complete medium-scale processing units containing all essential elements, including control.

Pilot-scale equipment is divided into two categories: to produce results applicable to full-scale design or to fulfil a far wider range of operating characteristics than is normally available in producing models.

The conversion of laboratory data from the research group into plant design data is believed to be only one function of the pilot plant. It requires thorough investigation of basic reactions, reactants, time, temperature, concentration and catalysis factors, a study of raw materials, operations needed, control and safety, and health hazards, the pilot plant in such cases being a research unit. It should be used for the selection of suitable equipment and materials, provide time and labour study information, and enable for a study of by-product recovery and waste-disposal problems. After a new plant or process is designed, the pilot plant continues to eliminate certain troubles.

A check list we suggest below includes all items being considered in the pilot plant investigation: flow relations; materials; equipment of operation; materials handling; labour.

The aim is to operate the pilot plant with the assurance that all the risks, both technical and economic, in the full-scale commercial plant have been minimized or eliminated.

The pilot plant has to be capable of operating for long periods under conditions that are not changed frequently, to obtain a fair approximation of labour costs and manufacturing expenses. It should not be dismantled until such times as the full-scale commercial plant starts its successful operation, because it is the place where quality and manufacturing improvements are worked out.

Titanium: modern technology's designer metal

W. Gregor in England and M. H. Klaporth in Germany discovered titanium independently in the 1790s. Titanium was named by M. H. Klaporth after the children of Gaia, the earth goddess of Greek mythology. In the initial period, the metal was rare and this was largely because of the fact that isolation from its ores was difficult and there was little demand for the metal.

However, the fact is that it is the seventh most abundant metal found in the earth's crust. It is up to 100 times as plentiful as everyday metals such as copper, zinc and nickel and 400 times more common than lead.

By the middle of the 20th century, titanium became famous and was considered a great discovery among the elements when it was found to have properties that suited ideally to the demands of modern technology. Titanium ores are now mined to the extent of 3 million tonnes each year, while 100 thousand tonnes of the metal itself are produced annually.

Titanium in powdered form is used to produce sparks in many fireworks. It has density that is greater than that of aluminium, but less than those of iron and copper. The lightness when combined with its strength and ability to withstand high temperatures makes it virtually the designer material for the construction of aircraft parts, jet engines and spacecraft. As technology advances, the demands for this versatile metal of low density, high strength and zero toxicity is sure to multiply.

Forensic chemistry

Forensic chemistry is the application of chemistry to law enforcement or the failure of products or processes. Many different analytical methods may be used to reveal what chemical changes occurred during an incident, and so help reconstruct the sequence of events. Forensic chemistry is unique among chemical sciences in that its research, practice, and presentation must meet the needs of both the scientific and the legal communities. As such, forensic chemistry research is applied and derivative by nature and design, and it emphasizes metrology and validation.

One particularly useful method for the simultaneous separation, identification, and quantitation of one or more individual components of an unknown substance or mixture is the use of a gas chromatograph-mass spectrometer (GC-MS). A GC-MS is actually two instruments that are attached together physically, and together comprising one of the so-called «tandem» or «hyphenated» techniques.

The gas chromatograph (GC) is essentially a hot (150–350 ^{o}C), temperature-controlled oven holding a bent or coiled, specially packed or coated glass column between one and a few dozen meters long. A small volume (typically a few microliters) of a drug sample or other unknown substance that has been dissolved in an organic solvent (such as chloroform or methanol) is quickly injected into the hot column. Volatile components in the sample are vaporized by the heat of the oven and are forced toward the end of the column by the flow of an inert «carrier gas» (typically helium). The special chemical component(s) within the column bind to substances contained in the moving vaporized sample mixture with slightly different force. As a result, different substances eventually are «eluted» (i. e. emerge from the end of the column) in differing amounts of time, which is known as the «retention time». The retention time of various components so eluted can then be compared to those of known standard molecules eluted using the same method (column length/polarity, flow rate of carrier gas, temperature program). While this comparison provides (presumptive) identification of the presence of a particular compound of interest in the unknown sample, in general the GC portion of the technique is used as a separation and quantitation tool, not an identification tool. Forensic chemists usually perform their analytical work in a sterile laboratory decreasing the risk of sample contamination.

Forensic chemists

Apply scientific disciplines to physical evidence. A forensic chemist is a professional chemist who analyzes evidence that is brought in from crime scenes and reaches a conclusion based on tests run on that piece of evidence. A forensic chemist's job is to identify and characterize the evidence as part of the larger process of solving a crime. Forensic chemists rarely conduct any investigative work; they handle the evidence collected from the crime scene. Evidence may include hair samples, paint chips, glass fragments, or blood stains. Understanding the evidence requires tools from many disciplines, including chemistry, biology, materials science, and genetics. The prevalence of DNA analysis is making knowledge of genetics increasingly important in this field. Explain and defend results Forensic chemists agree that public speaking skills and being comfortable with what you do are important personal characteristics for this career. As seen on Court TV, forensic chemists are often called upon to explain what was found and how they arrived at their conclusions.

Not all cases go to trial, but when one does, giving expert testimony in court is a significant piece of a forensic chemist's job. Some employers require their forensic chemists to go through several months of mock courtroom testimony training along with their regular training. Forensic chemists must be able to give an impartial explanation to the jury that will assist in a final judgment forensic chemists analyze the evidence but do not determine the verdict. Have various opportunities. The career path for most forensic chemists is through federal, state, or county labs associated with the medical examiner's office. However, there are different types of careers available, including those in other fields of forensic science, academe, or administration. Chemists can also move up within a particular organization, changing responsibilities along the way. For example, the director of a crime lab may supervise other forensic scientists rather than being involved in day-to-day analysis. A director may also be responsible for case review and general lab management. Some forensic chemists also use their technical training to pursue a career in patent law.

Work Description

Forensic chemists apply knowledge from diverse disciplines such as chemistry, biology, materials science, and genetics to the analysis of evidence found at crime scenes or on/in the bodies of crime suspects. The field is a combination of criminalistics and analytical toxicology. Criminalistics is the qualitative examination of evidence using methods such as microscopy and spot testing, whereas analytical toxicology looks for evidence in body fluids through a range of instrumental techniques from optical methods (UV, infra-red, X-ray) to separations analyses (gas chromatography, HPLC, and thin layer chromatography). Mass spectrometry is also frequently used since it provides the strongest evidence in court. Most often, forensic chemists do not know the nature of the sample before they analyze it. The results of their work are used in police investigations and court trials, at which they may be called upon to provide expert testimony and explain their findings to a jury.

Working Conditions

Forensic chemists generally work in government labs, which can be small, understaffed, and underfunded. They spend time preparing and giving testimony in court. Formerly under the jurisdiction of police departments, forensics has traditionally been totally male dominated. However, over the last 15 years, the field has opened up to women, who are moving up in its ranks.

Places of Employment

Most labs are associated with a federal, state, or local police department, medical examiner's office, forensic services lab, or branch of the Federal Bureau of Investigation. There are some private labs that carry out forensic analyses.

Personal Characteristics

Versatility and patience are the most often cited qualities of a forensic chemist. Forensic chemists must be able to spend hours rigorously applying analytical techniques to evidence and then defending their work in a court of law. They must be able to clearly and concisely answer challenges to their findings. Integrity is also an important characteristic, because it is not unusual for the different interests in a case to try to sway the forensic chemist's position.

Education and Training

A strong background in chemistry and instrumental analysis as well as a good grounding in criminalistics is vital. A forensic science degree at both the undergraduate and graduate level is recommended. Those interested in working with trace evidence, such as glass, hair, and paper, should focus on instrumentation skills and take courses in geology, soil chemistry, and materials science. If forensic biology and DNA analysis are preferred, take microbiology, genetics, and biochemistry courses. Those interested in the toxicological aspects of this work should study physiology, biochemistry, and chemistry.

Job Outlook

The forensic science field is guardedly optimistic about job prospects for the future. Greater interest in the use of DNA analysis is expected to create more jobs. Those interested in DNA work should keep up with the rapidly changing technology and develop skills that distinguish them from the pack.

From chemical science to forensics

Profiles: Forensic science
Name: John Silver
Age: 26
Job: Forensic scientist

After taking A Levels in Maths, Physics, Chemistry and Art, I studied for a Chemistry degree at the University of Newcastle upon Tyne. On graduating, I went on to gain an MSc in Forensic Science from the University of Strathclyde. As part of my Masters degree I spent three months conducting research at Florida International University in collaboration with the US Drug Enforcement Administration. Following this, I joined Hayward Associates Consulting Forensic Scientists five years ago as a trainee forensic scientist. After a period of on-the-job training, I started to take on my own casework. I am now a consulting forensic scientist specializing in the examination of footwear marks, glass and alcohol related matters.

Forensic scientists use their scientific knowledge to assist in legal proceedings. After an examination of items submitted to the laboratory, they present their findings to the court in the form of a report or witness statement. Depending on the circumstances of the case, they may be asked to attend court to give evidence in person.

In criminal matters, forensic scientists can undertake work for the prosecution or the defence. At Hayward Associates we undertake work on behalf of the defence.

After three years experience as a court reporting scientist, I was eligible to apply for registration with the Council for the Registration of Forensic Practitioners (CRFP). The CRFP is a professional regulatory body that manages a register of currently competent forensic practitioners.

I enjoy the variety I experience within my working day. One day I may be working on a motoring offence, the next day a murder. Since every case is different, I never stop learning. Although attending court as a witness is often a nerveracking experience, it can be very satisfying knowing that you have helped the court to understand a complicated scientific issue.

Other job opportunities related to forensics include: forensic development manager, medical research associate, medical examiner, crime laboratory analyst, crime scene examiner, pathologist, forensic chemist, toxicologist, pharmacologist, analytical chemist, biomedical scientist, clinical biochemist and research scientist.

Orensic science

Forensics is the term given to an investigation of a crime using scientific means. It is also used as the name of the application of scientific knowledge to legal matters. Forensic science has developed over the past 300 years or so, and its processes continue to improve and evolve today as science and technology find better and more accurate techniques. In 1929 the first American forensic lab was created in.

Forensic science covers many areas of traditional science and melds them together to create an area of science called forensics. Forensic science uses areas of science such as: chemistry (chromatography, spectroscopicanalysis, pH and other chemical tests); biology (entomology, fingerprinting, behaviour, hairs, DNA testing etc); physical science (blood spatter analysis, ballistics, structural analysis, car movements in car accidents).

Forensic science is an umbrella term that has various areas under it. When a crime is committed and the forensic team is called in, there are many experts who cover their specialised fields. Although all these people could be considered forensic scientists, they have specific areas that they work in. There are two main areas of forensic science and these are the minimum requirements for a criminal investigation.

Field officers – these are technicians who visit the scene of a crime and collect the physical evidence that may be related to the crime. They also document and record the scene by taking photographs and videos. Lab officers – these are technicians who analyze and complete tests on the evidence collected by the field officers.

The methods of forensic chemistry

The Mass Spectrometer has become an indispensable tool of many types of chemists and will continue to be important. This piece of equipment is used to identify chemical compounds by breaking them up into smaller charged particles and then detecting them. The first apparatus to be called a mass spectrometer was built by Francis Ashton in Cambridge, UK in 1918.

Using Mass Spectrometer is a Simple Method Using a mass spectrometer is actually simple, although the practical construction of the equipment is far more complex. First a mass spectrum is produced then it is interpreted. The spectrum is produced by a three stage process.

Ionisation

First the chemical that needs to be analysed must be ionised. This is commonly done by bombarding a small sample of it with high-energy electrons from a heated filament. These electrons collide with the chemical compound and can knock off one of the electrons in the molecule that is under analysis. This produces a positively charged ion. The resulting ion also has some energy that is left over and this can cause a rearrangement within the molecule and further fragmentation. The resulting charged particles of differing size and mass are then ready for the next stage of the process.

Sorting of Fragments

The ions are accelerated by repelling them from a negatively charged plate, through small slits in other electrodes, forming a beam of particles. This beam of particles is then passed between the poles of an electromagnet. This causes the particles to be deflected away from their course. Particles with different masses are deflected by different amounts, so the particles can are sorted according to their masses.

Detection

The final stage is the detection of the particles. This is done by steadily varying the strength of the electromagnet so that a fixed detector measures the relative quantities of particles of different masses. The result is a series of lines on a graph representing the relative abundances of ions of different masses.

Analysis

This spectrum must now be analysed. The line with the highest mass is usually the original molecule, so that the molecular mass of the molecule can be determined from that line. Now detective work must be done by looking at the pattern of other peaks, representing fragments of the original molecule.

Different types of compound will give different fragmentation patterns so these can be used to work out possible structures of the original molecule. Mass spectrometry is often used in organic chemistry to work out the structure of complicated compounds. It is also often used with gas chromatography to analyse mixtures of compounds. The chromatograph separates out the mixture and the mass spectrometer analyses them one at a time.

Chromatography

Chromatography was first described by the Russian botanist Tswet in 1906. Tswet was engaged in the extraction and purification of plant pigments. He extracted the pigments with a solvent calcium carboante. Various plant pigments were found in definite coloured zones in the tube giving a complete separation. Tswet called this separation a chromatogram and the method itself chromatography. Chromatography is a method of chemical analysis based upon the selective absorption and partial fractionation of various substances by certain suitable materials. A selective developing agent is then passed through the coloumn and the different substances in the solution are spread down the column into layers visibly separated from one another, if the substances are coloured. In the case of colourless substances, the layers may be located by the use of ultra-violet light or by removing the compact column intact and then determining the various layers by chemical tests.

The basic apparatus in column chromatography is the adsorption column. The adsorption column can be constructed of soft glass Pyrx or in special cases of quartz. The diameter and the length of the column depend on the quantity of the material to be adsorbed.

No universal adsorbent has been found. The choice of the adsorbent is determined by the type of separation. A good adsorbent should hold relatively large quantities of materials to be resolved. The resolved materials must be eluted from the adsorbent by polar solvents. The particle size of the adsorbent should be such as to allow rapid and uniform percolation. The adsorbent must not react with either the materials to be resolved or the materials to be used as solvents or colour developers. The adsorbent should not be porous, and, if possible, not coloured.

The substance passed through the column with the object of rapidly and completely liberating the adsorbed compound is known as the element. The choice of the eluent depends on the solubility of the adsorbate. In general, substances more polar than the adsorbate perform this task efficiently.

In paper chromatography the adsorption column is replaced the strips of impregnated paper. The adsorbent is precipitated into the paper. One end of the prepared paper is dipped into distilled water and allowed to stand until the water has climbed one centimeter along the paper. It is then removed and dipped into a solution of the materials to be separated. After the adsorbate has climbed about 2 cm along the strip, the paper is removed from the solution and returned to the distilled water. When the water has climbed to about 12 to 16 cm the strip is removed and dried between filter paper. Brushing the dried paper strip with the proper developer will produce bands similar to those produced in the adsorption column. The strip method requires a minimum of the test solution and several developers may be applied to the same strip.

In 1960 there emerged a new method in chromatography. This is thin layer chromatography (T.L.C.). The technique itself has been described in numerous publications. The main advantages of the technique over column and paper chromatography are as follows: firstly, the speed of separation and, secondly, the very high degree of resilution which is much superior to that of column or paper chromatography. Thirdly, it involves economy of the adsorbent, solvent and sample, and simplicity of operation. The preparation of the plates and the development of the chromatograms is a simple matter even to comparatively inexperienced operators. Even complex systems can be analysed visually (e. g., by the appearance or disapperance of the components) and simple systems may be assessed semi-quantitatively by comparison with parallel separations of prepared standard mixtures, as is often the practice with paper chromatograms.

What is ecology?

A few years ago, the average person would not have had the slightest idea of this term. Today, the word is on everyone‘s lips. The man in the street usually associated it with the effect of pollution and our efforts to clean it up.

According to the definition of a biologist, on the other hand, ecology is the study of plants, and animals in relation to their environment. A community of plants and animals within a particular habitat is called ecosystem. Every plant or animal of an ecosystem has a definite role to play to maintain an overall balance in the system.

This role is referred to as ecological niche. Man-made pollution frequently alters the environment in which a community of organisms lives and upsets its delicate balance. Unfortunately, pollution produces numerous adverse effects in addition to disturbing ecosystem.

Homo sapiens, of course, is a part of the world ecosystem. In primitive societies based on hunting and food gathering, he fitted in quite well, he ate roots and berries or trapped animals for food. He began to seriously disturb the balance of nature only after he started to practice farming on a large scale and keep a sizeable herds of grass-eating animals.

In recent years, it is the growth of giant cities accompanied by industrial development on a huge scale that has begun to introduce enormous amounts of noxious wastes into the environment. Our transportation devices are likewise serious offenders in this regard as are the numerous new synthetic materials such as plastics that soil and water bacteria cannot degrade.

Ozone hole grows bigger

The ozone layer is a naturally occurring belt of gases 10 to 30 miles (16 to 48 kilometers) high that makes life on Earth possible by blocking the sun's deadly ultraviolet radiation.

Since the late 1970s about half the ozone layer over Antarctica disappears each September and early October and then returns to normal by late November. Chlorofluorocarbons, which are used in refrigerators and air conditioners, and halon, which is used in fire extinguishers, are the manufactured chemicals principally to blame for ozone decay. Because of global concern over ozone loss, most nations are trying for phase out their use. Volcanic eruptions also contribute to the growth of the hole in the ozone layer, scientists said.

Scientists are concerned about continued erosion of the ozone because they say additional ultraviolet radiation reaching Earth may cause tens of millions of additional cases of skin cancer, cataracts and immune-system diseases. Crops, water life and even climate could be affected.

The science of ice coring

Every summer, as the weather changes, the surface ice in the Arctic Ocean and the Antarctic melts a bit. Then in winter, a new layer of ice is added on top. As the ice freezes, it traps dust and air bubbles in the ice, which will remain there almost forever. Over many millions of years, these ice layers have become many hundreds of metres thick.

Scientists have found that they can figure out the past by drilling «cores» from these ice-sheets. The bubbles in the core can be analysed (using spectroscopy) to tell us what the air was like all those years ago. Bubbles from the 20th century show more carbon dioxide and CFCs in the air. Bubbles from the last Ice Age (about 18,000 years ago) show very little carbon dioxide.

As you know, carbon dioxide. You can also tell how cold or warm the winter was. Two ways – one, the level of carbon dioxide. Secondly, the thickness of that year's ice itself can tell how cold it had got. A chemical study of dust in the cores also tells you what was going on that year. For example, ice samples from 1991 show a huge amount of ash.

That's the earth's way of remembering a famous volcanic explosion. Because in 1991, Mr. Pinatubo in the Philippines exploded, covering the entire earth with a thin sheet of ash.

Tiny pollen grains are found trapped in the ice cores (pollen can travel incredibly far on tiny wind currents). Many biologists are expert at telling which kind of plants they came from. So for each layer, we know what kinds of plants were growing that year. As the Ice Age receded, there are more pollen grains of tropical plants like bananas and mangoes, and fewer grains of plants like pines, which need cold weather.

Green: the new colour of chemistry

Every day millions of tonnes of hazardous chemicals are buried underground, dumped into rivers, lakes and seas or spewed into the air. The aim of green chemistry is to develop new methods that reduce and prevent pollution.

Paul Anastas and John C. Warner of the U.S. Environmental Protection Agency laid out the Twelve Principles of green chemistry. They are the following.

1. It is better to prevent waste than to treat it after it is formed.

2. Methods for making new chemicals should be designed so that all the materials used in the reaction become part of the final product.

3. These methods should use and generate substances that possess zero danger to human health and the environment.

4. «Green» chemical products should work as well as others, and still be less toxic.

5. The use of «auxiliaries» i. e. substances like solvents, purification agents etc., should be made unnecessary; or harmless substances should be used.

6. «Green» reactions should minimize the need for conditions like high pressure or low temperature. Instead, they should be possible at normal temperature and pressure.

7. A raw material should be renewable (e. g. like biogas) rather than deplete the natural resource (like coal).

8. A «green» process should reduce the number of steps, and therefore the need for intermediate products.

9. Reagents that can be, used again and again (called catalytic reagents) should be used instead of those that are needed in large quantities (stoichiometric reagents).

10. A «green» chemical product should be designed so that when it is not needed, it can break down into harmless chemicals.

11. A «green» process should allow for monitoring and control in order to prevent the formation of hazardous substances.

12. A «green» substance or process should not carry a risk for a chemical accident, such as a fire or leak of dangerous substance.

Green chemistry has many challenges ahead of it. To encourage scientists, many countries offer prizes for new technologies that follow these principles.

Scientists list 200 key wildlife sites

Two hundred sites where 95 per cent of the world‘s wildlife could be conserved have been identified by scientists. The sites, which range from river basins and arctic tundra to tropical forests and coral reefs, are to form the backbone of a 30-nation conservation effort headed by the World Wide Fund for Nature.

Under the plan, the charity is to form partnerships with companies, governments and local people to try to preserve habitats. The campaign is also aimed at industries which are causing huge environmental damage. Industries are being urged to tackle emissions of carbon dioxide, the greenhouse gas, through energy efficiency schemes.

Advances in green chemistry

A few technical advancements have been made so far. One of the most important is the use of dry media reactions. In this, the reagents are embedded in a dry material, rather than dissolved in a solvent. The matrix can be recycled after the reaction is over, thus eliminating what would otherwise have been a huge waste of solvent.

A company called Nature Works has developed a new packaging material called polylactic acid (PLA) using the above principles. The advantage of PLA is that it is not wasteful to make, and can be recycled. If you forget to recycle it and throw it away instead, it is degraded by bacteria into harmless substances.

Make a contribution to green chemistry.

You too, can make a contribution to green chemistry by taking a small pledge, when you do your chemistry practicals.

1. Reduce Waste: Use as little of the chemicals you need.

2. Increase Safety: Don't pour hazardous substances down the sink, dispose it through the correct methods.

3. Be Efficient: Work out the reaction carefully in your notebook before you do it in the lab.

4. Save Energy: If your reaction needs heating or cooling, do it for the minimum time needed.

If you follow the pledge, you'll not only have a greener experience, but a safer and more scientific one too.

Pharmaceutical chemistry

Pharmaceutical chemistry and medicinal chemistry are disciplines at the intersection of chemistry, especially synthetic organic chemistry, and pharmacology and various other biological specialties, where they are involved with design, chemical synthesis and development for market of pharmaceutical agents, or bio-active molecules (drugs).

Compounds used as medicines are most often organic compounds, which are often divided into the broad classes of small organic molecules (e. g., atorvastatin, fluticasone, clopidogrel) and «biologics» (infliximab, erythropoietin, insulin glargine), the latter of which are most often medicinal preparations of proteins (natural and recombinant antibodies, hormones, etc.). Inorganic and organometallic compounds are also useful as drugs (e. g., lithium and platinum-based agents such as lithium carbonate and cis-platin).

In particular, medicinal chemistry in its most common guise focusing on small organic molecules encompasses synthetic organic chemistry and aspects of natural products and computational chemistry in close combination with chemical biology, enzymology and structural biology, together aiming at the discovery and development of new therapeutic agents. Practically speaking, it involves chemical aspects of identification, and then systematic, thorough synthetic alteration of new chemical entities to make them suitable for therapeutic use. It includes synthetic and computational aspects of the study of existing drugs and agents in development in relation to their bioactivities (biological activities and properties), i. e., understanding their structure-activity relationships (SAR). Pharmaceutical chemistry is focused on quality aspects of medicines and aims to assure fitness for purpose of medicinal products.

Medicinal chemistry is by nature an interdisciplinary science, and practitioners have a strong background in organic chemistry, which must eventually be coupled with a broad understanding of biological concepts related to cellular drug targets. Scientists in medicinal chemistry work are principally industrial scientists.

Most training regimens include a postdoctoral fellowship period of 2 or more years after receiving a Ph.D. in chemistry. Many medicinal chemists, particularly in academia and research, also earn a Pharm.D. Some of these PharmD/PhD researchers are RPh's.

Some entry-level workers in medicinal chemistry, especially in the U.S., do not have formal training in medicinal chemistry but receive the necessary medicinal chemistry and pharmacologic background after employment – at entry into their work in a pharmaceutical company, where the company provides its particular understanding through active involvement in practical synthesis on therapeutic projects.

Medicinal chemistry has a History

Medicinal chemistry is the application of chemical research techniques to the synthesis of pharmaceuticals. During the early stages of medicinal chemistry development, scientists were primarily concerned with the isolation of medicinal agents found in plants. Today, scientists in this field are also equally concerned with the creation of new synthetic drug compounds. Medicinal chemistry is almost always geared toward drug discovery and development.

Is carrying out basic research

Medicinal chemistry research is an important area of research that is performed in many university labs. As an assistant professor at the University Of Maryland School Of Pharmacy, Alex Mackerell, Jr. has done research on cocaine and cocaine analogs to develop drugs for the treatment of cocaine addiction. His research, however, was not solely focused on just getting a product, but also on understanding basic chemical reactions and their properties. He says, «We were interested in the physical properties and in the underlying mechanisms of cocaine». The purpose of the research was to develop a cocaine antagonist that would cause ill effects when cocaine is ingested. This type of research characterizes the research being conducted in academic environments.

Can Lead To Treatment of Diseases

Grace Smith is using her bachelor's degree in pharmaceutical chemistry for a different kind of drug development. She is a part of a team of analytical chemists at the National Institute of Health (NIH) who formulate drugs that could be used to treat patients with very rare diseases. These formulations are called orphan drugs because they are used to treat diseases found in only small portions of the population. She says, «We try to develop a treatment either from scratch or from research that has already been done in other countries. My job is challenging because it requires working with several different compounds at one time». Everyday she relies on her knowledge from her undergraduate courses in analytical and organic chemistry. She uses this basic chemistry training when testing and retesting compounds for safety and efficacy, which is the measure of how well a drug product works in the human body.

Is Developing Guidelines

Chemists as the U.S. Food and Drug Administration (FDA) review new drug applications from pharmaceutical companies and are also responsible for reviewing the processes by which the substances are made. These chemists do not work in a laboratory, but their role in medicinal chemistry is important. Charles Kumkumian is the assistant director of the Office of Drug Evaluation for the FDA that, he says, is the largest regulatory group in the world, employing more than 9,000 people. He says that there are about 900 chemists employed in various functions throughout FDA. Ten percent of these are chemists who review new drug applications for entirely new therapeutic entities. An equal number of chemists review additional new drug applications that are generic formulas or over-the-counter dosages.

Links Many Scientific Disciplines

The focus on development of new synthetic drug compounds has resulted in the incorporation of many other disciplines, such as biochemistry and molecular biology, into medicinal chemistry. «Medicinal chemistry involves working in teams with scientists from a variety of other disciplines», says James Kaminski, a senior principal scientist at Schering Plough. «There is a lot of collaboration between chemists and biologists while searching for a lead on a new drug or doing research on a preclinical drug candidate. Then, when you look into the drug safety profile, you work with toxicologists and pharmacologists».

Joel Barrish, group/project leader in pharmaceutical and drug discovery research at Bristol-Company, says that most of his time is spent coordinating the synthetic chemistry efforts of chemists in his group with other members of the project working group outside of chemistry. These areas include biology, computer-aided design, x-ray crystallography, metabolism and pharmacokinetics, legal and regulatory affairs, clinical, franchise management, pharmaceutics, and process research chemistry.

Barrish says, «Working in teams is essential to discovering drugs because many different aspects of a molecule must be defined to identify a candidate for clinical studies». He adds, «Medicinal chemistry is the drug discovery engine that provides the tools for the rest of the organization so they can determine the importance of particular biological targets». Kaminski also believes that understanding and interacting with other scientists is key to being successful in this area. Most medicinal chemists find that the opportunity to do research with other scientists while helping to new drugs is an exciting part of their work. Barrish says, «Drug discovery research is a highly creative and stimulating work environment where people are driven to succeed by personal and scientific objectives, and the desire to contribute to society's well-being».

Work Description

Medicinal chemists apply their chemistry training to the process of synthesizing new pharmaceuticals. They also work on improving the process by which other pharmaceuticals are made. Most chemists work with a team of scientists from different disciplines, including biologists, toxicologists, pharmacologists, theoretical chemists, microbiologists, and biopharmacists. Together this team uses sophisticated analytical techniques to synthesize and test new drug products and to develop the most cost – effective and environmentally friendly means of production.

Work Conditions

Medicinal chemistry offers a variety of lab opportunities. Most chemists use their research skills to formulate, produce, and analyze new compounds.

However, each lab environment is unique daily activities and career opportunities differ with each one. In academia, chemists explore a compound's different mechanisms in basic research as well as teach at least one full course. In government, laboratory work is not always required, especially at the FDA where they review drug applications. Industry, on other hand, offers chemists a choice of moving into management or staying in the lab.

Places of Employment

Though a wide array of positions exists for chemists in medicinal chemistry, the availability of these jobs is dependent upon the economy, shifting government regulations, and research grants. Employment prospects include the academic environment, pharmaceutical companies, and government. Biotechnology organizations also employ chemists in this area. Industry provides the opportunity to choose between a traditional laboratory career or a non laboratory chemistry career in management. Government also offers a choice between a laboratory position and a nonlaboratory chemistry position, such as drug application review.

Personal Characteristics

Medicinal chemists must enjoy varied activities and must be receptive to exploring the unknown. A good imagination and persistence are also two important qualities to have when considering a career in medicinal chemistry.

Being a team player with good writing and verbal communication skills are invaluable assets when interacting with scientists from other disciplines.

Education and Training

Generally, pharmaceutical companies hire only people with research experience, advanced degrees especially in organic chemistry, and at least two years of post-doctoral experience. Most chemists in traditional research careers are Ph.D. chemists while chemists with B.S. degrees generally serve as research technicians. You can place yourself in a competitive position by getting as much experience as possible with a strong background in organic chemistry and biochemistry. A number of universities have formed medicinal chemistry programs in the past 20 years.

Grammar section
Nouns suffixes and prefixes

Noun suffixes and prefixes

Суффиксы	Примеры	
Указывающие на лицо, совершающее действие		
-or, -er	read*er* lead*er* inspect*or*	читатель лидер инспектор
-ist	commun	коммунист
-ian	russ*ian*	русский
Указывающие на абстрактные понятия		
-age	marri*age*	брак
-ance, -ence	import*ance* equival*ence*	важность эквивалент
-ation, -ion, - tion	convect*ion* socializat*ion* convers*ion*	конвекция социализация конверсия
-dom	free*dom*	свобода
-hood	neibour*hood*	соседство
-ment	govern*men*t	правительство
-ness	happi*ness*	счастье
-ship	friend*ship*	дружба
-sion, -ssion	miss*ion*	миссия
-ty	reali*ty*	реальность
-th	leng*th*	длина
-ure	litera*ture*	литература
-y	chemistr*y*	химия

Adjective suffixes

Суффиксы	Примеры	
-able, -ible	change*able* sens*ible*	изменчивый чувствительный
-al	chemic*al*	химический
-ant, -ent	import*ant* differ*ent*	важный различный

-ful -ish -ive -ous -y	beauti*ful* brown*ish* talkat*ive* gener*ous* sunn*y*	красивый коричневатый болтливый щедрый солнечный

Adverb suffixes

Суффиксы	Примеры	
Указывающие на отсутствие качества		
-less	harm*less*	безвредно
Указывающие направление действия		
-ward(s)	home*wards*	домой
Указывающие характер действия		

Verb suffixes

-ly	natural*ly*	естественно
Суффиксы		Примеры
-en -ize -fy -te	to wid*en* to character*ize* to simpli*fy* to opera*te*	расширять характеризовать упрощать действовать

Numeral suffixes

количественные		
-teen	fif*teen* nine*teen*	пятнадцать девятнадцать
-ty	twen*ty* six*ty*	двадцать шестьдесят
порядковые		
-th	fif*th* fourteen*th*	пятый четырнадцатый

Prefixes

Префиксы	Примеры	
Префиксы с отрицательным значением		
un- in- im- non- dis-	*un*happy *in*visible *im*possible *non*-stop *dis*abled	несчастный невидимый невозможно безостановочно неспособный

Префикс повторности действия		
re-	to *re*read, to *re*write, to *re*construct	
Префиксы с разными значениями		
mis-	*mis*understanding	непонимание
anti-	*anti*-fascist	антифашист
co-	*co*-operation	сотрудничество
en-	*en*large	увеличивать
ex-	*ex*-president	бывший президент
in-	*in*born	врожденный
counter-	*counter*-attack	контратака
inter-	*inter*national	международный
over-	*over*value	переоценивать
pre-	*pre*historic	доисторический
post-	*post*-editing	постредактирование
sub-	*sub*division	подразделение
ultra-	*ultra*-violet	ультрафиолетовый
under-	*under*estimate	недооценивать

Nouns

Существительными принято называть слова, обозначающие названия предметов, людей, животных, растений, веществ и понятий, например: a book, a woman, a student, a dog, a flower, bread, snow, problem, love. Все существительные делятся на имена собственные (имена людей, клички животных, названия городов, улиц и т. д.), которые всегда пишутся с большой буквы: Tom, London, America, и имена нарицательные, которые подразделяются на исчисляемые и неисчисляемые существительные. К исчисляемым существительным относят названия конкретных предметов и абстрактных понятий, которые поддаются счёту, например: a pen, a horse, a question, an effort. К неисчисляемым существительным относят названия веществ и отвлечённых (абстрактных) понятий, которые счету не поддаются, например: sand, sugar, oil, time, progress.

Образование множественного числа имён существительных

Основным способом образования множественного числа имён существительных является прибавление окончания -s: a bag – bags, a cat – cats, a rose – roses.

Если существительное заканчивается на: -s, -o, -ch, - sh, -ss или -x, множественное число образуется путем добавления окончания -es.

Example: tomato – tomatoes, church – churches, bush – bushes, kiss – kisses, box – boxes.

Если слово иностранного происхождения оканчивается на -o, мы добавляем «s».

Example: kilo – kilos, photo – photos, piano – pianos, soprano – sopranos.

Имена существительные, оканчивающиеся на -y с предшествующей согласной, образуют множественное число путём прибавления окончания -es, причём -y меняется на -i. Например, a dictionary – dictionaries.

Но: a boy – boys, a day – days (перед -y стоит гласная).

Некоторые имена существительные, оканчивающиеся на -f, -fe, образуют множественное число путём изменения -f на -v и прибавлением окончания –es: a half – halves; a wolf – wolves; a wife – wives. Но: roof – roofs, safe – safes.

Ряд существительных образуют форму множественного числа особым образом.

ед. ч.	мн. ч.
woman	women
tooth	teeth
mouse	mice
sheep	sheep
datum	data
man	men
foot	feet
goose	geese
child	children
deer	deer
ox	oxen

Притяжательный падеж существительных в английском языке

Существительные в английском языке имеют два падежа: общий падеж и родительный или притяжательный падеж. В общем падеже существительные не имеют никаких окончаний и отвечают на вопрос «кто, что»; притяжательный падеж образуется путём прибавления суффикса «-s» к существительным в единственном числе, а также к тем существительным во множественном числе, которые образуют его не по правилам, например boy's, girl's, men's, children's, и отвечает на вопрос «чей». Апостроф прибавляется к существительным во множественном числе: soldiers', workers'.

Example: this is the boy's book. These are the boys' books.

Существительные в родительном падеже обычно выступают в качестве определения к другому существительному и выражают принадлежность в широком смысле слова, например: the children's toys – игрушки (чьи?) детей the parents' consent – согласие (чьё?) родителей the girl's story – рассказ (чей?) девочки; или служит описанию предмета, например: sheep's eyes – глаза, как у овцы soldiers' uniform – солдатская форма a mile's distance – расстояние в одну милю. Существительные, обозначающие неодушевлённые предметы, вещества и отвлечённые понятия, как правило, в форме родительного падежа не употребляются, а образуют оборот с предлогом «of»: Example: the windows of the house – окна дома; the handle of the door – ручка двери.

Exercises

1. *Form the plural.*

Church, sheep, restaurant, country, gentleman, leaf, wolf, man, goose, deer, student, potato, cartoon, dress, child, woman, chicken, ox, weather, library, tree, costume, progress, bone, desert, factory, science, dictionary, hair, suburbs, station, pilot, map, city, dolphin, helicopter, fish, souvenir, lorry, ship, watch, scissors, bank, advice, calendar, information, mouse, ink.

2. *Complete sentences, using words in singular or plural.*

Air, country, day, friend, meat, language, letter, patience, people, photograph, queue, space.

1. I have my camera, but I don’t take many … . 2. There are seven … in a week. 3. A vegetarian is a person who doesn’t eat … . 4. Outside the cinema there is … of people waiting to see the film. 5. I’m not very good at writing … . 6. Today I go out with some … . 7. There are very few … in the shops today. They are almost empty. 8. I’m going out for a walk. I need some fresh … . 9. George always wants things quickly. He’s got no … . 10. Do you speak any foreign … ? 11. Jane travels a lot. She has been to many … . 12. Our flat is very small. We haven’t got much … .

3. *Change, using possessive case.*

Example: the owner/that car – the owner of that car.

The jacket/that man; the top/the page; the daughter/Charles; the cause/the problem; the newspaper/yesterday; the birthday/my father; the name/this street; the toys/the children; the new manager/the company; the result/the football match; the garden/our neighbours; the ground floor/the building; the children/Don and Mary; the economic policy/the government; the husband/Catherine.

4. *Rewrite starting with the underlined word.*

Example: the meeting tomorrow has been cancelled – Tomorrow's meeting has been cancelled.

1. The storm last week caused a lot of damage. 2. The only cinema in the town has closed down. 3. Exports from Britain to the United States have fallen recently. 4. Tourism is the main industry in the region.

Pronouns

Местоимение – часть речи, которая указывает на лицо, предметы, на их признаки, количество, но не называет их: I (я), who (кто), which (который), this (этот), these (те), some (несколько) и другие. Местоимение обычно употребляется в предложении вместо имени существительного или имени прилагательного, иногда – вместо наречия или числительного.

Example: John learns English. He likes it – Джон учит английский. Он ему нравится. He is a doctor. Everybody knows him – он врач. Каждый знает его.

По своему значению и грамматическим признакам местоимения делятся на следующие разряды:

– личные (I, you, he, she, it, we, you, they);

– притяжательные (my, your, his, her, its, our, your, their; mine, yours, his, hers, its, ours, yours, theirs);

– возвратные (myself, yourself, himself, herself, itself, ourselves, yourselves, themselves);

– указательные (this, these, that, those, such);

– вопросительные (who, what, whose, which);

– неопределенные (some/any, somebody, someone, something, anybody/anyone, anything, one);

– отрицательные (no, none, nobody/no one, nothing, neither);

– обобщающие (all, every, everybody, everything, both, either, other, another, each) и другие.

Характеристики личных, притяжательных, возвратных и указательных местоимений.

Личные местоимения в именительном падеже	Личные место-имения в объектном падеже	Притяжательные местоимения	Абсолютная форма притяжательных местоимений	Возвратные местоимения	Указательные местоимения	
					ед. ч	мн. ч
I	Me	My	Mine	Myself	This – этот	These – эти
You	You	Your	Yours	Yourself	That – тот	Those – те
He	Him	His	His	Himself		
She	Her	Her	Hers	Herself		
It	It	Its	Its	Itself		
We	us	Our	Ours	Ourselves		
You	You	Your	Yours	Yourselves		
They	Them	Their	Theirs	Themselves		

Pronouns – determines

Much	много – с неисчисляемыми существительными: much time, much money, much water, much snow, much milk, much food
Many	много – с исчисляемыми существительными: many books, many students, many houses, many trees, many flowers, many rivers
Little	мало – с неисчисляемыми существительными: little time, little money, little water, little snow, little milk, little food
Few	мало – с исчисляемыми существительными: few books, few students, few houses, few trees
A little	немного – I have a little time. Wait a little. There is a little water
A few	несколько – There are a few chairs in the room. I want to tell you a few words

Exercises

1. *Use pronouns «me», «you», «him», «us», «her», «it», «them».*

1. She gives … the book and asks to return … next week. 2. Are you going to invite … to your party? 3. I don't like the film, I don't want to speak about … .4. We'll be very happy if you go on a trip with … . 5. Don't ask … this question. I don't know how to answer … . 6. If she doesn't arrive tomorrow send … a telegram. 7. I'm sorry to trouble you, but I want … to do … a favour. 8. Let's not wait for … . They are always late. 9. Do you want … to do it for … ? I don't mind … . 10. My parents are coming to see … on Saturday. I like to spend my weekend with … .

2. *Use personal or possessive pronouns in the right form.*

1. The girls are here, … came early. 2. When Roger saw Ann … spoke to … 3. The boss left an hour ago. I didn't see … . 4. Sam met Ann at the entrance, … showed … the pictures. 5. The Browns moved into a new flat. … gave … new address, so I can visit ... . 6. Jane is … sister, … is older than … am. 7. Thank … for the book … gave … . … is very interesting. 8. … like to visit … friends who live not far from … house. 9. Bill takes … guitar lesson on Monday. … is the only day … is free after college. 10. I am very happy that … cat found … kitten. 11. … flat is on the third floor, … windows face the sea. 12. I invite … to a party. … hope … will bring … husband with … .

3. *Insert much, many, few или little.*

Example: He isn't very popular. He has *few* friends.

1. Ann is very busy these days. She has … free time. 2. Did you take … photographs when you were on holiday? 3. I'm not very busy today. I haven't got … to do. 4. The museum was very crowded. There were too … people. 5. Most of the town is modern. There are … old buildings. 6. The weather has been very dry recently. We've had … rain.

4. *Insert little/a little/few/a few.*

1. We must be quick. We have … time. 2. Listen carefully. I'm going to give you … advice. 3. Do you mind if I ask you … questions?4. This town is not a very interesting place to visit, so … tourists come here. 5. I don't think Jill would be a good teacher. She's got … patience. 6. «Would you like milk in your coffee?» «Yes, please …». 7. This is a very boring place to live. There's … to do. 8. «Have you ever been to Paris?» «Yes, I've been there … times».

5. *Insert myself/yourself/ourselves or me/you/us.*

Example: Julia had a great holiday. She enjoyed *herself*.

1. It's not my fault. You can't blame … . 2. What I did was very wrong. I'm ashamed of … . 3. We've got a problem. I hope you can help …. 4. «Can I take another biscuit?» «Of course. Help …!».5. Take some money with … in case you need it. 6. Don't worry about Tom and me. We can look after … . 7. I gave them a key to our house so that they could let … in. 8. When they come to visit us, they always bring their dog with … .

6. *Insert some or any.*

Example: We didn't buy any flowers.

1. If there are … words you don't understand, use a dictionary. 2. This evening I'm going out with … friends of mine. 3. «Have you seen … good films recently?» «No, I haven't been to the cinema for ages». 4. I didn't have … money, so I had to borrow … . 5. Can I have … milk in my coffee, please? 6. I was too tired to do … work. 7. You can cash these traveller's cheques at … bank. 8. Can you give me … information about places of interest in the town? 9. With the special tourist train ticket, you can travel on … train you like.

Adjectives. Degrees of comparison

Прилагательными называют слова, обозначающие свойства или качество предметов, например: large (большой), blue (голубой), simple (простой). В предложении они обычно выполняют функцию определения к существительному или именной части составного сказуемого, например: It was early spring (Была ранняя весна). The weather is cold (Погода холодная).

Прилагательные в английском языке не изменяются ни по родам, ни по падежам, ни по числам. Сравните: a long street (длинная улица), a long table (длинный стол), long tables (длинные столы).

Как и в русском языке, в английском различают три степени сравнения прилагательных: положительную, сравнительную и превосходную. Положительная указывает на качество предмета и соответствует словарной форме, т. е. прилагательные в положительной степени не имеют никаких окончаний: difficult (трудный), green (зелёный). Часто, когда говорят о равной степени качества разных предметов, употребляют союз «as ... as» (такой же..., как) или его отрицательный вариант «not so ... as» (не такой ..., как). The line AB is as long as the line CD (Линия AB такая же длинная, как и линия CD).

Если нужно указать, что один предмет обладает более выраженным признаком по сравнению с другим предметом, то употребляют прилагательное в сравнительной степени, которое образуется путём прибавления суффикса «-er» к основе прилагательного, состоящего из одного или двух слогов, например: short – shorter (короткий – короче).

Обратите внимание, что на письме конечный согласный удваивается, чтобы сохранить закрытый слог: hot – hotter (горячий – горячее).

Если основа прилагательного оканчивается на букву «-y» с предшествующим согласным, то при прибавлении суффикса «-er» буква «-y» переходит в «-i»: dry – drier (сухой - более сухой).

При сравнении разной степени качества употребляется союз «than» (чем). The line AB is longer than the line CD (Линия AB длиннее, чем линия CD).

Сравнительная степень прилагательных, состоящих из более, чем двух слогов, образуется при помощи слова «more» (более): useful (more useful); полезный (более полезный); The Russian language is more difficult than the English one (русский язык сложнее английского).

Превосходная степень указывает на высшую степень качества предмета и образуется при помощи суффикса «-est», от односложных и двусложных прилагательных или слова «most», от некоторых двусложных и более длинных прилагательных. Причём при прибавлении суффикса «-est» сохраняются те же правила, что и для суффикса «-er». Поскольку данный предмет выделяется из всех прочих подобных ему предметов по своему качеству, то перед прилагательными в превосходной степени обычно употребляют определённый артикль «the»: large – the largest (большой – самый большой); hot – the hottest (горячий – самый горячий); dry – the driest (сухой – самый сухой); useful – the most useful (полезный – самый полезный); It's the most difficult rule of all (это самое трудное правило из всех).

В английском языке существует ряд прилагательных, которые образуют степени сравнения не по общим правилам.

Положительная степень	Сравнительная степень	Превосходная степень
good (хороший)	better (лучше)	(the) best (самый лучший)
bad (плохо)	worse (хуже)	(the) worst (самый плохой)
much, many (много)	more (больше)	(the) most (больше всего)
little (мало)	less (меньше)	(the) least (меньше всего)
well (хорошо)	better (лучше)	best (лучше всего)
far (далеко)	farther, further (дальше)	farthest, furthest (дальше всего)

Многие наречия (в основном наречия образа действия) имеют степени сравнения: положительную, сравнительную и превосходную, которые образуются так же, как и степени сравнения прилагательных.

1. Односложные наречия и наречия early.

fast – быстро	faster – быстрее	(the) fastest – быстрее всего
soon – скоро	sooner – скорее	(the) soonest – скорее всего
early – рано	earlier – раньше	(the) earliest – раньше всего

2. Наречия, образованные от прилагательных при помощи -ly.

clearly – ясно	more clearly – яснее	(the) most clearly – яснее всего
	less clearly – менее ясно	(the) least clearly – наименее ясно

3. Наречия well (хорошо), badly (плохо), much (много), little (мало), far (далеко) образуют степени сравнения от других корней.

well – хорошо	better – лучше	(the) best – лучше всего
badly – плохо	worse – хуже	(the) worst – хуже всего
much – много	more – больше	(the) most – больше всего
little – мало	less – меньше	(the) least – меньше всего
far – далеко	farther – дальше	(the) farthest – дальше всего
	further – дальше	(the) furthest – дальше всего

Exercises

1. *Complete sentences, using comparative degree*.

Example: It's too noisy here. Can we go somewhere *quieter*?

1. You hardly ever phone me. Why don't you phone me … . 2. This coffee is very weak. I like it a bit … . 3. The hotel was surprisingly big. I expected it to be … . 4. My job is a bit boring sometimes. I'd like to do something … . 5. The weather is too cold in this country. I'd like to live somewhere … . 6. The hotel was surprisingly cheap. I expected it to be … . 7. I was surprised how easy it was to use the computer. I thought it would be …. 8. Your work isn't very good. I'm sure you can do … . 9. Don't worry. The situation isn't so bad. It could be … . 10. I was surprised we got here so quickly. I expected the journey to take … . 11. You're talking very loudly. Can you speak a bit … .

2. *Complete sentences, using comparative degree. Use «than» where necessary.*

Big crowded early easily high important interested peaceful reliable serious simple thin

Example: I was feeling tired last night, so I went to bed *earlier than* usual. I'd like to have a *more reliable* car. The one I've got keeps breaking down.

1. Unfortunately her illness was … we thought at first. 2. You look … Have you lost weight? 3. I want a … flat. We don't have enough space here. 4. He doesn't study very hard. He's … in having a good time. 5. Health and happiness are … money. 6. The instructions were very complicated. They could have been … . 7. There were a lot of people on the bus. It was … usual. 8. I like living in the countryside. It's … living in a town.

3. *Complete sentences, using superlative degree and preposition*.

Example: It's a very nice room. It *is the nicest room in* the hotel.

1. It's a very cheap restaurant. It's … the town. 2. It was a very happy day. It was … my life. 3. She's a very intelligent student. She … the class. 4. It's a very valuable painting. It … the gallery. 5. Spring is a very busy time for me. It … the year.

4. *In the following sentences use one of + a superlative + a preposition.*

Example: It's a very nice room. It *is one of the nicest rooms in* the hotel.

1. He's a very rich man. He's one … the world. 2. It's a very old castle. It … Britain. 3. She's a very good player. She … the team.

5. *Open brackets, using much /a bit and comparative degree of given words. Use «than» where necessary.*

Example: Her illness was *much more serious than* we thought at first. (much/serious)

1. This bag is too small. I need something …. (much/big) 2. I'm afraid the problem is … it seems. (much/complicated) 3. You looked depressed this morning but you look …now. (a bit/happy) 4. I enjoyed our visit to the museum. It was … I expected. (far/Interesting) 5. You're driving too fast. Could you drive …? (a bit/slowly) 6. It's … to learn a foreign language in the country where it is spoken. (a lot/easy) 7. I thought she was younger than me but in fact she's … (slightly/old)

6. *Translate sentences.*

Сегодня гораздо холоднее, чем было вчера. Теперь у меня уходит больше времени на дорогу, чем раньше. Во время спортивного кросса Дейв пробежал больше, чем остальные участники. В этом году я сдам экзамены успешнее, чем в прошлом. Автобус едет дольше, чем поезд. Наш университет значительно больше вашего. Эта книга гораздо интереснее, чем предыдущая. Путешествовать пароходом комфортнее, чем поездом. Эти задания значительно сложнее. Вы себя лучше чувствуете? Этот костюм красивее, но гораздо дороже. Говорят, что английский язык изучать легче, чем остальные. Наша новая квартира просторнее предыдущей.

The Article

Артикль служит определителем имени существительного, он передает значение определенности и неопределенности в существительном и при этом собственного, отдельного вещественного значения не имеет.

Неопределённый артикль *a* (*an* – перед словами, начинающимися с гласной) может сочетаться только с существительными в единственном числе. Неопределенный артикль происходит от числительного *one.*

Означает *один из многих, какой-то, любой* (Have you a sister or a brother? A cow gives milk. A ball is round).

Употребляется в значении *один:* wait a minute! We walked a mile or two.

Употребляется с существительными, обозначающими время, скорость, вес, расстояние: a minute, a pound, a hundred, a million.

Определённый артикль *the* происходит от указательного местоимения *that.* Употребляется перед существительными как в единственном, так и во множественном числе.

Определённый артикль употребляется, когда:

– из ситуации или контекста ясно, какое именно лицо или предмет имеется ввиду: they went to the station. Close the window and turn on the light;

– после существительного имеется определение, выделяющее лицо или предмет из ряда им подобных/ The book that (which) I gave you yesterday is very interesting;

– перед существительным стоит определение, выраженное: порядковым числительным. January is the first month of the year;

– перед прилагательным в превосходной степени. This is the biggest building in our town;

– перед словами same, right, very, only и др. Are we on the right road? Do you eat the same food every day?

– существительное обозначает предмет, единственный в своем роде или в определенной ситуации. The moon moves round the Earth. The sun shines by day in the sky;

– существительное обобщает весь класс подобных лиц (предметов). The clown first appeared in the English circus. The horse is a useful domestic animal.

Артикли не употребляются:

– перед неисчисляемыми существительными. I like milk. The socks are made of thick grey wool;

– перед существительными в значении обращения. Good morning, sweet child!

– перед названиями времен года. Summer is my favourite season. When winter comes, the weather gets cold;

– перед названиями приемов пищи. We have breakfast and supper at home, but we don’t have dinner at home;

– перед существительными, обозначающими общественные учреждения. School, hospital, prison.

Using/disusing article with nouns

Определенный артикль the	
географические названия и части света	the North Pole, the east, the west и др.
названия рек	the Volga, the Thames, the Nile
названия озер (без слова lake)	the Ontario
названия морей и океанов	the Black sea, the Pacific Ocean
названия горных цепей	the Urals, the Alps, the Caucasus
названия пустынь	the Sahara, the Karakum
названия каналов	the Panama Canal, the English Channel
названия некоторых государств и республик (со словами republic, Kingdom, state, federation)	the USA, the Russian Federation, the United Kingdom
названия большинства газет	the Times, the Washington Post
фамилии, называющие всю семью	the Browns, the Forsytes
названия достопримечательностей	the Kremlin, the Hermitage
Артикли не употребляются	
названия городов и стран	Moscow, New York, London
названия гор	Everest, Kilimanjaro
названия улиц и площадей	Downing Street, Red Square
имена	Tomas Smith, Ivan Petrov
дни недели, месяцы	Monday, Sunday, February, June
виды спорта, научные области знаний	basketball, hockey; sociology, physics

Exercises

1. *Insert article where necessary.*

1. «What do you do?» – «I'm a student. I am … first – year student». 2. They are … first– year students. 3. «Is Helen … student or … teacher?» – «She is … student». 4. This … young man is … student of … group № 3. 5. This is … good room. 6. «What room is this?» – «This is … room 25». 7. Is Mary from … Manchester or from … Glasgow? 8. … Thames is … long river. 9. His … room is good. 10. Read … first sentence, please. 11. Are ... Thompsons in … Middle East now? – Yes, they are. 12. My … father is … economist. He is at … home now. 13. I gave … magazine to my … friend. 14. I usually wear … cap. 15. Give me … pen. This … pen is bad. Give me another … pen. 15. Nick will show …book to … teacher.

2. *Insert article where necessary.*

1. After … work I usually go home. 2. He often comes to … work late. 3. I begin my work at … half past eight. 4. Close … window, please. It is cold in … room. 5. She is eating … apple. 6. He made … mistake in his dictation. 7. … lion is … wild animal. 8. I need … pencil. Give me … pencil, please. 9. Yesterday our team won … match. 10. He is not … man I am looking for. 11. I don't go to … school on … Sunday. 12. Are there any … flowers in … vase? 13. She lives on … fifth floor. 14. This … young woman is … engineer. 15. That man has two children. … first child was born 5 years ago and … second was born … last year. 16. Do you like … city? – It is one of … most beautiful cities in … world.

3. *Insert article where necessary.*

1. … London is … capital of … Great Britain, … full name of which is … United Kingdom of … Great Britain and … Northern Ireland. 2. Volga is fabulous river. It is one of … most beautiful … rivers in … Russia. 3. They used to spend their summer holidays on … Black Sea coast in … Crimea. 4. Many European adventurers crossed … Atlantic Ocean in … search of … riches on … American continent prior to … Columbus. 5. … Gorki Street was renamed into … Tverskaya Street. 6. … Red Square and … Kremlin are … heart of … capital. 7. … St. Petersburg was founded on … banks of … Neva by Peter … Great. 8. … Johnsons are our next-door neighbors. 9. … Canada is situated in … northern part of … North America. 10. We left for … East on … following morning. 11. They passed many coal mines on … way.

12. He arrived in … New York on … very rainy day. 13. She spent several hours at … Bronx Zoo on … Monday. 14. They took … wonderful boat ride around … Manhattan on … last day of their visit.

4. *Insert article where necessary.*

1. I don't usually like staying at … hotels, but last summer we spent a few days at … very nice hotel by … sea. 2. … tennis is my favourite sport. I play once or twice … week if I can, but I'm not … very good player. 3. I won't be home for … dinner this evening. I'm meeting some friends after … work and we're going to … cinema. 4. … unemployment is very high at the moment and it's very difficult for … people to find … work. 5. There was … accident as I was going … home last night. Two people were taken to … hospital. I think … most accidents are caused by … people driving too fast. 6. Carol is … economist. She used to work in … investment department of … Lloyds Bank. Now she works for … American bank in … United States. 7. A: What's … name of … hotel where you're staying? B: … Imperial. It's in … Queen Street in … city centre. It's near … station. 8. I have two brothers. … older one is training to be … pilot with … British Airways. … younger one is still at … school. When he leaves … school, he hopes to go to … university to study … law.

Verb *to be*

Формы глагола to be в настоящем простом времени.

Утвердительная форма	Вопросительная форма	Отрицательная форма
I am He (she, it) is We (you, they) are	Am I? Is he? Are we?	I am not He is not We are not

Глагол *to be* не требует вспомогательного глагола для образования вопросительной и отрицательной формы.

Глагол *to be* употребляется в качестве смыслового глагола, глагола-связки в составном именном сказуемом и вспомогательного глагола.

1. В роли смыслового глагола to be соответствует в русском языке глаголам «быть», «находиться». В этом случае в настоящем времени *to be* на русский язык не переводится, например: Pete is at college (Петя в колледже).

2. В роли глагола-связки в составном именном сказуемом to be соответствует в русском языке глаголам «быть», «являться», «состоять», «заключаться». В настоящем времени связка на русский язык тоже часто не переводится: He is a student (Он студент).

3. В роли вспомогательного глагола *to be* употребляется для образования всех времен групп Continuous и страдательного залога (Passive Voice). В этом случае to be не имеет самостоятельного значения, а выполняет лишь различные грамматические функции, являясь показателем времени, лица, числа, залога и т. д. Само же действие выражается смысловыми глаголами: She is translating the text now (Она переводит текст сейчас). The theatre was built a year ago (Театр был построен год назад).

В прошедшем времени глагол *to be* имеет форму *was* для местоимений I, he, she, it и were для you, we, they.

В будущем времени *shall be* или *will be*.

Exercises

1. *Conjugate verb to be in Present Simple.*

1. I am 18. 2. I am married. 3. I am a student.

2. *Make the sentences negative and interrogative.*

Example: Oxygen is a gas. Is oxygen a gas? Oxygen is not a gas.

1. My parents are pensioners. 2. I am 18. 3. We are students. 4. They are very active elements.

The verb «got»

Как самостоятельный глагол *to have* в настоящем времени (Simple Present) имеет 2 формы: have для всех лиц, кроме 3-го лица единственного числа, и has для 3-го лица единственного числа, в прошедшем времени (Simple Past) – had, в будущем (Simple Future) – shall have, will have.

Значение этого глагола – «иметь, владеть, обладать». Часто в разговорной речи вместо have, has употребляется сочетание have got, has got (краткие формы 've got и 's got) с тем же значением, особенно когда речь идёт о временном владении или только что приобретённом предмете или предметах: We've got a nice flat. У нас хорошая квартира. Have you got any pets? У вас есть домашние животные? Yes, a dog and a cat. Да, собака и кошка.

В вопросительной форме в британском варианте языка глагол have часто стоит перед подлежащим, в американском варианте вопросительная и отрицательная формы всегда образуются с помощью вспомогательного глагола do: do you have a car?

Exercises

1. *Use verbs «to be» or «to have» Present, Past, Future Simple.*

1. You … welcome. 2. The metro station … far from house. 3. Mary and Nelly … friends. 4. She … out. 5. It … 5 o'clock now. 6. She … a nice flat. 7. We … a little child. She … four. 8. They … a big car. 9. How … you? 10. How many little children …. they? 11. We … a small cottage. 12. He … bad habits. 13. How old … Mary? 14. What country … she from? 15. We … well. 16. She … at home. 17. He … no time. 18. How far … it from here? 19. It … easy to ask him about it. 20. It … not good of her to say so. 21. She … two mistakes in the test. Her mistakes … bad. 22. They … glad to see her. 23. It … a rainy day, … he an umbrella with him? 24. My parents … proud of me.

2. *Make the sentences from the words. Make the sentences negative and irrogative.*

1. Her name is Lucy. 2. Ted is nine. 3. Her face is round. 4. He is nice. 5. It is a good film. 6. My flat is fine. 7. I am happy. 8. They are clever. 9. Her baby is in bed. 10. She has a white dress. 11. They have a four year old son. 12. You have a big car. 13. We have many English books. 14. The house has five floors. 15. He has many uncles and aunts. 16. His cat is black. 17. We are at the university. 18. You are pale. 19. It is a nice day. 20. They are late. 21. She is from Russia. 22. It is time to go to bed. 23. You're a first-year student. 24. It's cold today. 25. We are glad to see them.

3. *Make the sentences from the words. Make the sentences negative and interrogative.*

1. A computer, machine, is, a very specific, really. 2. Can, remember, a computer, information. 3. The information, a computer, stores, in, its «memory». 4. Problems, solve, the most difficult, the science, computers, of, can. 5. Computers, questions, rockets and planes, answer about, bridges and ships.6. Replace, routine tasks, a computer, people, can, in, dull.

4. *Translate into English.*

1. Ане восемнадцать лет. Она студентка. 2. У наших родственников будет новая квартира. 3. У меня нет автомобиля. 4. У моего дяди большая семья. 5. Мамы нет, она на работе. 6. Семь часов. Пора вставать. 7. Холодно. У вас есть камин? 8. Дом моих родителей недалеко от Москвы. 9. По вечерам они всегда бывают дома. 10. Студенты в аудитории, у них сейчас лекция. 11. Эта книга была у нас в библиотеке. 12. Фильм неинтересный.

13. Она говорит, что у нее нет времени. 14. Ты сейчас занята? 15. Сколько вам лет? 16. Интересно, дома ли он сейчас? 17. В это время они обычно обедают. 18. Летом здесь очень жарко, но у нас есть бассейн. 19. Спроси его, почему он сердится. 20. Джон сейчас на Средиземном море. Я полагаю, он там хорошо проводит время.

Construction there + to be

Конструкция *there is* указывает на наличие какого-то предмета или лица в каком-то определенном месте или на событие, происходящее в указанное время.

Глагол to be может стоять в настоящем, прошедшем и будущем временах (Present, Past, Future Simple) и согласуется с последующим существительным.

На русский язык предложения с этой конструкцией переводятся глаголами «*имеется, есть, находится*» или не переводятся совсем. Рекомендуется переводить, начиная с обстоятельства места.

Утвердительная форма

There is oxygen in the atmosphere (в атмосфере есть кислород). There were many students at the lecture yesterday (на лекции вчера было много студентов). There will be English classes in our College in a week (через неделю в нашем колледже будут занятия по английскому языку).

Вопросительная форма

В вопросительной форме глагол to be ставится перед словом there: is there oxygen in water? (В воде есть кислород?) Was there fresh air in the laboratory? (В лаборатории был свежий воздух?) Will there be problem here? (В этом будет проблема?)

Отрицательная форма

Для образования отрицательной формы отрицание no ставится после конструкции there is (there are) There is no life on that planet. (На этой планете нет жизни.) There was no fresh air in the laboratory. (В лаборатории не было свежего воздуха.) There will be no life on the Moon. (На Луне не будет жизни.)

В кратких отрицательных ответах используется отрицание not: is there a clock on the table? No, there is not.

	present	past	future
Утвердительная форма	there is a metal there are metals	there was a metal there were metals	there will be a metal there will be metals
Вопросительная форма	is there a metal? are there metals?	was there a metal? were there metals?	will there be a metal? Will there be metals?
Отрицательная форма	there is no metal there isn't any metal there are no metals there aren't any metals	there was no metal there wasn't any metal there were no metals there weren't any metals	there will be no metal (metals) there won't be any metal (metals)

Exercises

1. *Read and translate the sentences.*

1. There is oxygen in the air. 2. There is no life without oxygen. 3. How many students are there in your group? 4. There were many new words in that text. 5. There will be a new theatre in our district. 2. Make the sentences negative and interrogative. 1. There was an interesting article in this newspaper yesterday. 2. There will be 15 faculties at this new university. 3. There is water on the earth and in the atmosphere. 4. There are mistakes in this work. 5. There were 2 institutes in our city 30 years ago.

3. *Ask question with «How many…?».*

Example: There are many new words in this exercise. How many new words are there in this exercise?

1. There were 5 exams last term. 2. There are 2 terms each year .3. There will be many English books in our library. 4. There are 13 old houses in our street.

4. *Change the sentence using «there is» («there are»).*

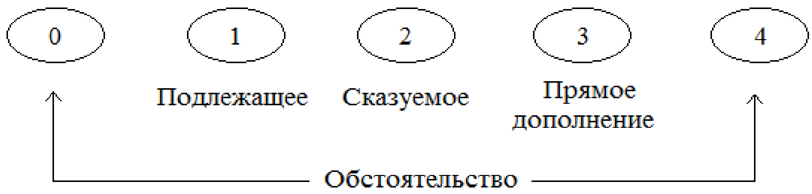
Example: A very rare metal is found in this alloy. There is very rare metal in this alloy.

1. Water is found in the air. 2. Oxygen is found in water. 3. Microscope is found in this room. 4. Oxygen is found in the atmosphere.

Word order

В английском языке существует твердый порядок слов в предложении.

Формула порядка слов



Подлежащее обычно выражается существительным или местоимением без предлога. Сказуемое выражается глаголом в личной форме. Прямое дополнение обычно выражается существительным или местоимением без предлога. Обстоятельство обычно выражается предложной группой существительного, местоимением или неличными формами глагола.

Определение входит в группу подлежащего или дополнения и обычно выражается прилагательным, существительным с предлогом of, неличными формами глагола и т. д.

Exercises

1. *Составьте предложения из следующих слов.*

1. a gas, element, is, nitrogen, the. 2. support, it, not, does, life. 3. is, called, the, oxidation, reaction. 4. is, but, it, different, very, oxygen, from. 5. live, cannot, alone, oxygen, we, in.

Types of questions in English

Выделяют следующие основные типы вопросов, используемые в английском языке.

1. Общий вопрос (general) относится ко всему предложению в целом, и ответом на него будут слова yes или no: Do you like cheese? – Yes, I do. Are you a schoolboy? – No, I am not. Have you seen this film? – Yes, I have.

Порядок слов в общем вопросе:

1. Вспомогательный (модальный, глагол-связка) глагол.
2. Подлежащее (существительное или местоимение).
3. Смысловой глагол (или дополнение).

2. Специальный вопрос (special) относится к какому-нибудь члену предложения или их группе и требует конкретного ответа: What is your name? – My name is Jim. Where do you live? – I live in London.

Порядок слов в специальном вопросе:

1. Вопросительное слово (what, where, who, when, how и т. д.).

2. Вспомогательный (модальный, глагол-связка) глагол.

3. Подлежащее.

4. Смысловой глагол.

5. Дополнения, обстоятельства.

Обратите внимание: в специальных вопросах, обращенных к подлежащему в Present и Past Simple, не употребляется вспомогательный глагол to do (did) и сохраняется прямой порядок слов: Who wants to live forever?

3. Альтернативный вопрос (alternative) предполагает выбор из двух возможностей: Do you like coffee or tea? (Вы любите кофе или чай?)

Альтернативный вопрос начинается как общий вопрос, затем следует разделительный союз *or* и вторая часть вопроса.

4. Разделительный вопрос (Tail or Tag Question) состоит из двух частей.

Первая часть представляет собой повествовательное предложение, вторая, отделенная от первой запятой, – краткий вопрос. You like tea with sugar, don't you? (Вы любите чай с сахаром, не так ли?)

Обратите внимание: глагол во второй части разделительного вопроса должен, как правило, соответствовать глаголу в первой его части: You are a student, aren't you? You have a brother, haven't you? You like cheese (play football, drink water и т. д.), don't you?

В последнем случае глагол *to do* будет использоваться со всеми глаголами, по отношению к которым он будет вспомогательным.

Если в повествовательной части разделительного вопроса содержится утверждение, то во второй – отрицание. Если в повествовательной части – отрицание, то во второй части – утверждение: You don't like fish and chips, do you?

Exercises

1. *Make up general questions to the sentences*.

1. There is a tea-pot on the table. 2. I work from nine to ten. 3. We are leaving for Hamburg next Saturday. 4. I have been busy the whole evening. 5. My friend studied in Sorbonne when he was young. 6. It is winter. 7. I can swim in cold water. 8. I had to go there in the daytime. 9. I will show you how to do it. 10. You must work hard. 11. She didn 't play well that evening. 12. I can't read English authors in the original. 13. I wasn't prepared to this sort of questions.

2. *Make up special questions:*

– к подлежащему;
– к сказуемому;
– к дополнениям, обстоятельствам.

Обратите внимание: в ряде случаев, чтобы поставить вопрос, приходится значительно видоизменять исходное предложение - мы задаем вопросы не к конкретным словам, а к заложенным в них значениям. Например, если требуется поставить вопрос к сказуемому в предложении с пассивной конструкцией, такой как: The man was run over by a car , то лучше, осмыслив, что произошло с подлежащим, так и спросить: What happened to the man?

1. John visited me in the hospital yesterday. 2. A yellow bird fell on the roof of his «Pontiac». 3. I was taken by surprise. 4. Despite the stormy weather he was able to swim to the shore. 5. He couldn't reach the hammer which lay on the shelf. 6. Our bus was broken into. 7. I have been cheated by the best friend. 8. A girl from Barbados wrote a letter to the BBC. 9. The clock stopped an hour ago. 10. You have to stop near the traffic lights.

3. *Make up alternative and tag questions.*

1. I like my tea with cream. 2. He decided to go to the theatre. 3. John had to walk to the village. 4. Although the weather was fine they decided to stay at home. 5. Last winter our class visited Rome. 6. I'm used to drinking a glass of milk before going to bed. 7. We were invited to stay at the castle for a fortnight. 8. I'm fond of opera. 9. We are going to Moscow with my brother today. 10. If I don't pass the exams I'll try to do it again next time.

The Verb

Глагол – часть речи, которая обозначает действие или состояние лица или предмета. Глагол в английском языке обладает гораздо более сложной, чем в русском, системой видовременных форм. Эта система охватывает личные формы (Finite) и неличные формы (Non-finite Forms).

Личные формы глагола выражают следующие категории: лицо, число, время, вид, залог, наклонение. Личная форма, как и в русском языке, в предложении всегда употребляется в функции сказуемого.

We live in Russia (Мы живём в России); they write letters every day. (Они пишут письма каждый день); do you hear what he is saying? (Вы слышите, что он говорит?).

Base forms of verbs

Infinitive to write to develop	Past Simple wrote developed	Participle II written developed	Participle I (-ing форма) writing developing

Инфинитив представляет собой неличную форму глагола, которая только называет действие. Он не имеет ни лица, ни числа и соответствует неопределённой форме глагола в русском языке. В словаре глагол даётся обычно в форме инфинитива. Формальным признаком инфинитива является частица to.

По способу образования 2-я и 3-я формы все глаголы английского языка делятся на правильные (стандартные) и неправильные (нестандартные).

English verb tenses. Active voice

Время	Образование
Simple показывает действие как факт (обычное, повторяемое)	глагол в личной форме
Continuous показывает действие как процесс	to be + ing
Perfect показывает действие, законченное до определённого момента в настоящем, прошедшем и будущем	to have + причастие II
Perfect Continuous показывает действие, начатое некоторое время назад и все ещё продолжающееся или только что закончившееся	to have been + ing

Modal verbs

Модальные глаголы не обозначают действия или состояния, а лишь передают отношение говорящего к действию, выраженному инфинитивом. Модальные глаголы могут показывать, что говорящий рассматривает действие как возможное, желательное, необходимое, сомнительное, допустимое, требуемое и т. д. I can’t go with you (Я не могу идти с вами); We must go now (Теперь нам надо идти).

Модальные глаголы отличаются от других глаголов рядом особенностей.

1. Они не изменяются по лицам и не имеют окончания -s в 3-м лице единственного числа.

2. У них нет неличных форм – инфинитива, причастия и герундия, а следовательно, нет и аналитических видовременных форм.

3. За исключением глаголов *can (could)* и *may (might)* модальный глагол имеет только одну форму.

4. Инфинитив смыслового глагола, следующий за модальным глаголом (за исключением ought), употребляется без частицы *to*.

5. В вопросительном и отрицательном предложениях модальный глагол употребляется без вспомогательного глагола. В вопросительном предложении перед подлежащим ставится сам модальный глагол, в отрицательном отрицание *not* присоединяется к модальному глаголу.

Наиболее употребительны следующие модальные глаголы.

Can (could). Выражает:

– умение, физическую и умственную возможность, способность (Can you skate?);

– возможность выполнения действий при соответствующих обстоятельствах (You can see the forest through the other window);

– разрешение или просьбу (Can you use your car? You can use my car);

– сомнение и неуверенность (Can it be true?);

– невероятность (It can’t be true).

May (might). Выражает:

– разрешение (May I borrow you pen?);

– предположение с оттенком неуверенности (He may be ill);

– неодобрение или упрек (You might have helped me).

Must. Выражает:

– обязательность совершения действия (You must talk to your son about his future);

– запрещение (He must not leave his room for a while);

– предположение, граничащее с уверенностью (Your father must be eighty now.)

To have to. Выражает:

– обязанность (He had to do it.);

– отсутствие необходимости (You don’t have to go there).

To be to. Выражает:

– долженствование, необходимость как результат договоренности (We are to discuss it next time).

Should и *ought to*. Выражают:
– моральное обязательство (You should (ought to) be always polite);
– порицание прошлого действия (You should (ought to) have helped me);
– совет (You should (ought to) see a doctor);
– предположение (He should (ought to) be at home).

Exercises

1. *Insert modal verbs may (might) or can (could).*

1. … you help me? 2. I … not imagine her speaking in public: I knew that she was so shy. 3. Something was wrong with the car: he … not start it. 4. A fool … ask more questions than a wise man … answer. 5. She asked me if she … use my telephone. 6. … I use your pen? 7. … find a pen on that table. 8. The school was silent: nothing … be heard in the long dark corridors. 9. You … take this book: I don't need it. 10. You … read this book: you know the language well enough.

2. *Complete the sentences using should or ought to.*

1. You … follow instructions before taking medicines. 2. It's very late. Children … be in bed. 3. You … not smoke here. 4. It's his anniversary next week. Maybe we … to sent him a telegram. 5. Her room is dirty. She … clean it. 6. This hotel is very expensive. You … not stay here. 7. She drives very fast. She … drive carefully. 8. They … not let the children see such films.

3. *Complete the sentences using must, have to, ought to, should***.**

1. If you want to be fit, you … not eat cake, but you certainly… walk a lot. 2. I'm late. I … hurry. 3. We … wait an hour for them. 4. … you get up very early on Saturday or Sunday? 5. There is light in the house, somebody … be in. 6. We … reach the station in half an hour. 7. His English … be giving him a lot of trouble. 8. The bus we took didn't go up the hill and we … walk. 9. The doctor says I … stay in bed for a week. 10. Every child … know traffic rules. 11. My parents are going out to a party tomorrow and I … stay with my younger brother. 12. It's dark outside, it … be about 7 now. 13. You … not eat so many sweets because they contain a lot of calories. 14. When he was at the university he … work to pay his own tuition (плата за обучение). 15. You … not speak to your mother like this. 16. … I offer her my help? 17. They got married at last. They … be very happy. 18. She … know the truth, you … tell her. 19. Why … I do somebody else's work? 20. Mother leaves early on Mondays and he … make his breakfast himself. 21. It's 2 o'clock, you … be hungry. 22. I think you … give up smoking. 23. Why … they worry if they're paid so well?

4. *Translate the sentences using modal verbs can, could, may, might.*

1. У детей богатое воображение, они могут легко придумывать различные истории. 2. Ты можешь взять словарь, он мне больше не нужен. 3. Неужели это правда, что она вышла замуж за Джона? 4. Не может быть, чтобы вы этому действительно верили. 5. Я могла бы вам это сразу сказать, но мне не хотелось вас расстраивать. 6. Можете зайти к нам после семи, если хотите. 7. Возможно, меня летом не будет в городе. 8. Не возвращайте эту книгу в библиотеку, она может вам понадобиться. 9. Ты могла бы посоветоваться с сестрой. 10. Вы могли бы быть вежливее с ним! Ведь он старше вас. 11. Неужели ребенок все еще спит? 12. Неужели они опоздали на поезд? 13. Оливер спросил, можно ли ему получить еще тарелку каши? 14. Я могла бы вас встретить, но не получила вашего письма. 15. Можно мне занять это место? 16. Больному стало лучше. Вы можете навестить его завтра.

Simple tenses

В английском языке различают три простых времени: настоящее простое (Present Simple), прошедшее простое (Past Simple) и будущее простое (Future Simple).

Времена группы Simple употребляются для обозначения обычных, регулярных действий в настоящем, прошедшем или будущем, а также для описания последовательных действий и констатации фактов.

Present Simple

Глаголы в Present Simple совпадают по форме с инфинитивом (неопределенной формой), но употребляются без частицы «to». В 3-м лице единственного числа глаголы имеют окончание -(e)s.

I form	We form
You form	You form
He/ She/ It forms	They form

Окончание -s произносится как [s] после глухих согласных и как [z] после звонких согласных и гласных:

He works [wə:ks]. He sees [si:z]. He learns [lə:nz].

Вопросительная и отрицательная формы (кроме глагола to be) образуются с помощью вспомогательного глагола «do» или «does» в 3-м лице единственного числа.

Do I form?	Do we form?
Do you form?	Do you form?
Does He/ She/ It form?	Do they form?

Отрицательная форма:
I do not (don't) form.
You do not (don't) form.
He/ She/ It does not (doesn't) form.
We do not form.
They do not form.

Present Simple часто употребляется с наречиями, выражающими частотность: *always* всегда, *often* часто, *seldom* редко, *sometimes* иногда, *never* никогда, *hardly ever* почти никогда, *nearly always* почти всегда, *usually* обычно, *generally* как правило, *every day* каждый день (*week, month, year* – неделю, месяц, год).

Exercises

1. *Conjugate the verbs.*

to support, to burn, to combine, to read, to write.

2. *Use auxiliary verbs «do» or «does».*

1. … he live in Kazan? 2. … oxygen support combustion? 3. … they Know about it? 4. … the students translate texts?

3. *Identify in what person and number the verbs are.*

My friend translates, they live, he studies, I form, we read.

4. *Ask your partner and listen to his/her answer.*

Example: Oxygen supports combustion.
– Does oxygen support combustion?
– Yes, it does. (No, it doesn't).

1. My sister reads much. 2. I go to the cinema every week. 3. We air the room in the mornings. 4. He studies all forms of life.

5. *Disprove the statements.*

Example: He studies chemistry.
He doesn't study chemistry.

1. Colours form spectrum. 2. It forms water. 3. You live in Moscow. 4. Gases of the atmosphere combine.

6. *Open the brackets using verbs in Present Simple. Make the sentences negative or interrogative.*

1. Her brothers always (to tell) the truth, she sometimes (to lie). 2. They (to laugh) a lot, she (to cry) a lot. 3. We (to eat) much, she (to eat) little. 4. I (to like) meat, she (to like) fish. 5. We (to go) to the disco three time a week, he never (to go) there. 6. They (to ask) questions, my little sister (to ask) many questions too. 7. My brother and I always (to help) our mother with the housework, but our sister never (to help) her. 8. I always (to give) her good advice, she (to follow) it. 9. You (to like) ballet, she (to like) opera. 10. My friends often (to visit) me, my girlfriend never (to visit) me. 11. We always (to get) up early, she always (to get) up late. 12. We (to be) from Moscow, she (to be) from Canada. 13. They (to make) friends easily, she hardly (to make) friends. 14. They (to look) very happy, she (to look) unhappy. 15. My friends (to go) to the Crimea every summer, she (to go) to the Caucasus every summer. 16. We (to drive) slowly, he (to drive) fast. 17. They (to speak) Spanish and Italian, she (to speak) English.

7. *Complete the sentences using these verbs.*

believe, eat, flow, grow, make, rise, tell, translate, speak, drink, cause, live
1. Ann … German very well. 2. Rice … in Britain. 3. I never … coffee. 4. The sun … in the east. 5. Bees … honey. 6. Vegetarians … meat. 7. An atheist … in God. 8. Bad driving … many accidents. 9. An interpreter … from one language into another. 10. My parents … in a very small flat. 11. A liar is someone who … the truth. 12. The River Amazon … into the Atlantic Ocean.

Past Simple

Утвердительная форма образуется двумя способами: если глагол правильный, прибавляется суффикс -ed к основной форме, например: to form – formed. Если глагол неправильный, он имеет особую форму. Глаголы в Past Simple ни по лицам, ни по числам не изменяются.

Вопросительная и отрицательная формы образуются с помощью вспомогательного глагола «did».

Did he support this theory yesterday?

He did not support this theory yesterday.

Суффикс -ed произносится как звук [d], если он следует за звонким согласным и гласным, как [t], если он следует за глухим согласным, и как [id], если основа спрягаемого глагола оканчивается на звуки [t] и [d]: asked [a:skt], lived [livd], counted ['kэuntid], decided [di'saidid].

Запомните наиболее распространенные обстоятельства времени, употребляемые с глаголами в Past Simple: yesterday – вчера; at that time – в то время; the day before yesterday – позавчера; last week (month, year) – на прошлой неделе (в прошлом месяце, году); two days ago – два дня тому назад.

Глагол *to be* в прошедшем простом времени принимает форму was, если подлежащее стоит в единственном числе, и were – во множественном числе. We were friends at school. I was late for the lecture.

Exercises

1. *Make up interrogative and negative forms.*

Example: I mixed two volumes in the usual proportion. Did I mix two volumes in the usual proportion? I did not mix two volumes in the usual proportion.

1. I liked to play football when I was a boy. 2. They lived near the metro 3 years ago. 3. You went to the cinema 2 months ago. 4. She combined these elements in the equal proportion two days ago.

2. *Make the correct form of the verb «to be» (Present Simple, Past Simple).*

1. I … a student of the mechanical faculty three years ago. 2. Heat … not matter but a form of energy. 3. We … friends at college. 4. I … 18. 5. … you at the concert yesterday?

3.*Put the verbs in initial form:*

spoke, was, did, went, gave, took, wrote, had, knew, read.

4. *Rewrite the text in the past tence.*

He gets up at seven o’clock. He washes his face, cleans his teeth and combs. He goes to the kitchen and has his breakfast. For breakfast he has a cup of coffee and cheese. When the breakfast is over, he goes to the office. He takes a bus to get to his work. At the office he works till two o’clock. At two o’clock he has dinner. He finishes his work at seven o’clock in the evening. He decides to walk a little after his working day. He returns home at nine. He doesn’t want to have supper, he only drinks tea. Suddenly he remembers that he has to phone to his friend. He dials the number but nobody answers. His friend is not at home. He goes to his room and decides to watch TV. When the TV programe is over, he sleeps.

5. *Open the brackets using verbs in Present Simple or Past Simple.*

1. They (to be) in London last month. 2. Who of your friend (to speak) English? 3. How many lessons you (to have) every day? 4. I (not to be) at home yesterday, I (to go) for a walk. 5. He usually (to sleep) well. But last night he (to sleep) bad. 6. Your sister (to be) a doctor? – Yes, she (to become) a doctor two years ago. 7. He (not to shave) today because he (not to have) time. 8. You (to get) up early on Sunday? – Yes. But last Sunday I (to sleep) till ten. 9. When you (to leave) the meeting yesterday? 10. She (to enjoy) the film, which we (to see) last week?

Future Simple

Будущее простое время (Future Simple) образуется из вспомогательного глагола will и основной формы глагола.

I will form	We will form
You will form	You will form
He/ She/ It will form	They will form

Указатели времени: tomorrow (завтра); in a week (через неделю); next year (через год) и др.

Вопросительная форма образуется путем постановки вспомогательного глагола *will* перед подлежащим:

– Will you form?

– Yes, I will.

Отрицательная форма образуется путем постановки отрицания not после вспомогательного глагола *will*, например: They will not test the gas tomorrow.

В придаточных предложениях условия и времени вместо будущего времени употребляется настоящее. Придаточные предложения условия и времени вводятся союзами: If (если); after (после) When (когда) till (untill) (до сих пор); before (до, перед) as soon as (как только).

Exercises

1. *Make the sentences interrogative and negative.*

Example: Elements will combine in definite proportions. Will elements combine in definite proportions? Elements will not combine in definite proportions. 1. We will test the gas in this experiment. 2. It will burn in the air. 3. This gas will remain in the air. 4. Oxygen will support combustion. 5. It will form saltpeter.

2. *Make up as many sentences as possible.*

Oxygen			combine	
We			support	the text
It	will	not	burn	in the air
They			live	combustion
He			read	with many elements
You			do	

3. *Put predicate in correct verb tense.*

1. We (to study) Chemistry next year. 2. Oxygen (to support) live and combustion. 3. I (to read) the chemical literature last Sunday. 4. Elements (to combine) forming compounds. 5. Nitrogen (to be) necessary to life. 6. He (to come. home at 6 o'clock last night). 7. The students (to have. A meeting tomorrow). 8. She (to go) to the Institute every day.

4. *Open the brackets using verbs in Present Simple or Future Simple (All actions will take place in the Future tense).*

1. If the weather (to be fine), the plane (to leave) in time. 2. They (to visit) their parents next month if they (to get) letter from them. 3. Jack (to miss) the train if he (not to hurry). 4. When he (to feel) better, he (to invite) us. 5. She (to finish) her work when she (to be) at the office. 6. What she (to do) when she (to return) home? 7. I (to take) my child to the ZOO if I (to have) time. 8. They (not to swim) if the water (to be) cold. 9. Dan (to send) us a postcard when he (to get) to St. Petersburg. 10. I (not to go) for a walk before my parents (to come) home.

5. *Open the brackets using verbs in Present Simple или Future Simple.*

1. If you (to take) a taxi, you (to be) there in time. 2. He says that he (to stay) at home, until I (to ring) him up. 3. I (to give) you my answer when I (to be) sure of my feelings. 4. I (to be) very thankful if you (to help) me. 5. I (not to give) you my opinion before I (to study) the matter thoroughly. 6. They say that they (not to go) skiing if the weather (to be) nasty. 7. When you (to learn) all the truth you (not to like) him any more. 8. If he (not to like) your plan, he (to refuse) to take part in the work. 9. He says that as soon as the film (to be) on, we (to see) it together. 10. If you (to follow) my advice, everything (to be) all right. 11. You (to understand) me when you (to

know) my life story. 12. He says that he (to wait) till I (to finish) my work. 13. If I (to have) an opportunity, I (to talk) to her about you. 14. I (to begin) the work as soon as I (to find) all necessary books. 15. He says that he (to help) me if I (to ask) him for his help.

6. *Translate the sentences.*

1. Если ты приедешь в наш город, ты остановишься у нас. 2. Когда он осознает свои ошибки, он извинится перед родителями. 3. Я обещаю, что как только вернусь домой, позвоню тебе. 4. Я обязательно сообщу тебе, как только узнаю что-нибудь новое. 5. Он говорит, что купит эту книгу, когда у него будут деньги. 6. Друзья спрашивают нас о том, где мы остановимся, когда приедем на побережье. 7. Он говорит, что никогда не простит меня, если узнает, что я говорю неправду. 8. Когда мы закончим работу, обязательно отдохнем.

Present Participle

Present Participle может быть образовано от основы глагола при помощи окончания *-ing.* Переводится на русский язык причастием или деепричастием, оканчивающимся на *–ащ/-ящ, -ущ/-ющ -ий -ся: forming - образуя, образующий; burning – горя, горящий; standing – стоя, стоящий.*

Если глагол оканчивается на непроизносимое -*е,* то при образовании Present Participle -*е* опускается: *smile – smiling; write – writing.*

Если глагол состоит из одного слога, то при образовании *Present Participle* удваивается конечная согласная: *sit – sitting; run – running; swim – swimming.*

Present Participle участвует в образовании времен групп *Continious* в сочетании со вспомогательным глаголом *to be: They are writing now.*

В предложении *Present Participle* может выступать в функции:

– определения к существительному: *I like to see smiling faces* (мне нравится видеть улыбающиеся лица);

– обособленного определения, заменяющего придаточное определительное предложение: *The girl sitting at the table is her sister* (Девочка, сидящая за столом, – ее сестра);

– обстоятельства: *He went out smiling* (Он вышел улыбаясь).

Past Participle

Past Participle – причастие прошедшего времени от стандартных глаголов образуется путем прибавления суффикса *-ed* к основной форме глагола, например: *to mix* (смешивать), *mixed* (смешанный).

Форма *Past Participle* неправильных глаголов образуется особыми способами их нужно заучивать (прил. Б): *to give* (давать), *given* (данный).

Причастие прошедшего времени соответствует в русском языке причастию страдательного залога настоящего времени с суффиксами *-ем, -им* и прошедшего времени с суффиксами *-нн, -т*. Например: *Combustion supported by oxygen is very intensive* (горение, поддержанное кислородом, является очень интенсивным).

Причастие прошедшего времени участвует в образовании времен групп *Perfect* и страдательного залога: *I have just got tickets to the theatre* (я только что купил билеты в театр); *This article was written by my friend* (эта статья была написана моим другом).

Функции причастия прошедшего времени в предложении:

– определения к существительному: *The gases formed cannot support life* (Образованные газы не могут поддерживать жизнь);

– обособленного определения, заменяющего придаточное определительное предложение: *Here is the letter received from Nick* (вот письмо, полученное от Коли).

Exercises

1. *Translate the sentences containing participles.*

1. The colour of the element found is red. 2. Water found in nature is a mixture that has no colour and taste. 3. Saltpeter formed is not an element. 4. Burning in the air this gas forms CO2. 5. Supporting combustion oxygen forms oxides that cannot be found in the earth. 6. Nitrogen combined with other elements forms saltpeter, ammonia, etc.

2. *Translate the participle.*

Соединяясь, образованный, горя, найденный, соединенный, действующий, поддержанный, имеющий, устраняя, остающийся, сожженный.

3. *Make up present participle and past participle from the verbs and translate.*

To support, to combine, to form, to spread, to find, to burn.

4. *Identify which member of the sentence is the participle and translate the sentences.*

1. The gases forming the atmosphere support life. 2. Living in Kazan she will study chemistry. 3. Combining with other elements nitrogen forms nitric compounds. 4. When mixed with oxygen hydrogen is explosive. 5. Concentrated acid is an active oxidizing agent when heated. 6. The gases combined burned with the explosion. 7. When cooled to a very low temperature many substances change their physical properties.

Continuous tenses

Времена системы *Continuous* образуются с помощью вспомогательного глагола to be в соответствующем времени, лице и числе и *Participle I* смыслового глагола.

Времена системы *Continuous* употребляются для обозначения действия – процесса, протекающего в определенный период времени.

В *Present Continuous* время протекания действия совпадает с моментом говорения: I am reading now (я читаю сейчас).

		Утвердительная форма	Вопросительная форма	Отрицательная форма
am is are + Ving	Present	I am He She is It forming We You are They	Am I He Is She It forming ? We Are You They	I am He She is It not forming We You are They
was were + Ving	Past	I He She was It forming We You were They	I He Was She It forming ? We Were You They	I He She was It not forming We You were They
will be + Ving	Future	I He She It will be forming We You They	I He She Will It forming ? We You They	I He She It Will not forming We You They

В *Past* и *Future Continuous* отрезок времени, в течение которого протекает действие, обозначен:

– точным указанием времени: *I was writing a letter at 8 o'clock yesterday* (я писал письмо в 8 часов вчера вечером). *At 9 o'clock a.m. I'll be working at this experiment* (в 9 часов утра я буду работать над этим экспериментом);

– другим действием: *She was working at her experiment when I phoned her* (Она работала над экспериментом, когда я позвонил). *She will be planting roses tomorrow when he comes (*Она будет сажать розы завтра, когда он придет.)

Exercises

1. *Conjugate the verbs:*

в Past Continuous: to study, to read, to form, to occur.
в Future Continuous: to call, to have, to find, to live.

2. *Ask your partner what he/she has been doing at different times*.

Example: – I wonder what you were doing at that time yesterday? – I was reading a book.

When you phoned; at 10 a.m. tomorrow; last night from 5 to 8; at 9 p.m.; at 3 o'clock.

3. *Identify tense form.*

Will be collecting; was supporting; are visiting; is burning; am opening; are building.

4. *Express surprise and your partner again*.

Example: – I'm testing this gas now.
– Really? Are you testing this gas now?

I'm studying English now; I was heating this solution when you came; He will be mixing these substances at 9 a.m. tomorrow.

5. *Express disagreement with your partner*.

Example: – Are you discussing this problem?
– Nothing of the kind (Ничего подобного). I'm not discussing this problem.

1. Is your friend heating the mixture now? 2. Will she be weighting this product at 9 a.m. tomorrow? 3. Were they applying the new method when you came yesterday?

Perfect tenses

Present Perfect употребляется для выражения закончившегося действия. Время совершения его указывается неопределенно, а результат действия налицо в настоящий момент. В том случае, когда время совершения действия в прошлом указывается определенно, употребляется Past Simple. Present Perfect переводится на русский язык обычно прошедшим временем совершенного вида. Present Perfect часто употребляется с наречиями неопределенного времени, которые ставятся между вспомогательным глаголом и причастием прошедшего времени спрягаемого глагола.

Наиболее часто употребляемые наречия неопределенного времени: ever (когда-либо); never (никогда); just (только-что); already (уже); not yet (еще не).

Present Perfect образуется при помощи вспомогательного глагола *to have* в настоящем времени смыслового глагола и причастия прошедшего времени: I (we, you, they) have weighed the product. He (she, it) has weighed the product.

Вопросительная форма образуется путем постановки вспомогательного глагола to have перед подлежащим: Have we weighed the product? Has she weighed the product?

Отрицательная форма образуется путем постановки отрицания not после вспомогательного глагола: *I have not weighed the product. She has not weighed the product.*

Утвердительная форма			Вопросительная форма			Отрицательная форма		
I	have	formed	have	I	formed	I	have not	formed
You	have		have	You		You	have not	
He She It	has		has	He She It		He She It	has not	
We You They	have		have	We You They		We You They	have not	

Exersises

1. *Ask your partner and translate into Russian.*

Example: – The molecules of this gas have already reached the organs of smell. Really?

– Have the molecules of this gas have already reached the organs of smell?

1. We have seen the motion of molecules under the strongest microscope. 2. They have used the Periodic Table by D.I. Mendeleev. 3. She has used many experimental results. 4. He has felt the odor of ammonia at a distance.

2. *Tell you have not done that. Translate the sentences into Russian.*

Example: – My friend has seen this concert over TV.

– As for me, I have not seen this concert.

1. My friends have made some mistakes in their work. 2. He has explained these facts according to the atomic-molecular theory. 3. You have done much of your work. 4. They have used calorimeter to measure the amount of heat produced.

3. *Translate into English.*

1. Мы только что разложили это сложное вещество. 2. В этом месяце я провел несколько экспериментов. 3. Образованная смесь сгорела. 4. В результате эксперимента два объема остались несоединенными. 5. Я уже разделил смесь на ее составляющие.

Past Perfect Tense

The Past Perfect Tense (прошедшее совершенное время) выражает прошедшее действие, предшествовавшее какому-то определенному моменту в прошлом или завершившееся до другого действия в прошлом. Past Perfect употребляется в следующих случаях.

1. Для выражения прошедшего действия, которое уже совершилось до определенного момента в прошлом. Этот момент может быть указан обстоятельством времени: by 5 o'clock (к пяти часам), by Saturday (к субботе), by that time (к тому времени), by the end of the year (к концу года). She had left by the 1st of June (она уехала (еще) до первого июня). I had cleaned the apartment by 5 o’clock (к пяти часам я убрала квартиру).

2. Для выражения прошедшего действия, которое уже завершилось до другого, более позднего прошедшего действия, выраженного глаголом в Past Simple. В таких случаях Past Perfect употребляется главным образом в сложноподчиненных предложениях. They had already gone when I arrived (Они уже ушли, когда я появился).

Past Perfect часто употребляется в придаточных предложениях с союзами: after (после того как), before (прежде чем, до того как).

Past Perfect образуется путем сочетания вспомогательного глагола to have в Past Simple и Participle II знаменательного глагола.

Утвердительная форма		Отрицательная форма		Вопросительная форма
I, we You He, she, it They	had done had worked	I You He, she It, they	had not worked had not done	Had I worked (done) ? Had you worked (done)? Had he (she, it) worked? Had they worked (done)?

Exersises

1. *Open brackets, using verb in Past Perfect. Make the following sentences negative and interrogative.*

1. My father (to visit) London before, and so the city was not new to him. 2. When we came the plane (to take off). 3. I went to sleep as soon as the show (to finish). 4. When they came home mother (to do) everything about the house. 5. I went to see the sights after I (to buy) a map of Moscow. 6. Karen didn't want to come to the cinema with us because she already (to see) this film. 7. We knew our itinerary only after the leader of the group (to tell) us. 8. After I (to spend) all the money I turned to my father. 9. She understood the letter after she (to read) it a second time. 10. We (to keep) waiting until we lost patience.

2. *Open brackets, using verb in Past Simple or в Past Perfect.*

1. When the police (to arrive), the car (to go). 2. When she (to get) to the shop, it (to close). 3. The train (to leave) when he (to come) to the station. 4. We (to eat) everything by the time he (to arrive) at the party. 5. I (to know) that he (not to learn) the poem. 6. He (to take) the decision before I (to come). 7. Nick (to return) from office by seven o'clock. 8. I (to think) that my parents already (to return). 9. It (to be) the second time she (to make) that mistake. 10. He (to be sure) that we (not to recognize) him. 11. The car (to go) when I (to look) into the street. 12. You (to find) your key which you (to lose) before? 13. Meg (to say) that she (to be) in this city. 14. The doctor (to arrive) when we already (to help) him. 15. He (to study) guitar for two years when he (to be) a teenager.

The Future Perfect Tense

The Future Perfect Tense (будущее перфектное время) употребляется для выражения будущего действия, которое закончится до определенного момента в будущем. Момент в будущем, до которого закончится действие, может быть выражен:

– обстоятельством времени с предлогом by: by five o'clock (к пяти часам), by the end of the year (к концу года). By the end of the week we’ll have finished this work (К концу недели мы закончим эту работу);

– другим будущим действием, выраженным Present Simple в придаточном предложении времени и условия с такими союзами, как before (до того как), when (когда). When we meet next time, I’ll have read this book (Когда мы встретимся в следующий раз, я уже прочитаю эту книгу).

Future Perfect образуется при помощи вспомогательного глагола to have в Future Simple и Participle II знаменательного глагола: shall/will have + worked.

Утвердительная форма		Отрицательная форма		Вопросительная форма
I, we He, she, it you, they	will have worked	I, we He, she, it, you, they	will not have worked	Shall (will) I (we) have worked ? Will he (she, it, you, they) have worked ?

Exersises

1. *Open brackets, using verb in Future Perfect. Make the following sentences negative and interrogative.*

1. I (to do) it by that time. 2. He (to write) a letter by the time she comes. 3. We (to build) a new house by the end of the year. 4. Mother (to cook) dinner when we come home. 5. You (to do) your homework by seven o’clock. 6. They (to arrive) by the evening. 7. She (to come) by five o’clock. 8. I (to look) by this time through all magazines.

2. *Open brackets, using verb in Future Simple, Future Continuous, Future Perfect.*

1. He (to write) a letter at seven o’clock tomorrow. 2. Where she (to go) to buy a new dress? 3. What country he (to visit) by the next year? 4. Our family (to have) dinner at half past four. 5. What time he (to come) this evening? – He (to come) by seven o’clock. 6. I (to meet) you at the station at nine o’clock tomorrow. My train already (to arrive) by that time. 7. What you

(to buy) him for his birthday? 8. When you (to finish) the University? 9. My sister and I (to do) washing-up by the time mother comes. 10. I (to go) to the cinema with you tomorrow.

3. *Translate the sentences using verb in Future Perfect.*

1. Они не переведут эту статью до трех часов. 2. Она сделает эту работу до конца месяца. 3. Почему твой друг не напишет статью до вечера? 4. Ты закончишь читать эту книгу до завтра? 5. Сбудется ли мое желание до Нового года? 6. Они уже уйдут к тому времени. 7. Почему она не начнет работать до девяти утра? 8. Эта телепередача закончится к четырем часам? 9. Учитель проверит все тексты до завтра. 10. К этому времени дети уже уберут в комнате? 11. Все туристы соберутся у отеля к шести часам? 12. Никто не придет сюда до конца дня. 13. Телеграмма придет, когда вы не будете ждать ее. 14. Мои родители придут домой к семи часам вечера. Я сделаю уроки к этому времени. 15. Он обещал написать доклад до десяти вечера.

The Passive Voice

В английском языке, как и в русском, существует два залога глагола: действительный (the Active Voice) и страдательный (the Passive Voice). Страдательный употребляется в английском языке так же часто, как и действительный.

Если подлежащее является действующим лицом, мы имеем дело с действительным залогом: My friend wrote a book (мой друг написал книгу).

Если подлежащее не является действующим лицом, а действие направлено на подлежащее, то в этом случае предложение употребляется в страдательном залоге: The book was written by my friend (книга была написана моим другом).

Если указано, кем произведено действие, то употребляется предлог *by*.

Страдательный залог образуется при помощи вспомогательного глагола to be в соответствующем времени, лице, числе и причастия прошедшего времени смыслового глагола.

Мы имеем грамматическую конструкцию, состоящую из двух глаголов.

Первый глагол – вспомогательный, одна из форм глагола *to be*. Он помогает образовать данную грамматическую форму. Глагол показывает, когда происходит действие, он определяет грамматическое время всего предложения, т. е. если глагол *to be* стоит в Present Simple, то и все предложение стоит в этом времени. На русский язык вспомогательный глагол не переводится.

Второй глагол – смысловой, он употребляется в 3-й форме глагола, это соответствует причастию прошедшего времени. Он не меняется, несет смысл, поэтому переводится.

The Passive Voice

	Simple	Continuous	Perfect
Present	Образуется	Образуется	Образовали
	am is formed are	am is being formed are	have has been formed
	(обычно, всегда, каждый день)	(сейчас, все еще)	(уже)
Past	Был образован	Образовали	Образовали
	was were formed	was were being formed	had been formed
	(вчера, когда-то в прошлом)	(когда я пришел)	(к тому моменту, уже)
Future	Будет образован will be formed (завтра)	Употребляется форма Future Simple	Образуют will have been formed (к тому моменту)
	be	be being	have been

При образовании вопросительной формы страдательного залога вспомогательный глагол ставится перед подлежащим:

Is this metal heated? (этот металл нагревается?); will this metal be heated? (этот металл будет нагрет?); has this metal been heated? (этот металл нагрели?); when was this metal heated? (когда был нагрет этот металл?).

При образовании отрицательной формы страдательного залога частица *not* ставится после вспомогательного глагола:

This metal is not heated; this metal will not be heated; this metal has not been heated.

Образование вопросительной и отрицательной форм показано на примере времен группы Simple.

Simple tenses

	Affirmative	Interrogative form	Negative form
Present	The heat *is produced* by combustion of coal	*Is* the heat *produced* by combustion of coal?	The heat *is not produced* by combustion of coal
	Compounds *are found* in nature	*Are* compounds *found* in nature?	Compounds *are not found* in nature
Future	The heat *will be produced* by combustion of coal	*Will* the heat *be produced* by combustion of coal?	The heat *will not be produced* by combustion of coal
	Compounds *will be found* in nature	*Will* compounds *be found* in nature?	Compounds *will not be found* in nature
Past	The heat *was produced* by combustion of coal	*Was* the heat *produced* by combustion of coal?	The heat was not produced by combustion of coal
	Compounds *were found* in nature	*Were* compounds *found* in nature?	Compounds *were not found* in nature

С модальными глаголами must, can, may, should to, have to, be to, пассивная форма образуется с помощью глагола to be без частицы to и Past Participle (Participle II) основного глагола.

This experiment must be finished today.

Gases can be collected and weighed by this apparatus.

Exersises

1. *Read and make up the sentences in passive voice*.

1. This grammar rule is being discussed at the lesson today. 2. Only English must be spoken in our lab. 3. What specialists are trained in the Kazan Chemical Technological University? 4. The first Russian University was founded in 1755. 5. Equal volumes will be mixed.

2. *Make up sentences according the sample and translate into Russian*.

Example: Heat is produced by chemical reaction.

Liquids will be mixed by a mixer.

Liquids Heat Compound Water Carbon dioxide Diamonds Graphite Oxides Metals	is are will be was were	mixed produced called found	by in	chemical reaction combustion combination of nitrogen and oxygen a mixer ores nature industry

3. *Choose correct grammar verb form. Make up the sentences negative and interrogative.*

1. Ammonia (forms, is formed) by chemical of nitrogen and hydrogen. 2. These gases (are formed, form) the gas ammonia. 3. The text 4 (translated, will be translated) by students tomorrow. 4. Two volumes will (mix, be mixed) in the usual proportion. 5. We will (mix, be mixed) oxygen and hydrogen in the in the proportion of 1:2 at the next lesson. 6. Heat (produces, is produced) when elements (combine, are combined) chemically.

4. *Make up sentences in passive voice.*

1. The students heated this mixture in lab yesterday. 2. We mix various volumes and form water. 3. They will take these volumes in equal proportions. 4. They cannot produce ammonia in a liquid form. 5. She is examining the solid mass under the microscope. 6. My friend has heated the mixture in a test-tube.

5. *Translate the sentences into English using passive voice.*

1. Эта проблема обсуждается сейчас на конференции. 2. Тепло выделяется при горении угля. 3. Вода будет образована в результате химического соединения водорода и кислорода. 4. Может получиться взрыв, когда эти газы соединяются химически. 5. Если элементы были соединены химически, получилось сложное вещество.

6. *Choose the row that contains only passive voice verbs.*

a) is combined, can be mixed, will produce; found;
b) are formed; will be found; is equal; can not form;
c) cannot be produced; is found; are formed; will be combined.

Samples of module tests
Module test 1

1. *Choose the correct form of the verb to be in Present, Past or Future.*

1. My mother … an engineer.
a) is; b) was; c) am.
2. My aunt … at the cinema yesterday.
a) was; b) were; c) are.
3. … your chief at work tomorrow?
a) was; b) is; c) will be.
4. We … at home tomorrow.
a) will be; b) will are; c) are.
5. Where ... the cat?
a) is; b) are; c) was.
6. They … not in Kazan now.
a) were; b) are; c) is.
7. Yesterday they … at work.
a) were; b) are; c) is.
8. … you busy or free now?
a) are; b) is; c) will be.
9. The first class next Monday … English.
a) is; b) will be; c) are.
10. There … an interesting film on TV tonight.
a) is; b) was; c) am.

2. *Choose the correct form of the verb to have в Present, Past, Future Simple.*

1. They... no English magazines
a) have; b) will have; c) had.
2. Miss Brown ... no family of her own.
a) will have; b) has; c) have.
3. … your child many toys?
a) have; b) had; c) has.
4. … the Smiths a garden?
a) have; b) has; c) will have.
5. When little Ann was a child she … many dolls.
a) had; b) will have; c) has.
6. They … an English class yesterday.

a) will have; b) had; c) has.

7. The students … a seminar tomorrow.

a) will have; b) have; c) has.

8. Next year their parents … a house of their own.

a) had; b) will have; c) has.

9. We usually … a break at this time.

a) will have; b) have; c) had.

10. Although he … his own car, he often uses buses.

a) had; b) have; c) has.

3. *Make up verb to be in construction.*

1. There … a way out of the situation. 2. … there any problems with your car yesterday? 3. There … many guests tomorrow 4. There … nobody in the room now. 5. … there any information for me when I was absent? 6. There … not any fields of science to explore in future. 7. There … some plans to do the work last year. 8. … there a meeting yesterday? 9. There … a book to return at the library. 10. … there students in the classroom?

4. *Choose the correct form of adjective.*

1. Happiness is …than money.

a) important; b) more important; c) the most important.

2. This coat is … of all.

a) an expensive; b) a less expensive; c) the least expensive.

3. That painting is … than the one in your living room.

a) impressive; b) less impressive; c) the least impressive.

4. A snail is … than a tortoise.

a) slower; b) more slow; c) the slowest.

5. This room is not so … as that one on the first floor.

a) comfortable; b) more comfortable; c) the most comfortable.

6. Money is not so … as health.

a) important; b) more important; c) the most important.

7. Susan is …person in the whole band.

a) a wonderful; b) a more wonderful; c) the most wonderful.

5. *Make the adjectives with modal verbs.*

1. The younger you are, the … (easy) it is to learn. 2. Of the three girls, this one is the … (pretty). 3. Which instrument makes … (beautiful) music in the world? 4. China has got … (large) population in the world. 5. Betty is … (hard-working) than Jane. 6. The weather was not very good yesterday, but it's … (good) today.

Module test 2

1. *Complete the sentences with modal verbs.*

1. You … talk to your children about their future. 2. You … see the field through this window. 3. You … follow instructions before taking medicines. 4. Sandra … speak two languages. 5. Tom … come and help you tomorrow if you like. 6. You … attend this museum from 9 till 17 o'clock every day.

2. *Make the correct sequence.*

1. Must, things, asking, you, not, my, without, borrow. 2. All, windows, the, in, we, must, wash, house. 3. We, answer, question, the, had to, all. 4. He, get up, on, if, wants, the, to, bus, must, early, Monday, he, catch.

3. *Choose the correct word order.*

1. a) Does Sandra always get up early in the morning?
b) Does Sandra get up early always in the morning?
c) Does Sandra get up always in the morning early?
d) Does Sandra get up always early in the morning?

2. a) How much did cost it for the return ticket?
b) How much for the return ticket did it cost?
c) How much did it cost for the return ticket?
d) How did much it cost for the return ticket?

3. a) She not will come home early.
b) She will come not home early.
c) She won't come home early.
d) Not she will come home early

4. *Make verb in correct form.*

1. He often … (phone) his mother in London. 2. We … (not have) a holiday yesterday. 3. I'm afraid they … (not wait) for us tomorrow.

5. *Choose the correct answer.*

1. My mother … a bad headache.
a) have got; b) am; c) has got.
2. We … a car, but we are going to buy it.
a) don't have; b) aren't have; c) hasn't.
3. My parents … in Greece last year.
a) were; b) was; c) are.
4. They … (write) this story last week.
a) wrote; b) write; c) written.

5. You … in Paris tomorrow evening.
a) will arrive; b) shall arrive; c) arrives.
6. … you buy a new house next year?
a) shall; b) do; c) will.

Module test 3

1. *Make the words in correct word order.*

1. What; doing; the girl; is; now? 2. moment; we; flying; the; over; are; desert; At; the. 3. was; I; sitting; when; in; I; the; heard; garden; a noise. 4. you; Were; for; me; waiting; o'clock; at; six; yesterday? 5. They; be; will; sitting; in; train; the; this, tomorrow; time. 6. will: He; be; sleeping; you; when; come; tonight; back.

2. *Make verb in correct form.*

1. Listen! Somebody … (sing) a lovely song. 2. Where are our children? – They … (play) in the yard. 3. When you rang me yesterday, I … (have) a bath. 4. When I arrived, Tom … (lie) on the sofa. 5. Don't phone Jim from 5 to 6 – he … (have) English. 6. He … (not sleep) when you come back tonight.

3. *Choose the right answer.*

1. Take your umbrella. It … cats and dogs.
a) are raining; b) rains; c) is raining.
2. Can you phone a bit later? Jane … a bath.
a) is having; b) has; c) having.
3. I saw a light in your window as I … by.
a) passed; b) was passing; c) were passing.
4. While he … for her call, somebody knocked the door.
a) were called; b) was calling; c) called.
5. – Let's meet at the station at 5 o'clock.
– OK. I … for you there.
a) will wait; b) will be waiting; c) will have waited.
6. If you arrive at 8 o'clock, they … the meal.
a) will still be cooking; b) will cook; c) will have cooked.

Module test 4

1. *Choose the correct form of verb.*

1. My friend … me to solve this problem yet
a) have helped; b) haven't helped; c) hasn't helped.

2. I … already ... my dinner.
a) have … had; b) has … had; c) was … had.
3. She … just … a box of chocolates.
a) have … opened; b) has … opened; c) haven't … opened.
4. He … a difficult article from English into Russian.
a) has translated; b) have translated; c) was translated.
5. Who … this book?
a) have written; b) write; c) has written.
6. The teacher … us nothing about it.
a) has told; b) have told; c) haven't told.
7. We … two English classes today.
a) has had; b) have had; c) are had.
8. What's the matter? Why … he ...?
a) have … topped; b) were … stopped; c) has … stopped.
9. My cousin is looking for a new job, but he … it yet.
a) haven't been found; b) hasn't been found; c) hasn't found.
10. How long … you … ill?
a) have … been; b) has … been; c) was … been.
11. ... they ... the electric bill this month?
a) Has ... paid; b) Have ... paid; c) Was ... paid.
12. Jay ... never ... abroad.
a) have ... travelled; b) has ... travelled; c) was ... travelling.
13. Helen speaks French so well because she … in France.
a) has lived; b) lived; c) will live.
14. The weather … …, and we can go for a walk.
a) will change; b) has changed; c) was changed.
15. … you ever ... your holidays in the Crimea?
a) Has … spent; b) Have … spent; c) Do … spent.
16. The laboratory … recently.
a) has been equipped; b) have been equipped; c) will be equipped.
17. The rate of the reaction … with the help of catalyst.
a) have been changed; b) are not changed; c) has been changed.
18. He ... from the cinema by 5 o'clock.
a) have returned; b) will return; c) had returned.
19. By two o'clock the teacher … all the students.
a) were examining; b) had examined; c) is examining.
20. By the time you come to my place I … the article.
a) will have translated; b) will be translating; c) will be translated.

2. *Make up the right order.*

1. I, been, to, have, never, Washington. 2. bought, car, my, has, a, my, friend, new. 3. an, for, years, he, been, engineer, two, has. 4. have, known,1990, we, since, him. 5. how long, worked, this, have, you, at, plant. 6. test, driving, his, passed, already, has, friend, my. 7. Friday, since, I, haven't, last, seen, him. 8. you, been, New York, have, to, ever. 9. seen, has, manager, who, the. 10. already, passed, have, exams, we, our.

3. *Insert missing word.*

1. My father went to Spain two days … . 2. I have been studying English … five years. 3. She hasn't finished her work … . 4. He has been in Madrid … ten years. 5. I have worn contact lenses … five years. 6. They have been here … last Monday. 7. I haven't seen my friend … a week. 8. She has … finished her test paper.

4. *Choose some or any.*

1. There aren't … tomatoes in the fridge. 2. There are … children in the park. 3. There isn't … Coke in the cupboard. 4. Are there … books on the table. 5. There is … orange juice in the glass. 6. I'd like … water, please. 7. Have you … pencils? 8. He didn't give me … money. 9. Only … students came in time. 10. At this time we usually have… food.

5. *Make up sentences.*

1. good, you, some, I, have, news, for. 2. milk, want, any, do, you? 3. apples, got, any, I, haven't. 4. you, any, would, juice, like? 5. England, he, me, sent, some, from, postcards. 6. the, plate, some, is, cheese, there, on. 7. sugar, any, can, me, give, you?

Список химических элементов

Ac – actinium [ækt'tınıənt] актиний
Ag – argentum ['ə:ʤ(ə)ntəm] серебро
Al – aluminium алюминий
Am – americium [ˏæmə'rısıəm] америций
Ar – argon ['ə:gɔn] аргон
As – arsenic ['ə:snık] мышьяк
At – astatine ['æstə'ti:n] астат
Au – aurum (gold) ['ɔ:rəm] золото
B – boron ['bɔ:rɔn] бор
Ba – barium ['bɛərıəm] барий
Be – beryllium [be'rılјəm] бериллий
Bi – bismuth ['bızməθ] висмут
Bk – berkelium [ˏbə:kılıəm] беркелий
Br – bromine ['broumin] бром
C – carbon ['kɑ:bən] углерод
Ca – calcium ['kælsıəm] кальций
Cd – cadmium ['kædmıəm] кадмий
Ce – cerium ['si:rıəm] церий
Cf – californium [ˏkælı'fɔ:njəm] калифорний
Cl – chlorine ['klɔ:rın] хлор
Cm – cerium ['kju:rıəm] кюрий
Co – cobalt [kə'bɔ:lt] кобальт
Cr – chromium ['kroumjəm] хром
Cs – caesium ['si:zıəm] цезий
Cu – copper ['kɔpə] медь
Dy – dysprosium [dıs'prousıəm] диспрозий
Er – erbium ['ə:bıəm] эрбий
Es – einsteinium [aın'staınıəm] эйнштейн
Eu – europium [ju:'roupıəm] европий
F – fluorine ['fluərı:n] фтор
Fe – ferrum ['ferəm] железо
Fm – fermium ['fə:mıəm] фермий
Fr – francium ['frænsıəm] франций
Ga – gallium ['gælıəm] галий
Gd – gadolinium [ˏgædə'lınıəm] гадолиний
Ge – germanium [ʤə:'meınıem] германий
H – hydrogen ['haıdrıʤ(ə)n] водород
He – helium ['hi:ljəm] гелий
Hf – hafnium ['hæfnıəm] гафний
Hg – hydrargyrum (mercury) [haı'drɑ:ʤırəm] ртуть
Ho – holmium ['holmıəm] гольмий
I – iodine ['aıədi:n] йод
In – indium ['ındıəm] индий
Ir – iridium [aı'rıdıəm] иридий
K – kalium ['keılıəm] калий
Kr – krypton ['krıptɔ] криптон
Ku – kurchativium [kurʧə'tɔvıəm] курчатовий
La – lanthanum ['lænθənəm] лантан
Li – lithium ['lıθıəm] литий
Lr – lawrencium [lɔ:'rensıəm] лоуренсий
Lu – lutecium [l(j)u:'ti:sıəm] лютеций
Md – mendelevium [ˏmendə'lenəm] менделевий
Mg – magnesium [ˏmæŋgə'ni:z] магний
Mn – manganese [ˏmæŋgə'ni:z] марганец
Mo – molybdenum [mɔ'lıbdınəm] молибден
N – nitrogen ['naıtrıʤən] азот
Na – natrium ['neıtrıəm] натрий
Nb – niobium [naı'oubıəm] ниобий
Nd – neodymium [ˏni:ə'dımıəm] неодим
Ne – neon ['ni:ən] неон
Ni – nickel [nıkl] никель
No – nobelium [nouı'belıəm] нобелий
Np – neptunium [nep'tju:njəm] нептуний
O – oxygen ['ɔksıʤən] кислород

Os – osmium ['ɔzmɪəm] осмий
P – phosphorus ['fɔsf(ə)rəs] фосфор
Pa – protactinium [ˌproutæk'tɪnɪən] протактиний
Pb – plumbum ['plʌmbəm] свинец
Pd – palladium [pə'leɪdɪəm] палладий
Pm – promethium [prə'mi:θjəm] прометий
Po – polonium [pə'lounɪəm] полоний
Pr – praseodymium [ˌpreɪzɪə'dɪmɪəm] празеодимий
Pt – platinum ['plætɪnəm] платина
Pu – plutonium [plu:'sounjəm] плутоний
Ra – radium ['reɪdjəm] радий
Rb – rubidium [ru:'bɪdɪəm] рубидий
Re – rhenium ['ri:njəm] рений
Rh – rhodium ['roudjəm] родий
Rn – radon ['reɪdɔn] радон
Ru – ruthenium [ru(:)'θi:nɪəm] рутений
S – sulphur ['sʌlfə] сера
Sb – antimony ['æntɪmənɪ] сурьма
Sc – scandium ['skændɪəm] скандий
Se – selenium [sɪ'li:njəm] селен
Si – silicon ['sɪlɪkən] кремний
Sm – samarium [sə'mɛərɪəm] самарий
Sn – stannum ['stænəm] олово
Sr – strontium ['strɔnsjəm] стронций
Ta – tantalum ['tæntələm] тантал
Tb – terbium ['tə:bɪəm] тербий
Tc – technetium [tek'ni:sɪəm] технеций
Te – tellurium [te'ljuərɪəm] теллур
Th – thorium ['θɔ:rɪəm] торий
Ti – titanium [tɪ'teɪnjəm] титан
Tl – thallium ['θæliəm] таллий
Tm – tullium ['tʌlɪəm] тулий
U – uranium [ju'reɪnjəm] уран
V – vanadium [və'neɪdjəm] ванадий
W – wolfram ['wɪlfrəm] вольфрам
Xe – xenon ['zenɔn] ксенон
Y – yttrium ['ɪtrɪəm] иттрий
Yb – ytterbium [ɪ'tə:bjəmj] иттербий
Zn – zinc [zɪnk] цинк
Zr – zirconium [zə:'kounjəm] цирконий

Словарь химических терминов

A

acceleration – замедление, торможение
according to – в соответствии с…
acetic acid – уксусная кислота
achievement – достижение
acid – кислота
airborne – находиться в воздухе
alcohol – спирт
alloy – сплав, сплавлять
alumina – окись алюминия
aluminium sulphate – сернокислый алюминий
ammonia – аммиак
amount – количество
analytical – аналитическая химия
animate – живой, органический
aqueous solution – водный раствор
article – продукт, вещество

B

barge – баржа
barium – барий
bauxite – алюминевая руда
biochemist – биохимик
biochemistry – биохимия
branch – отрасль
butyl rubber – бутилкаучук
by volume – по объему
by-products – побочные продукты

C

calcium chloride – хлорид кальция
calcium phosphate – фосфат кальция
carbon – углерод; уголь
catalyst – катализатор
cell-like – похожий на клетку
cellular – клеточный, клеточного строения
ceramic – керамический

charge – заряд
chemistry – химия
chemical shipments – отгрузка химических товаров
cemistry of arsenic and phosphorous organic compounds – химия мышьяк- и фосфорорганических соединений
chemistry of nitro compounds – химия нитросоединений
chimney – труба
coagulant – коагулянт, сгущающее вещество
colloidal – коллоидная химия
combustion – сгорание
common salt – поваренная соль
composition – состав
compulsory – обязательный
condenser – конденсатор
condition – условие
confidence – уверенность
conjugate – соединенный, сопряженный
corresponding – соответствующий
corrosive – коррозийный, едкий
covalent – ковалентный
crude oil – непереработанная нефть
crystalline – кристаллический
current of electricity – электрический ток
to cause – вызывать
to combine – соединяться
to consist of – состоять из
to constitute – составлять
to convert – превращать

D

decay – распад, разложение
demand – спрос
dendritic – древовидный, дендрический
deoxidizing effect – раскисляющее действие
derivative – производное
desired – требуемый, желаемый
development – развитие
device – прибор
diatomic – двухатомный

dilute – разжижать
dioxide – двуокись
disperse – рассеивать
dispose – располагать
dispose of – отделаться, избавиться
divinyl – дивинил
domestic market – внутренний рынок
dwelling zone – жилая зона
to dissolve – растворять
to drive – руководить

E

economic slowdown – замедленный экономический рост
electrochemistry – электрохимия
electrolysis – электролиз
electron configuration – электронная конфигурация
electropositive – электроположительный
emission – выделение, распространение
emulsifier – эмульгатор
energy changes – преобразование энергии
enforceable – обеспечиваемый применением силы, осуществимый
ester – сложный эфир
ethanol – этиловый спирт
ethylbenzol – этилбензол
evaporation – выпаривание
evolve – выделять (газы, теплоту)
explosive – взрывчатое вещество
extensively – широко

F

facilities – оборудование
fermentation – брожение, ферментация
fertilizer – удобрение
field – область, отрасль
first deputy director general – первый заместитель директора
fluoresce – флуоресцировать
formula – формула
fossil – окаменелый
fuel – топливо

fume – пар с сильным запахом
function – функция
to find – находить
to fix – закреплять, связывать

G

gallium – галлий
generally – обычно
growth – рост, развитие

H

hardness – твердость
headquarters – главное управление
heat–treatment – термическая обработка
high density polyethylene – полиэтилен высокого давления
hood – крышка, чехол
hydrated lime – гашенная известь
hydrocarbon – углеводород
hydrochloric acid – соляная кислота
hydrogen chloride – хлорид водорода
hydroxide – гидроокись

I

impurity – загрязнение, примесь
in the vicinity – поблизости
inanimate matter – неорганический
indices – от index – индекс
industrial chemistry – промышленная химия
inorganic chemistry – неорганическая химия
insoluble – нерастворимый
insulator – изолятор
interest rate – процентная ставка
intermediate – промежуточный
interstellar space – межзвездное пространство
invention – изобретение
isoprene rubber – изопреновый каучук
isoprene–monomer – изопрен мономер
isotope – изотоп
to isolate – выделять

L

latent – скрытый
legal entity – юридическое лицо
light transmission – светопередача
linseed oil – льняное масло
liquid state – жидкое состояние
to lay the foundation – положить основу
to liquefy – переходить в жидкое состояние

M

magnetic field – магнитное поле
manufacture – производство
mater – материя
measuring technique – измерительная техника
methane – метан
modern – современный
molecule – молекула
mortar – строительный раствор
mucous membrane – слизистая оболочка

N

necessary – необходимый
nitric acid – азотная кислота
nitrogen – азот
nitrogen fixation – связывание азота
nitrogenous – азотный
non–metals – неметаллы
nuclear – ядерная
nuclear chemistry – ядерная химия
nucleic acid – нуклеиновая кислота
number – большое количество

O

oil dehydration – обезвоживание нефти
ore – руда
output – выпуск
oxide – окисел, окись
to outperform – перевыполнять
to oxidize – окислять, оксидировать

P

paramagnetic – парамагнитный
percolate – просачиваться, проникать сквозь
periodic law – периодический закон
periodicity – периодичность
peroxide – перекись
pharmaceutical chemistry – фармацевтическая химия
phosphorous – фосфористый
phosphorus – фосфор
photocell – фотоэлемент
photon – фотон
physical chemistry – физическая химия
plaster – штукатурка
Plaster of Paris – гипс
plastics – пластмассы
poisonous – ядовитый
pollutant – загрязняющий агент
polyatomic – многоатомный
polyether – простой полиэфир
polymerization process – процесс полимеризации
predecessor – предшественник
premise – постройки
processing – обработка
property – свойство
propulsion – движение вперед
purification – очистка
put up – обходиться

Q

quantum – доля, часть
quarter – квартал
quicklime – негашенная известь

R

radio and clock faces – циферблаты часов и шкалы радиоприемников
rare gases – редкие газы
raw material – сырье
reagent – реактив, реагент
reflect – отражать

research – исследование
restraint – ограничение
revenue – годовой доход
row materials – сырье
to release – выпускать; сбрасывать
to resume – продолжать

S

scandium – скандий
science – наука
self-contained – снабженный всем необходимым
semiconductor – полупроводник
semiconductor physics – физика полупроводников
sensitive – чувствительный
sequence – последовательность
shaped in the same manner – полученный таким же образом
shipments – погрузка
silicon dioxide – двуокись кремния
silicone resins – кремний-органические смолы
similar – подобный
similarity – сходство, подобие
simple – простой
single – единичный
single crystal – монокристалл
solar battery – солнечная батарея
soldering – припой
soluble – растворимый
solution – раствор
species – виды, разновидность
sticky – липкий, клейкий
strict – строгий
structure – структура, строение
styrene – стирол (фенилэтинол, винилбензол, этенилбензол)
substance – вещество
substandard – несоответствующие стандартам
sulfuric = sulphuric acid – серная кислота
sulphite – сернистокислый, сульфитный
sulphur – сера
superphosphate – суперфосфат
synthetic rubber – синтетический каучук

to state – формулировать
to strengthen – укреплять
to strengthen – придавать прочность
to subject – подвергать
to supply – доставлять, поставлять

T

tetravalent – четырехвалентный
textile fibres – текстильные волокна
thermal expansion – тепловое расширение
tide – морской прилив, отлив
tin – олово
tire = tyre – шина, покрышка
to treat – обрабатывать, подвергать действию
transistor – транзистор
transpiration – испарение

U

unlike – различный
unstable – неустойчивый
to undergo – подвергаться чему-либо, испытывать
to unite – соединяться

V

valence group – валентная группа
valency = valence – валентность
vegetation – растительность
versatile – многосторонний, гибкий
vesicle – пузырек
vinegar – уксус
viscosity – вязкость

W

waste products – отходы
windmill – ветряная мельница
works – завод, фабрика
wrap – обертывать, сворачивать

Y

yield – количество произведенного

Приложение А

Чтение химических формул

Знак + читается: plus, and, together with, react with.

Знак – обозначает одну связь или единицу родства и не читается.

Знак = читается: give, form, produce.

Знак $\rightarrow$ читается: give, pass, over, lead to.

Знак $\longleftrightarrow$ читается: forms and is formed from

Цифра (внизу) после названия элемента обозначает число атомов в молекуле.

Цифра перед названием элемента обозначает число молекул.

Примеры: H_2O, HNO_3, $AgNO_3$, $C + O_2 \rightarrow CO_2$: C plus O two give C O two *или:* one atom of carbon reacts with one two-atom molecule of oxygen and produces one molecule of carbon dioxide.

$2H_2 + O_2 \rightarrow 2H_2O$: two molecules of H two plus O two give two molecules of H two O.

Или: two two-atom molecules of hydrogen react with one two-atom molecule of oxygen and produce two molecules of water.

$N_2 + 3H_2 \longleftrightarrow 2NH_3$: N two plus three molecules of H two form and are formed from two molecules of NH three.

Reading of an equation: $Zn + H_2SO_4 \longleftrightarrow ZnSO_4 + H_2$

The «plus» sign on the left of the arrow means «reacts with»; the arrow means «forming» or «producing»; and the «plus» sign on the right of the arrow means «and».

So this equation is read: «One atom of zinc reacts with one molecule of sulphiric acid producing one molecule of zinc sulphate and one molecule of hydrogen».

Приложение Б

Irregular verbs

Infinitive	Past Simple	Past Participle	Перевод
arise	arose	arisen	подниматься
awake	awoke	awoke, awaked	просыпаться
be	was, were	been	быть
bear	bore	born	нести, рождать
beat	beat	beaten	бить
become	became	become	становиться
begin	began	begun	начинать
bend	bent	bent	сгибать
bind	bound	bound	связывать
bite	bit	bit	кусать
bleed	bled	bled	кровоточить
blow	blew	blown	дуть
break	broke	broken	ломать
breed	bred	bred	выращивать
bring	brought	brought	приносить
build	built	built	строить
burn	burned, burnt	burned, burnt	гореть
burst	burst	burst	взрываться
buy	bought	bought	покупать
can	could	-	мочь
cast	cast	cast	бросать
catch	caught	caught	ловить
choose	chose	chose	выбирать
cling	clung	clung	прилипать
come	came	come	приходить
cost	cost	cost	стоить
cut	cut	cut	резать
deal	dealt	dealt	иметь дело с
dig	dug	dug	копать
do	did	done	делать
draw	drew	drawn	тянуть
dream	dreamt	dreamt	мечтать
drink	drank	drunk	пить
drive	drove	driven	ехать, везти
eat	ate	eaten	есть
fall	fell	fallen	падать
feed	fed	fed	кормить

feel	felt	felt	чувствовать
fight	fought	fought	сражаться
find	found	found	находить
fly	flew	flown	летать
forget	forgot	forgotten	забывать
forgive	forgave	forgiven	прощать
freeze	froze	frozen	замерзать
get	got	got, gotten	получать
give	gave	given	давать
go	went	gone	идти
grow	grew	grown	расти
hang	hanged, hung	hanged, hung	висеть, вешать
have	had	had	иметь
hear	heard	heard	слышать
hide	hid	hidden	прятаться
hit	hit	hit	ударять
hold	held	held	держать
hurt	hurt	hurt	причинять боль
keep	keep	keep	держать, хранить
know	knew	known	знать
lay	laid	laid	класть
lead	led	led	вести
learn	learned, learnt	learned, learnt	учиться
leave	left	left	оставлять
lend	lent	lent	давать взаймы
let	let	let	позволять
lie	lay	lain	лежать
lose	lost	lost	терять
make	made	made	делать
may	might	-	мочь
mean	meant	meant	значить
meet	met	met	встречать
mistake	mistook	mistaken	ошибаться
overcome	overcame	overcome	преодолевать
pay	paid	paid	платить
put	put	put	класть
read	read	read	читать
ride	rode	ridden	ездить верхом
ring	rang	rung	звонить
rise	rose	risen	вставать
run	ran	run	бежать
say	said	said	сказать

see	saw	seen	видеть
seek	sought	sought	искать
sell	sold	sold	продавать
send	sent	sent	посылать
set	set	set	ставить
shake	shook	shaken	трясти
shine	shone	shone	светить, сиять
shoot	shot	shot	стрелять
show	showed	shown	показывать
shut	shut	shut	закрывать
sing	sang	sung	петь
sink	sank	sunk	опускаться
sit	sat	sat	сидеть
sleep	slept	slept	спать
smell	smelt	smelt	пахнуть
spell	spelt	spelt	произносить по буквам
spend	spent	spent	тратить
spread	spread	spread	распространяться
stand	stood	stood	стоять
strike	struck	struck	ударять(ся)
swear	swore	sworn	клясться
sweep	swept	swept	подметать
swim	swam	swum	плавать
take	took	taken	брать
teach	taught	taught	учить
tear	tore	torn	рвать
tell	told	told	рассказывать
think	thought	thought	думать
throw	threw	thrown	бросать
understand	understood	understood	понимать
wear	wore	worn	носить
win	won	won	выигрывать
write	wrote	written	писать

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Составители: **Айтуганова** Жанна Илевна,
Галиахметова Альбина Тагировна

Кафедра иностранных языков КГЭУ

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