Учреждение образования
«БЕЛОРУССКИЙ ГОСУДАРСТВЕННЫЙ
ТЕХНОЛОГИЧЕСКИЙ УНИВЕРСИТЕТ»

АНГЛИЙСКИЙ ЯЗЫК

**Учебно-методическое пособие
для студентов специальностей
1-48 01 01 «Химическая технология
неорганических веществ, материалов и изделий»,
1-48 01 04 «Технология электрохимических производств»,
1-48 01 06 «Промышленная водоподготовка и водоочистка»,
1-57 01 01 «Охрана окружающей среды
и рациональное использование природных ресурсов»**

Минск 2021

УДК 811.11(075.8)
ББК 81.2Англя73
А64

Рассмотрено и рекомендовано редакционно-издательским советом Белорусского государственного технологического университета.

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Английский язык : учеб.-метод. пособие для студентов
А64 специальностей 1-48 01 01 «Химическая технология неорганических веществ, материалов и изделий», 1-48 01 04 «Технология электрохимических производств», 1-48 01 06 «Промышленная водоподготовка и водоочистка», 1-57 01 01 «Охрана окружающей среды и рациональное использование природных ресурсов» / сост. : А. М. Романова, В. В. Царенкова, С. И. Шпановская. – Минск : БГТУ, 2021. – 155 с.
ISBN 978-985-530-886-8.

В учебно-методическом пособии дается текстовый материал из оригинальной научно-технической литературы по химической и электрохимической технологиям, охране окружающей среды и другим темам, а также практические задания. Пособие включает аутентичные материалы, имеет многоуровневую структуру. Распределение материала организовано по принципу «от простого к сложному», поэтому материал может быть использован для обучения слушателей с разной языковой подготовкой.

Книга может использоваться как для аудиторной, так и для самостоятельной работы.

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ПРЕДИСЛОВИЕ

Период подготовки с использованием данного учебно-методического пособия рассчитан на три семестра (второй, третий и четвертый) в качестве прикладной дисциплины, обучение по которой проводится в тесной связи с изучаемыми профилирующими дисциплинами, а также с учетом будущей профессиональной деятельности выпускника и соответствия его подготовки критериям и модулям компетенций, сформулированным белорусским и международным химическими сообществами.

Учебно-методическое пособие состоит из шести частей. Организация работы по данному пособию основана на том, что студенты каждой из указанных специальностей изучают материал 10 либо 11 разделов (из трех частей). Разделы 1.1–1.2 (часть 1) едины для всех этих специальностей во втором семестре. Разделы 2.1–2.4 (часть 2) едины для всех этих специальностей в третьем семестре. В четвертом семестре у студентов каждой специальности своя часть. Так, разделы 3.1–3.4 (часть 3) предназначены для изучения студентами специальности 1-48 01 01 «Химическая технология неорганических веществ, материалов и изделий». Разделы 4.1–4.4 (часть 4) написаны для изучения студентами специальности 1-48 01 04 «Технология электрохимических производств». Разделы 5.1–5.5 (часть 5) предназначены для изучения студентами специальности 1-48 01 06 «Промышленная водоподготовка и водоочистка». Разделы 6.1–6.4 (часть 6) изучаются студентами специальности 1-57 01 01 «Охрана окружающей среды и рациональное использование природных ресурсов». Также в состав пособия вошли три дополнительных текста и таблица химических элементов на английском языке.

Пособие включает аутентичные материалы, имеет многоуровневую структуру. Распределение материала организовано по принципу «от простого к сложному», поэтому материал может быть использован для обучения слушателей с разной языковой подготовкой.

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Part 1
CHEMICAL INDUSTRY AND ECOLOGY

1.1. CHEMICAL INDUSTRY OF BELARUS

Ex. 1. Read and translate the following words.

Ferrous and non-ferrous metallurgy – черная и цветная металлургия; food industry – пищевая промышленность; fertilizers – удобрения; soda – сода; sector – отрасль; mining and chemical industry – горно-химическая промышленность; basic chemistry – основная химия; organic synthesis chemistry – химия органического синтеза; fine chemistry – тонкая химия; pipeline – трубопровод; nitrogen fertilizers – азотные удобрения; phosphorous fertilizers – фосфорные удобрения; potash fertilizers – калийные удобрения; JSC, joint stock company – ОАО, открытое акционерное общество; household chemicals – бытовая химия; fibres and yarns – волокна и нити; paint and varnish – краска и лак; feed biomethine – кормовой биометин; feed yeasts – кормовые дрожжи; fiberglass and fiberglass fabrics – стекловолокно и стеклоткани; synthetic resins and plastics – синтетические смолы и пластмассы; low labor intensity – невысокая трудоемкость; rubber-technical and tire industry – резино-техническая и шинная промышленность; oil and gas chemical cycle – нефтегазо-химический цикл; forest chemical cycle – лесохимический цикл; mining-chemical cycle – горно-химический цикл; paint and varnish production – лакокрасочная производство; cord fabric – кордная ткань (плотное шерстяное, хлопчатобумажное или синтетическое полотно в рубчик шириной около 3–8 мм); oil refineries – нефтеперерабатывающие заводы; MPa (megapascal) – МПа (мегапаскаль); cryolite – криолит; nepheline flame retardant – нефелиновый огнезащитный состав; anhydrous technical sodium sulfite – безводный технический сульфит натрия; nitrogen-phosphorus-potash fertilizer – азотно-фосфорно-калийное удобрение.

Ex. 2. Read and translate text A.

Chemical Industry of the Republic of Belarus

The chemical industry is one of the most important branches of the world economy, thanks to which the work of ferrous and non-ferrous

metallurgy, construction, agriculture, pharmaceuticals, and the food industry is ensured. In the modern world, the importance of the chemical industry is very great, because its achievements significantly facilitate people's lives.

This industry is characterized by the following features:

- the use of a large amount of raw materials for the manufacture of products, this is especially true of rubber, plastic, soda, fertilizers;
- chemical industry materials are very diverse;
- high level of energy costs;
- low labor intensity combined with the need for highly qualified specialists;
- large capital investments. The work of chemical enterprises is impossible without complex structures and mechanisms;
- complex industry structure;
- and environmental problems associated with the manufacture of chemical products.

Factors of placement of the chemical industry are raw materials, energy, water, labor resources, consumer, and transport.

The chemical industry is a complex of heavy industries that unites enterprises that produce chemical products. In the structure of the chemical industry, the following ***sectors*** can be distinguished:

- *mining and chemical industry,* which is engaged in the extraction, enrichment and primary processing of mining and chemical raw materials;
- *basic chemistry,* which is engaged in the production of mineral fertilizers, acids and salts;
- *organic synthesis chemistry,* which is engaged in the production of plastics, chemical fibers, synthetic rubber, dyes;
- *and fine chemistry,* which is engaged in the production of household chemicals, perfume and cosmetic products, medicines.

Let's take a closer look at the sub-sectors of the chemical industry in our country.

The chemical industry is one of the largest branches of the industrial complex of the Republic of Belarus. The industry has taken a leading position in the export of products to the CIS countries and all over the world.

In the chemical complex of the Republic of Belarus, three cycles are most developed: oil and gas chemical cycle, forest chemical cycle, and mining-chemical cycle. The mining and chemical cycle was

formed on the basis of the use of potash salts. The petrochemical cycle was formed on oil and gas coming mainly from Russia via the Druzhba and Surgut – Polotsk pipelines, as well as on small local resources. The formation of the forest chemical cycle is ensured by the availability of forest resources. Timber harvesting is carried out in the Gomel, Vitebsk, Minsk Regions, and in the east of the Brest Region.

The BSTU graduates work at the following enterprises of the chemical complex of Belarus.

Basic Chemistry. Enterprises of basic chemistry specialize in the production of fertilizers. Thus, the production of *potash fertilizers* is concentrated in Soligorsk. Four potash plants, which are part of the production association "Belaruskali", use local reserves of potash salts (40 per cent of potash salts produced in the CIS). Production of *nitrogen fertilizers* is concentrated in production association "Azot" (Grodno). The raw material for production is natural gas, which comes through a gas pipeline from Russia. The production of *phosphorous fertilizers* is concentrated in Gomel. Raw materials for the production of this type of fertilizer are apatite concentrates imported from the Murmansk region of the Russian Federation. And the production of table salt is concentrated in JSC "Mozyrsol" (Mozyr). The raw material for production is the Mozyr deposit of table salt.

Organic synthesis chemistry is based on hydrocarbon raw materials produced by the Novopolotsk and Mozyr oil refineries. Organic raw materials are also coal, peat, wood, and fats.

The production of ***chemical fibres and yarns*** enables manufacture of artificial fibers (Mogilev, Svetlogorsk; "Khimvolokno", Mogilev; "Polymir", Novopolotsk; Grodno) and cord fabric (Svetlogorsk).

The production of ***fiberglass and fiberglass fabrics*** is carried out in Polotsk.

The production of ***synthetic resins and plastics*** includes the production of caprolactone (Mogilev), manufacture of alkyd and polyester resins (Lida), plastics (Termoplast, Minsk, Borisov, Gomel, Rudensk, and Mozyr).

Paint and varnish production has been established in Gomel, Lida, and Minsk.

The rubber-technical and tire production is represented by such a giant as "Bobruiskshina" (Bobruisk) and a number of rubber production enterprises in Bobruisk, Borisov, Krichev, and Mogilev.

The production of ***household chemicals*** is also an important part of the chemical industry of our country, which includes the production of

detergents and bleaching agents (Brest Plant of Household Chemicals, Baranovichi Plant of Household Chemicals, Borisov Plant of Household Chemicals, and Kalinkovichi Plant of Household Chemicals).

The chemical and pharmaceutical production is widely represented by the following enterprises: Minsk Plant of Medical Drugs, Borisov Plant of Medical Drugs, Drogichensk Plant (producing hematogen), Grodno Plant of Medical Drugs, as well as plants in Skidel and Smolevichi.

Novopolotsk Plant of Vitamin and Protein Concentrates, Mozyr Plant of Feed Yeasts, Bobruisk Hydrolysis Plant, Rechitsa Hydrolysis Plant, Nesvizh Plant of Feed Biomethine, and Pinsk Biochemical Plant specialize in ***microbiological products***.

Ex. 3. Answer the following questions.

1. What does chemical industry mean for modern society? 2. By what features can one characterize chemical industry? 3. What factors of placement of the chemical industry can you list? 4. What sub-sectors can be distinguished in chemical industry? 5. What fertilizers are produced by basic chemistry? 6. The production of synthetic resins and plastics isn't presented in chemical industry of our country, is it? 7. By what enterprises is chemical and pharmaceutical production widely represented in Belarus?

Ex. 4. Translate the following sentences.

1. Сырьем для производства азотных удобрений является природный газ, который поступает по газопроводу из России. 2. Сырьем для производства фосфорных удобрений служат апатитовые концентраты, завозимые из Мурманской области Российской Федерации. 3. Химическая промышленность является одной из наиболее крупных отраслей промышленного комплекса Республики Беларусь. 4. Горно-химическая отрасль занимается добычей, обогащением и первичной обработкой горно-химического сырья. 5. Материалы химической промышленности отличаются большим разнообразием. 6. Работа химических предприятий невозможна без сложных конструкций и механизмов. 7. В современном мире значение химической промышленности очень велико, поскольку ее достижения существенно облегчают жизнь людей. 8. Факторы размещения химической промышленности – сырьевой, энергетический, водный, трудовые ресурсы, потребительский и транспортный.

Ex. 5. Combine expressions from left-hand column with those in the right-hand column to make sentences.

1. Organic synthesis chemistry is based on …	a) the rubber-technical and tire production
2. Organic raw materials for organic synthesis chemistry are …	b) coal, peat, wood, and fats
3. The use of a large amount of raw materials for the manufacture of products is …	c) hydrocarbon raw materials produced by the oil refineries
4. Enterprises of basic chemistry specialize in …	d) oil and gas chemical cycle, forest chemical cycle, and mining-chemical cycle
5. There are … in the chemical complex of the Republic of Belarus	e) the production of fertilizers
6. "Bobruiskshina" is well known for …	f) one of those features that characterize chemical industry

Ex. 6. Read and translate text B.

Petrochemical Complex of the Republic of Belarus

The petrochemical complex is based on 83 enterprises and organizations belonging to the state concern "Belneftekhim", which produces 92.6 per cent of the total output of the industry and is the main exporter of chemical products. In the total volume of industrial products of Belarus, the share of the concern's enterprises exceeds 15 per cent, in national exports-more than 25 per cent, including exports to foreign countries – more than 45 per cent. The main activities of the concern are the extraction, transportation, processing of oil and sale of petroleum products, the production of mineral fertilizers, the production of chemical fibers and threads, the tire industry, the production of glass fiber products, the production of lacquers and paints, and plastic products. The share of the chemical industry in the total volume of the concern is more than 65 per cent, and in the total volume of exports – more than 60 per cent. Let's study the giants of the chemical industry of Belarus, which are part of the concern.

The production association "Khimvolokno" (Mogilev) is the largest complex in Europe for the production of polyester fibers and yarns. Its peculiarity is the integration into a single industrial complex of a number of industries related to the technological cycle-from the production of raw materials to the production of finished products (polyester fibers and yarns). It produces a wide range of products for industrial and technical purposes: polyester fibers and bundles, polyester threads

for the production of sewing threads, polyester technical threads, polyester threads for the production of curtain and tulle products, polyester complex threads, textured (painted and unpainted), viscose textile thread, polypropylene film for food packaging, consumer goods. The company's products are delivered to more than 40 countries in Europe, Asia, and America.

The production association "Khimvolokno" (Svetlogorsk) is a modern highly automated enterprise of the chemical industry, which includes the production of viscose technical and textile yarns, cord fabric, the production of polyester textile yarns, the production of carbon fiber materials and composites, pilot workshops and a plant for the production of non-woven polypropylene material "spunbond". Technological processes and equipment for the production of synthetic yarns correspond to the modern world level and ensure the production of high quality products. The company's products are delivered to 24 countries in Europe, Asia, and America.

The production capacities of the production association "Khimvolokno" (Grodno) allow to produce more than 50 thousand tons of polyamide-6 products of the following range: cord fabric for the tire industry, technical thread for the fishing industry, rubber products, conveyor belts, textured rope fabric for the production of carpets, floor tufting coatings, staple fiber, polyamide-6 (PA-6) in granules (glass-filled and with other organic and inorganic fillers). The company's products are delivered to 16 European countries.

The production association "Polymir" (Novopolotsk) is a modern highly automated enterprise specializing in the production of high-pressure polyethylene, polyacrylonitrile fibers, polyester and polyamide resins, organic synthesis products and consumer goods. Polyethylene is used for the manufacture of injection, blown and special products, and films for various purposes. Polyacrylonitrile fibers are widely used in the textile industry (for the production of fabrics, knitwear, artificial fur, and carpet products). Organic synthesis products are used for the production of polyacrylonitrile fibers, plastics and consumer goods. The company's products are delivered to 12 countries in Europe and Asia.

The production association "Steklovolokno" (Polotsk) specializes in the production of glass fiber and products based on it: glass threads, fiberglass, glass mesh, glass wool. The production capacity is designed for the production of 17.3 thousand tons of continuous glass fiber and

products made from it. From a tennis racket to a space complex – this is the range of applications of the association's products. It is used in such areas as electronics, electrical engineering, transport, aerospace, chemical equipment production, shipbuilding, construction, production of goods for sports and recreation. The company's products are delivered to 25 countries in Europe, Asia and America.

The production association "Belaruskali" (Soligorsk) is the world's largest producer of potash fertilizers. The share of the enterprise in the total volume of world exports of potash fertilizers is more than 11 per cent. The association produces: small-crystal potassium chloride, granular potassium chloride, mixed potassium salt, technical sodium chloride, table salt for food and animal husbandry, liquid brine, salt blocks for halocambers. The company's products are delivered to 55 countries in Europe, Asia, Africa and America.

The production association "Azot" (Grodno) is a large modern enterprise that produces ammonia, urea, liquid fertilizers, ammonium sulfate, sulfuric acid. The company's products are delivered to 19 countries in Europe, Asia, America, and Africa.

The tire plant "Belshina" (Bobruisk) is a wide-profile enterprise that produces 170 standard sizes of tires for passenger cars, trucks and heavy trucks, buses, trolleybuses, lifting and transport and road construction machines, tractors and agricultural machinery. The plant's capacity is 4.3 million tires per year. Modern technical level of equipment of the enterprise, qualified personnel, introduction of advanced achievements of science and technology guarantee high quality of products. The company's products are delivered to more than 30 countries in Europe, Asia, and America.

The open joint stock company "Lakokraska" (Lida) produces modern paint materials in large volumes. Varnishes and enamels based on condensation resins (more than 80 names) are produced, which are used in mechanical engineering and everyday life. Varnishes and enamels based on polymerization resins (about 60 brands and colors) are used as protective coatings for equipment operating in aggressive environments. Polyvinyl acetate dispersion, phthalic anhydride are used for the production of paints. The company's products are delivered to 13 countries in Europe and Asia.

Borisov Plant of Plastic Products produces plastic products: polyethylene film, including heat-shrinkable, pressure pipes made of polyethylene (pressure from 0.25 to 1 MPa), pipes for gas pipelines, pro-

files and other products used in machine-building, instrument-making, watchmaking and other industries, as well as consumer goods. The company's products are delivered to 6 European countries.

Gomel Chemical Plant produces sulfuric acid, aluminum fluoride, cryolite, nepheline flame retardant, anhydrous technical sodium sulfite, nitrogen-phosphorus-potash fertilizer NPK of various brands, ammoniated superphosphate, aluminum sulfate. The company's products are delivered to 14 countries in Europe, Africa and Latin America.

Products based on chemical technologies are also produced by enterprises of other industries (forestry, perfume, oil and fat, glass, microbiological, etc.). These industries operate in contact with the enterprises of the chemical complex, receiving from them sulfuric acid, phosphorus, reagents, dyes. Therefore, the scale of the chemical industry in professional, social and environmental relations is not limited to the chemical complex of production.

Ex. 7. Answer the following questions.

1. What state concern presents the petrochemical complex of our country and how many enterprises and organizations does it include? 2. Name the main activities of this concern. 3. What giants of the chemical industry of Belarus do you know? 4. What does the production association "Khimvolokno" (Mogilev) produce? 5. Does production of the production association "Khimvolokno" (Svetlogorsk) differ from that of the production association "Khimvolokno" (Grodno)? 6. What production specializes in the production of high-pressure polyethylene, polyester and polyamide resins, organic synthesis products and consumer goods? 7. What production specializes in the production of glass fiber and products based on it: glass threads, fiberglass, glass mesh, glass wool? 8. "Belaruskali" is the only production association in Belarus that produces fertilizers, isn't it? 9. If you what to buy modern paint materials in large volumes, like varnishes and enamels, it'll be better to go to "Lakokraska" (Lida), isn't it? 10. What do you think is there any production of plastic products or acids in Belarus?

Ex. 8. Find synonyms.

Emit; increase; mankind; use; grow; influence; noxious; impact; harmful; cause; release; utilize; reason; fight; struggle; humankind.

Ex. 9. Work in pairs to make dialogues on texts A and B.

Ex. 10. Speak on the topic "Chemical Industry of Belarus".

1.2. ECOLOGY

Ex. 1. Read and translate the following words.

A–B. Amount – количество; to affect – воздействовать; boundary – граница; to contaminate – загрязнять; despoliation – грабеж; contemporary – современный; consequence – последствие; damage – вред; to devastate – опустошать; domestic – внутренний; to decrease – уменьшаться; effect – результат; to exist – существовать; to expand – расширять; environment – окружающая среда; to exert – оказывать; to elaborate – разрабатывать; excessive – избыточный; equilibrium – равновесие; frontier – граница; huge – огромный; humidity – влажность; harmful – вредный; interplay – взаимодействие; interconnection – взаимосвязь; to interfere – мешать, вмешиваться; to impair – ухудшаться; to merge – соединяться; noxious – вредный, отравленный; nutrient – питательный; to override – отвергать; to overtake – догонять; pollution – загрязнение; perish – гибель; to persist – упорствовать; to support – поддерживать; sufficient – достаточный; withstand – противостоять.

C. To distribute – распределять, распространять; surroundings – окрестности, окружение, среда; terrestrial – земной; internal – внутренний; external – внешний, наружный; radon – радон; dwelling – жилище, дом; to restrict – ограничивать; outer space – космос; background – фон; double – двойной, усиленный; adverse – неблагоприятный, вредный; health – здоровье; probably – вероятно; chest – грудная клетка; nuclear weapons – ядерное оружие; luminous – светящийся; travel – путешествие, движение; altitude – высота; to estimate – оценивать, подсчитывать; annual – ежегодный, годовой; considerable – значительный, важный; occupational – профессиональный; further – добавочный, дальнейший; miner – шахтер, горняк.

Ex. 2. Read and translate text A.

Ecology

Ecology is the study of the environment and the way plants, animals, and humans live together and affect each other. This word came from the Greek “oikos” which means “home”. All living beings exist within a complex interplay of organisms and environment, including both living and non-living elements. What must man, as the most powerful species within that interplay, understand about how organisms affect each other? What must we know about the balance of nature in

order to deal intelligently with the effects of our activities? Is it possible to manipulate the environment successfully?

Can man ever learn to live contentedly within the fragile networks of the planet Earth? What will happen if he doesn't?

The whole of nature can be compared to be a complex household in which everyone has a specific job, including the nonliving structure of the building itself. This concept has given rise to the word "ecology". The term was first introduced by German biologist E. Haekel in 1870, and since the late 1960s it has become a subject of international interest.

We have begun to realize that man, as the dominant species on this planet, has more influence over nature than any other living creature, and that his influence is increasing all the time. Recently it has become obvious that the power of our interfering with nature, overriding its dicta and altering its routines, has overtaken our understanding of how nature works. The result is despoliation of our own home, the planet Earth.

The plant and animal population of a particular area, including each individual of the various communities that exist there, together with the nonliving environment which supports them, make up an ecosystem. This is a useful working unit for study because it shows its own internal patterns of relationships, but the boundaries are not always easy to define. One ecosystem merges into another just as the activities of one species merge into those of another. The important point is that an ecosystem includes all the organisms in it, from the bacteria in the soil to the birds and insects in the air, as well as all the factors of the nonliving environment – nutrients, temperature, wind, relative humidity, light intensity, soil type, geographical position and so on. Each of these factors has some effect on the living organisms and some also have an effect on each other. Ecology studies the complex interrelations between living organisms, on the one hand, and the living organisms and the environment, on the other hand.

Ex. 3. Answer the following questions.

1. What can the whole of nature be compared? 2. What does the term "ecology" mean? 3. Who was the first to introduce the term? 4. Since what time has ecology become a subject of international interest? 5. What is the dominant species of our planet? 6. What is the result of man's increasing interference with nature? 7. What is ecosystem? 8. What does it include and study?

Ex. 4. Find synonyms.

Obvious; to make up; boundary; to merge; pollution; to pollute; to exist; to affect; realize; effect; to begin; to include.

Result; to understand; to influence; to live; to contaminate; to fuse; frontier; apparent; contamination; to build; to involve; to start.

Ex. 5. Translate the following sentences.

1. Ecology is to study plants, animals in relation to their environment. 2. Every plant and animal of an ecosystem has a definite role to play to maintain an overall balance in the system. 3. The initiative of "Green Peace" movement caused the world public to pay special attention to the problem of environmental protection. 4. We ought to protect the environment. 5. It is necessary to teach ecology at school. 6. Man-made pollution is too serious not to be paid attention to. 7. To improve his living conditions man began to invent different technologies. 8. Where is the work to be done?

Ex. 6. Read and translate the text.

An ecosystem is a natural organic whole of a biologic community and its nonliving environment. Constant interactions between living organisms, say, plants, bacteria and animals and their physical environment in any ecosystem are the pathways by which matter and energy are distributed. The most important thing is that these interactions bind the living and nonliving components together into a stable system. Many opposing forces operate within the ecosystem which may lead to imbalances or disruption but normally the ecosystem is stabilized due to its self-compensating properties. The state of balance in any ecosystem is self-sustainable so that even slight imbalances are corrected before they become severe, irreparable and fatal. Any stable natural ecosystem consists of a great number of various species, from minute living things like viruses or bacteria to giants like whales or sequoias, each playing a unique role in relation to the whole system.

Ex. 7. Agree or disagree.

1. Ecology is a linguistic science. 2. More attention ought to be paid to Ecology. 3. Ecological problems are not very important now. 4. All the ecological problems can't be ever solved. 5. Scientists are not worried about any of the ecological problems at present.

Ex. 8. Read and translate text B.

Environment and Science

The exchange of substances and energy is continuously growing nowadays, in the expanded utilization of natural resources and the increase of domestic refuse and industrial wastes which are returned into the environment, drastically forces man's overall impact on nature.

At the same time, the ability of nature to reproduce intensively used resources and to self-purify from the wastes is limited.

Therefore, old and rapidly developing industrial regions are running short of natural resources the reproduction of which is being decreased and the quality of which is impaired: pollutants are accumulating in the environment which exerts a noxious influence on living organisms, including man. The total sum of problems of the interaction of society with nature under the conditions of contemporary scientific and technological progress has been insufficiently elaborated.

At first glance such a statement may seem false, since many natural sciences have long been dealing with various aspects of the environment, in particular, the study of the impact of society's economic activity on the environment.

Nevertheless, the actual causes of unfavorable changes in the natural environment and the essence of the impact of technological factors on natural ecosystems have been studied insufficiently.

Evidence of all of this is the fact that the realization of large technological measures (mining, building, hydroengineering, etc.), execution of extensive land reclamation work, introduction of chemical processes into agriculture necessary for increasing yield-capacity and fighting pests as well as significant positive effects often yield unexpected and unpleasant results.

Modern industrial production creates new materials and wastes which are non-existent in nature and in many respects foreign to living organisms by their physical and chemical structure. The human body is not prepared yet, in terms of its evolution, to withstand the impact of new chemical substances, new energy types, and various physical radiation.

As a result, the actual economic effect of a certain project often turns out to be lower than the anticipated one, while excessive air and water pollution and perishing of forest and farmlands, losses of fisheries and many other unfavorable changes in the environment make it necessary to carry out new, previously unforeseen measures.

Ex. 9. Answer the following questions.

1. What is the reason of growing exchange of substances and energy nowadays? 2. What is the reaction of nature to human activity? 3. What can you tell about the ability of nature to reproduce intensively used resources? 4. Why is the quantity of natural resources decreasing all the time? 5. Why is the quality of them impaired? 6. How has the total sum of problems of the interference of society with nature been

elaborated? 7. What do you understand under the expression "large technological measures"? 8. What are the results of the realization of technological measures? 9. Does the actual economic effect of a certain project always turn out to be higher or lower than anticipated one and why? 10. What is the interplay of new compounds with living organisms? 11. What is the reaction of the human body to new materials? 12. Which is more important increasing people's standard of living or protecting the environment?

Ex. 10. Find synonyms.

Emit; increase; mankind; use; grow; influence; noxious; impact; harmful; cause; release; utilize; reason; fight; struggle; humankind.

Ex. 11. Read and translate the text.

Local, regional and global environmental changes and the increasing shortage of vital resources like fresh water, fossil fuels and fertile soil is a growing factor in the emergence of armed conflicts, especially in and between developing countries. The permanent loss of the very foundations of life, such as inhabitable land, agriculturally productive land, adequate drinking water reserves can lead to social problems and violent conflicts both within and between states. When entire peoples are forced to leave their homes because the land is no longer able to feed them or because the logging of rainforests left them with no game to hunt, they are hardly likely to be received with open arms by the inhabitants of more fertile region. Or when one country in need of more drinking water decides to create a reservoir by damming the only river supplying the entire region, the neighbours dependent on that source will not stand by and let it happen.

Ex. 12. Be ready with dialogs on text C.

Natural and Man Made Radiation

What are the natural sources of radiation? Naturally occurring radioactive materials are distributed across the whole of the earth in soils, rocks, water and plants. The radiation emitted from the surroundings is called terrestrial radiation. Naturally radioactive materials are present in our own bodies and the radiation emitted from these materials is known as internal radiation.

Uranium is a radioactive material dispersed throughout soil and rock. As it decays the radioactive gases radon and thoron are produced which normally disperse into the atmosphere. The concentrations are low but

detectable. When radon and thoron enter a dwelling from the walls or floor, higher concentrations may build up if ventilation is restricted.

Radiation, from outer space and from the sun, known as cosmic radiation, is largely absorbed by the atmosphere but some penetrates to ground level where it adds to the natural background radiation.

The total radiation dose per person in the UK in a year from all natural sources, such as cosmic, terrestrial and from within the body, is an average 1870 micro Sv (187 mrem). In some areas of the UK the natural background dose due to terrestrial radiation may be double the average and in some parts of the world it is many times higher. Scientists estimate that the average person in the USA receives a dose of about 360 mrem of radiation per year. 80 per cent of that exposure comes from natural sources: radon gas, the human body, outer space, rocks and soil. The remaining 20 per cent comes from man-made radiation sources, primarily medical X-rays.

What about man-made radiation? The X-ray equipment used in hospitals is probably the best known source. A chest X-ray gives an effective dose of about 20 micro Sv (2 mrem). Radioactive substances are widely used for medical purposes.

Artificial radioactive materials have spread throughout the world as a result of nuclear weapons tests in the atmosphere, 20 to 30 years ago.

Other small sources of man-made radiation are: luminous watches; the burning of coal which releases naturally occurring radioactive materials into the environment; and air travel, since at high altitudes there is less shielding from cosmic radiation.

Due to the use of man-made sources of radiation in industry, universities and hospitals, a considerable number of people are exposed to additional small amounts of radiation as a result of their work. This occupational exposure adds an average of 8 micro Sv per person (0.8 mrem), a further 0.4 per cent of the total, and also includes a significant contribution from exposure of miners to radon and thoron and their decay products.

Ex. 13. Form adjectives with the opposite meaning according to the model in (im, ir), un + a – a, e.g. “pure – impure” and translate the words obtained:

In – active, accurate, attentive, comparable, correct, dependent, direct, effective, human, soluble, significant, visible, organic, sufficient;

Im – possible, material, mobile, modest, moral, perfect, possible;

Ir – rational, regular, resistant;

Un – safe, equal, known, favourable, pleasant, true.

Ex. 14. Speak on the topic “Ecology”.

Part 2
INORGANIC CHEMISTRY

2.1. CHEMISTRY AS A SCIENCE

Ex. 1. Read and memorize the following words.

To break down – разрушать; change – изменение; to change – менять; composition – состав; compound – соединение; to consist of – состоять из; density – плотность; to determine – определять; substance – вещество; to include – включать; to involve – включать; liquid – жидкий; matter – вещество, материя; to obtain – получать; processing – обработка; property – свойство; pure – чистый; raw material – сырье; relationship – взаимосвязь; solid – твердый; solubility – растворимость; subject – предмет; to subject – подвергать; to treat – обрабатывать; treatment – обработка; e.g. – for example – например; for this reason – по этой причине; both … and … – как …, так и …; either … or … – или … или; in order to – для того чтобы; i.e. – that is – то есть.

Ex. 2. Read and translate the text.

Chemistry

Chemistry is the science of substances, their properties and their changes. It studies the composition and structure of substances, the relationship between the properties of substances and their chemical composition and structure, the conditions and methods of their changes and transformations.

Chemical changes of substances are called chemical reactions. 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 always accompanied by some physical changes, e.g. by the liberation or the absorption of energy in the form of light, heat or electricity. For this reason chemistry is closely related to physics. The problems common both to chemistry and physics form the subject of special sciences – physical chemistry and chemical physics.

Chemistry is also closely related to other natural sciences, especially to biology, since any process in a living organism is accompa-

nied by continuous chemical changes of substances in that organism. We could add many other areas of study to the list: medicine, agriculture, oceanography, engineering, mathematics, etc.

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. 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 color, smell, solubility, density, hardness and boiling and melting points. Chemical properties include the behavior with other materials.

Matter exists in three states: the solid, the liquid and the gaseous state. A substance usually can be transformed from one state to another under the changes of its temperature.

Chemistry plays a very important part in modern life, especially in man's industrial activities, since almost all branches of industry are connected with some application of chemistry.

Nature gives us various raw materials, e.g. wood, coal, ore, oil, etc. We subject these natural raw materials to chemical treatment and obtain various substances with different physical and chemical properties. Then we use these substances in agriculture, e.g. mineral fertilizers, in industry for the manufacture of various industrial products, e.g. steel, plastics and in everyday life, e.g. soap, soda, medicines, etc.

In order to manufacture useful things it is often necessary to treat natural raw materials chemically, i.e. to subject them to chemical processing. To do this successfully we are to learn the general laws of changes and transformations of substances, and it is chemistry that gives us this knowledge. Metals, glass, plastics, dyes, drugs, insecticides, paints, paper, soaps, detergents, explosives and perfumes are all made of chemicals.

Ex. 3. Answer the questions.

1. What does chemistry study? 2. What is a chemical reaction? 3. What does a chemical change involve? 4. Does a physical change involve changes in composition? 5. What sciences is chemistry closely related to? 6. Analysis is the process of breaking down a compound into simpler substances, isn't it? 7. What are physical properties of

a substance? 8. What are the three states of matter? 9. Why must we learn the general laws of chemistry? 10. What things are manufactured from chemicals?

Ex. 4. Identify an odd word.

1. Chemistry, physics, mathematics, linguistics biology. 2. Structure, plastics, composition, property, ingredient. 3. Solid, liquid, difficult, gaseous, volatile. 4. Paint, paper, soap, wood, perfume, plastics.

Ex. 5. Match the words with their definitions.

1. Substance	a) the production of a substance from simpler materials after chemical reaction
2. Property	b) the act or process of preparing something by a special method
3. Raw material	c) a particular kind of matter with uniform properties
4. Mixture	d) the temperature at which a solid substance melts
5. Synthesis	e) the basic material from which a product is made
6. Melting point	f) quality or characteristic of something
7. Processing	g) a substance made by mixing other substances together

Ex. 6. Say whether the following statements are true or false.

1. Chemistry is the science of substances, their properties and their changes. 2. A physical change involves changes in composition and in properties. 3. Chemistry studies societies and human behavior. 4. Chemical changes of substances are called chemical reactions. 5. Chemical changes are accompanied by some physical changes. 6. The forms of energy are light, heat and electricity. 7. Analysis is the formation of a compound from simpler substances. 8. Matter exists in two states: the solid and the gaseous state. 9. Every substance has physical and chemical properties. 10. The building blocks of matter are bricks. 11. In order to manufacture useful things it is often necessary to treat natural raw materials chemically.

Ex. 7. Complete the sentences with the words from the table below.

pure, properties, composition, raw materials, plays, changes, living organism, physical, compounds, analysis

1. Chemistry studies chemical … and structure of substances. 2. Chemical … of substances are called chemical reactions. 3. Chemical

changes of substances are accompanies by … changes. 4. Any process in a … … is accompanied by changes of substances. 5. All forms of matter consist of … substances or mixtures. 6. … are combinations of elements. 7. … is the process of breaking down a compound into simpler substances. 8. Chemical … include the behavior with other materials. 9. Chemistry … a very important part in modern life. 10. Nature gives us various … .

Ex. 8. Complete the sentences with the words derivationally related to the words in brackets.

1. Chemistry studies the composition and … of substances (structural). 2. A chemical change … changes in composition and in properties (involvement). 3. Chemical changes are accompanied by the liberation or … of energy (absorb). 4. Chemistry is closely related to other … sciences (nature). 5. All … of matter consist of pure substances or mixtures (formation). 6. The composition of a pure substance never … (changeable). 7. A substance usually can be … from one state to another (transformation). 8. Nature gives us … raw materials (vary).

Ex. 9. Put the words in the right order.

1. Properties, relationship, substances, chemistry, the, the, studies, between of. 2. Only, a, changes, properties, involves, in, change, physical. 3. Are, liberation, by, chemical, the, changes, of, or, energy, accompanied, absorption, the. 4. Closely, to, is, biology, related chemistry. 5. The, matter, are, blocks, building, elements, of. 6. Combinations, elements, are, of, compounds. 7. Include, with, the, chemical, materials, other, properties, behavior. 8. Very, modern, in, chemistry, life, a, important plays, part.

Ex. 10. Say it in English.

Вещество; состав; изменение; включать; свойство; сопровождать; естественные науки; соединение; точка кипения; химическая обработка.

Ex. 11. Complete the sentences using the information from the text.

1. Chemistry studies the composition and structure of … . 2. The problems common both to chemistry and physics form the subject of special … . 3. Any process in a living organism is accompanied by continuous chemical … . 4. The formation of a compound from simpler substances is known as … . 5. Every substance has physical and chemical … . 6. A substance can be transformed from one state to another under the changes of its … . 7. Almost all branches of industry are connected with some application of … . 8. In order to manufacture useful things it is necessary to subject natural raw materials to chemical …

Ex. 12. Speak on the topic “Chemistry as a Science”.

2.2. BASIC CHEMICAL CONCEPTS

Ex. 1. Read and learn the following words.

Atom – атом; calculation – вычисления; constituent – составная часть; to distinguish – различать; to decompose – разлагать на составные части; to denote – обозначать; definite – определенный; to differ – различаться; to divide – делить; to distribute – распределять; equation – уравнение; equal – равный; to introduce – представлять, вводить; intact – неповрежденный; indivisible – неделимый; initial – начальный; liquid – жидкость; meaning – значение; numerically – численно; nucleus – ядро; to oxidize – окислять; phenomenon – явление; pressure – давление; to represent – представлять; to retain – сохранять; solid – твердое тело, твердый; subsequent – последующий; to separate – отделять; to weigh – взвешивать.

Ex. 2. Read and translate text A.

Chemical Symbols

In order to illustrate chemical reactions and the elements and compounds involved in them, chemists – use symbols and formulas. A chemical symbol is a one-or two-letter designation of an element. Berzelius was the first who introduced chemical symbols into science in 1813. He suggested denoting the elements by the initial letters of their Latin names. Oxygen is designated by the letter O, suplhur by S, potassium (Kalium) by K. When the names of several elements begin with the same letter, one of the subsequent letters is added to the initial one, e.g. carbon (Carboneum) has the symbol C, calcium (Calcium) the symbol Ca, etc.

Chemical symbols have a definite quantitative meaning as well. Each symbol denotes either one atom of the element or a weight of the element numerically equal to its atomic weight, e.g. CL denotes one atom or 35.5 parts by weight of chlorine.

We combine chemical symbols and get chemical formulas of various complex substances. Just as the symbol of an element represents its atom, so the formula of a substances represents either one molecule or a weight of the substance numerically equal to its molecular weight, for example, the formula H_2O stands for either one molecule or 18 parts by weight of water.

Simple substances are also denoted by formulas which show how many atoms the molecule of the simple substance consists of, e.g. the

formula of hydrogen is H_2. If the atomic composition of the molecule of the simple substance is unknown, it is designated by the simplest possible formula, i.e. simply by the symbol of the element.

The symbols of elements and the formulas of substances serve two purposes in chemistry: (1) they designate atoms or molecules, and (2) they denote weights corresponding to atomic or molecular weights. When we express reaction by chemical equations, the symbols and formulas stand for the atoms and molecules of the reacting substances, and in all chemical calculations they stand for weights proportional to their atomic and molecular weights.

There are over 100 different elements, which are made up of atoms. Elements can be divided into metals and non-metals. Chemical symbols and formulae are used to represent elements and compounds.

Ex. 3. Answer the following questions.

1. When did Berzelius introduce chemical symbols into science? 2. How did he suggest denoting the chemical elements? 3. How are the chemical elements designated if they begin with the same letter? 4. What does a chemical symbol denote? 5. In what way do we get chemical formulas? 6. What does a formula of a substance represent? 7. How is the atomic composition of the molecule of a simple substance designated? 8. What purpose do the symbols of elements and formulas of substances serve? 9. What do symbols and formulas stand for in chemical equations? 10. What do symbols and formulas stand for in chemical calculations?

Ex. 4. Say it in English.

Вводить химические символы в науку; обозначать элементы начальными буквами латинских названий; одна и та же буква; определенное количественное значение; численно равный атомному весу; молекулярный вес; одна из последующих букв; неизвестный состав; выражает реакции химическими уравнениями.

Ex. 5. Put the words in the right order.

1. Berzelius, chemical, introduced, symbols, 1813, into, science, in. 2. The, are, letters, names, initial, Latin, elements, denoted, the, by, of, their. 3. We, reactions, can, by, express, equations, chemical. 4. Formulas, how, substance, many, of, consists, show, atoms, of, the, simple, molecules.

Ex. 6. Complete the sentences using the information from the text.

1. Berzelius was the first … . 2. Oxygen is designated by … . 3. When the names of several elements begin … . 4. We combine

chemical symbols and get … . 5. Simple substances are also denoted by formulas … . 6. Symbols and formulas serve … . 7. There are over … different elements, which … . 8. Chemical symbols and formulae are used to … .

Ex. 7. Translate the following sentences into Russian.

1. A symbol is a shorthand way of writing the name of an element. 2. Chemical formulas identify compounds. 3. Chemical formulas are used to designate compounds by showing the kind and number of atoms that are present. 4. When a number written slightly below the line follows a symbol, it tells how many atoms of that element are found in the molecule. 5. Chemical equations show chemical changes. 6. Chemists combine chemical symbol to get chemical formulas of various complex substances. 7. One atom of oxygen combines with two atoms of hydrogen to form one molecule of water.

Ex. 8. Read and translate text B.

Composition of Substances

Any substance which has a clear and specific chemical composition and structure is known as a chemical. All substances consist of molecules. Molecules are the smallest particles of a substance which retain its chemical properties. The molecules of one and the same substance are identical, while the molecules of different substances differ in weight, size and other properties. Every substance exists as long as its molecules are intact.

The molecules of substances consist of still smaller particles called atoms. Atoms are chemically indivisible particles that make up molecules. Each different type of atoms is called a chemical element, that is, the term "element" is used to denote a substance which cannot be decomposed into simpler substances. Oxygen, hydrogen, Sulphur are examples of chemical elements. Under ordinary conditions of temperature and pressure some of the elements are solids, e.g. copper, Sulphur, others are liquids, e.g. mercury; still others are gases, e.g. hydrogen, oxygen.

The distribution of chemical elements in nature is very unequal. Oxygen is the most widely distributed element on our planet. Most of it is in chemical combination with other elements. Silicon is the second most abundant element. The six most common metals are aluminium, iron, calcium, sodium potassium, magnesium. These eight elements make up about 98 per cent of our planet.

Chemical elements are not many. After many years of experiments and tests scientists have found only 107 elements. In contrast, there are several hundred thousands of compounds which can be decomposed into elements.

Compounds are characterized in the following way: 1. A compound always consists of two or more different elements. 2. The composition of any given compound is always perfectly definite. For example, iron sulphide Fe_2S_3 contains iron and sulphur in the proportion of 7 parts by weight of iron to 4 of sulphur. 3. The chemical energy of a compound is always different from the sum of chemical energies of its constituents taken separately. 4. A compound has its own characteristic properties which differ in many respects from the properties of its constituents.

The third class of substances is very large. It includes different mixtures. In the structure of a mixture we can distinguish several substances. Ordinary concrete is an example of a mixture. In a broken piece of concrete it is easy to distinguish crushed stone, sand and cement. In many cases, however, mixtures and compounds are not so easily distinguished.

Ex. 9. Answer the following questions.

1. What particles do all substances consist of? 2. What is a molecule? 3. How do molecules differ? 4. How long does every substance exist? 5. Define an atom. 6. What does the term element denote? 7. In what states can elements exist? 8. What does the state of elements depend on? 9. What are the most abundant elements? 10. What are the most common metals? 11. Define a chemical compound. 12. What are the main characteristic of compounds? 13. What do you know about the third class of substances?

Ex. 10. Find the pairs of synonyms.

Denote; produce; study; change; relate; branch; obtain; subject; different; various; the same; transform; manufacture, designate; learn; connect; get; process; identical; field.

Ex. 11. Say it in English.

Состав веществ; сохранять химический состав; идентичные молекулы; различать по весу, размеру; существовать до тех пор, пока молекулы целы; химически неделимые частицы; жидкие и твердые вещества; разлагаться на более простые элементы; неравномерное распространение химических элементов; данное соединение; во многих отношениях.

Ex. 12. Complete the sentences using the information from the text.

1. The molecules of one and the same substance are identical while … . 2. The molecules of substances consist of … . 3. Atoms are … . 4. Under ordinary conditions of … . 5. The distribution of chemical elements … . 6. The six most common metals are … . 7. Compounds are characterized in the following way … . 8. The third class of substances includes … .

Ex. 13. Translate the following sentences into Russian.

1. It is pleasant if one dedicates himself to learning about what goes on in chemical systems. 2. The colloidal state for a substance is one in which it exhibits colloidal properties. 3. No one has ever observed these phenomena. 4. One has to remember that this reaction is followed by an explosion. 5. One of the important problem is to obtain water sufficiently pure to meet our needs.

Ex. 14. Speak on the topic "Basic Chemical Concepts".

2.3. CHEMICAL ELEMENTS IN THE ECOSPHERE

Ex. 1. Read and learn the following words.

Crust – кора; envelope – оболочка; vast – огромный; to refer – относиться; to be referred to as – называться, обозначаться; percentage – процентное содержание; rock – горная порода; soil – почва; occasionally – иногда; to distribute – распределяться, распространять; to accumulate – накапливать; accumulation – накопление, скопление; to deposit – отлагать, осаждать; to estimate – оценивать; layer – слой; dry – сухой; dust – пыль, прах, мусор, порошок; average – средний; in addition – кроме того.

Ex. 2. Read and translate the following text.

Chemical Elements in the Ecosphere

There are four distinct regions of our earth environment. The rocky and mountainous crust of the earth is called the lithosphere (Greek: litho = stone). The envelope of gases surrounding the earth is the atmosphere (Greek: atmos = vapour). The hydrosphere (Greek: hydro = water) includes the vast amount of water in lakes, rivers, oceans, and underground deposits, the water contained in the ice and snow of the

earth, and the water that makes up the clouds and moisture in the atmosphere. Within the atmosphere and hydrosphere and upon the lithosphere dwell the various plants and animals that constitute the biosphere (Greek: bio = life). Since these four realms are interrelated and form our normal environment, they are referred as a whole as the ecosphere (Greek: oikos = house).

The four portions of our environment contain elements in various states of combinations. The Table gives the percentages by mass of the 18 elements that make up about 99.5 per cent of the ecosphere.

The lithosphere, which is made up mainly of rock and some soil, contains combined silicon, oxygen, aluminium, and many other metals. Most of the metals are combined in chemical compounds, and a few, such as gold, are found only occasionally as the free uncombined metal. Metals are distributed within the lithosphere in very small percentages. Sometimes, as a result of geological processes, certain chemical substances are localised in the lithosphere. These accumulations of substances are called *mineral deposits*. When such mineral deposits contain elements that humans need and mining is feasible, the mineral is called an *ore*. It is estimated that usable mineral deposits make up far less than 1 per cent of the crust of the earth.

The Percentages by Mass of the Elements in the Ecosphere

Element	Percentage	Element	Percentage
Oxygen	49.20	Chlorine	0.19
Silicon	25.67	Phosphorus	0.11
Aluminium	7.50	Manganese	0.09
Iron	4.71	Carbon	0.09
Calcium	3.39	Sulphur	0.06
Sodium	2.63	Barium	0.04
Potassium	2.40	Fluorine	0.03
Magnesium	1.93	Nitrogen	0.03
Hydrogen	0.87	Other elements	0.47
Titanium	0.58		

The lithosphere consists mainly of hydrosphere and oxygen combined as water. However, many elements in various dissolved forms are found in seawater. Much salt or sodium chloride, NaCl, as well as significant amounts of magnesium and bromine are obtained from seawater.

The atmosphere is the layer of air surrounding the earth. Air is a homogeneous mixture of gases.

Percentage of Major Components of Dry Air by Volume

Nitrogen	N_2	78.1%	Neon	Ne	$1.8 \cdot 10^{-3}$%
Argon	Ar	0.93%	Helium	He	$3.3 \cdot 10^{-4}$%
Oxygen	O_2	21.0%	Krypton	Kr	$1 \cdot 10^{-4}$%
Carbon Dioxide	CO_2	$3 \cdot 10^{-2}$%			

The atmosphere also contains variable amounts of water vapour and dust.

The biosphere includes all plant and animal life. The major elements that structure living matter are carbon, oxygen, and hydrogen. These elements are combined in the chemical substances of life so that average percentage-by-mass composition of biosphere is 52 per cent oxygen, 39 per cent carbon, and 6.7 per cent hydrogen. In addition, there are over 10 elements that are found in the biosphere in small amounts. The most important of these elements are nitrogen, sulphur, and phosphorus.

Ex. 3. Study the difference between the following terms: *cent, per cent, and percentage*.

1. **Cent** comes from the French language (Latin – *centum*).

2. **Per cent**. Both parts of the word combination *per cent* are foreign borrowings in English. The preposition *per* [p] was used in the Latin language with a number of nouns, e.g.: *per capita* – на голову (душу), *per annum* – в год, *per centum* – на сотню, etc.

But later the preposition **per** began to be used, in the English language not only in combination with Latin words, e.g.: per man, per hand, per minuta, per year.

Note that the preposition *per* may be translated into Russian by means of different prepositions. Compare: *per head* – с головы, на голову, на душу; *per year* – в год; *per man* – на человека.

3. **Percentage**. The word consists of the following parts: per – cent – age. *Per-* as a part of the word has become a prefix, and *-age* is a noun-forming suffix.

The word *percentage* denotes an abstract notion (процент, процентное содержание, процентное отношение). A large *percentage* corresponds to the Russian – большой процент, много. A small *percentage* corresponds to the Russian – небольшой процент, мало.

E.g.: It is found that definite *percentage* of the atoms of a given element have specific masses. For example, 75.5 per cent of the atoms of naturally occurring chloride have one mass, while 24.5 per cent of the atoms have another mass.

Ex. 4. Mind the rules of reading mathematical expressions and read in accordance with the model.

Model: $1.8 \cdot 10^{-3}\%$ – one point eight multiplied by ten to the minus third power per cent

$3 \cdot 10^{-2}\%$ $5.3 \cdot 10^{-4}\%$ $1 \cdot 10^{-4}\%$

Ex. 5. Arrange the words that are read in rhyme.

Model: oxygen – hydrogen

Calcium, chlorine, hydrogen, radium, fluorine, nitrogen, potassium, argon, sodium, carbon.

Ex. 6. Define the verbs from which the adjectives with the suffix *-able* are formed and translate the given word combinations using the model.

Model: drinkable water → drink + -able
какая? ← вода
которую можно пить → питьевая вода

Measurable distances; an excusable mistake; eatable fruits; reliable information; changeable composition; an applicable rule; variable amounts; comparable properties; predictable results; exportable goods; the foreseeable future; separable components; a demonstrable distinction.

Ex. 7. Fill in the blanks with the Past Participles given below: *interrelated, distributed, polluted, accumulated, referred to as, estimated*.

1. Homogeneous mixtures of variable compositions are … solutions. 2. Silicon is the second most widely … element in the ecosphere. 3. The inside temperature of the Sun is … to be about 30,000,000°C. 4. Energy appears in many … forms. 5. Up to 30 per cent of the river water in the United Kingdom is … in some way. 6. Strontium-90, which is chemically similar to calcium, can be … in bones and teeth.

Ex. 8. Answer the following questions.

1. What is called the lithosphere? 2. The envelope of gases surrounding the earth is called the atmosphere, isn't it? 3. What does the word "hydro" mean? 4. What constitutes the biosphere? 5. What is referred to as the ecosphere? 6. Is iron the most widely distributed element in the ecosphere? 7. What does the lithosphere consist of? 8. What is called an ore? 9. Is it oxygen or nitrogen that makes up the

largest percentage of the atmosphere? 10. What are the major elements that structure living matter?

Ex. 9. Find in the right-hand column opposites to the words in the left-hand column.

free	significant
homogeneous	combined
of no importance	moist
underground	occasionally
dry	small
various	miner
very often	the same
major	overground
vast	heterogeneous

Ex. 10. Form and translate the sentences, paying attention to the words meaning "quantity".

<table>
<tr><td rowspan="4">The Earth contains</td><td colspan="3">few, a few, not many, some</td><td rowspan="4">precious metals

useful substances</td></tr>
<tr><td rowspan="2">a</td><td>small
moderate
certain</td><td rowspan="2">number of</td></tr>
<tr><td>large
great
considerable</td></tr>
<tr><td colspan="3">a great, many, a lot of, plenty of</td></tr>
</table>

Ex. 11. Are the following statements true or false according to the information in the text? If a statement is false, what is the correct information?

1. The hydrosphere includes the vast amounts of water in 1akes, rivers, ocean and underground deposits. 2. The Greek word "bio" means "vapour". 3. The four spheres of our environment contain elements in various states of combinations. 4. The lithosphere contains silicon, oxygen, aluminium, and many other metals. 5. Metals are distributed within the lithosphere in great percentages. 6. The atmosphere contains variable amounts of water vapour and dust.

Ex. 12. Read text B using and answer the following questions.

1. What question did Mr Yuh Fukiai, a Japanese scientist, try to answer?
2. Why is the article called "Hydrogen in the Earth's Core"?
3. How does the scientist explain the deficit in the density of the Earth's core?

Hydrogen in the Earth's Core

If the Earth's core is made of iron, why is its density less than the density of iron? Because, says Yuh Fukiai, of Chuo University in Japan, it has hydrogen dissolved in it.

Fukiai has picked up a neglected idea that water and molten iron react to produce iron oxides and a solution of hydrogen in iron. He claims that at the high pressures prevailing deep inside the Earth the solubility of hydrogen in iron is sufficient to account for the measured deficit in the density of the Earth's outer core.

Extending the ides to examine the early evolution of the Earth, Fukiai suggests that molten blobs of iron sinking to form the core of the proto-planet may have "scavenged" both hydrogen and other dissolved volatiles, leaving a surface layer that degassed during a violent convective overturn to produce the early atmosphere and hydrosphere. This natural explanation for the sudden formation of the atmosphere – an event testified to by argon isotope studies – offers a possible solution to a long-standing geographical problem.

Ex. 13. Speak on the topic "Chemical Elements in the Ecosphere".

2.4. CHEMICAL NOMENCLATURE AND REACTIONS

Ex. 1. Read and learn the following words.

A. Assign the final name – присвоить окончательное название; confirme – подтвердить; the International Union of Pure and Applied Chemistry (IUPAC) – Международный союз чистой и прикладной химии; temporary names – временные названия; prefix – префикс; ending – окончание; products of nuclear fusion – продукты ядерного синтеза; ununtrium – унунтрий; ununpentium – унунпентий; bohrium – бохрий; calcium – кальций; chlorine – хлор; chloros – хлор; dubnium – дубний; fermium – фермий; gallium – галлий; helium – гелий; iodine – йод; lead – свинец; limestone – известняк; livermorium – ливерморий; mendelevium – менделевий; mercury – ртуть; neptunium – нептуний; polonium – полоний; promethium – прометий; silicon – кремний; tantalum – тантал; tin – олово; nitric and nitrous acids – азотная и азотистая кислоты.

B. Chemical substances (reactants) – химические вещества (реагенты); to convert – преобразовывать; chemical bonds – химические связи; balanced chemical equations – сбалансированные химические уравнения; to pose questions – ставить вопросы; to conduct an experiment – проводить эксперимент; periodicity – периодичность; combination reaction – комбинированная реакция; decomposition reaction – реакция разложения; single-displacement reaction – реакция одинарного смещения; double-displacement reactions – реакция двойного смещения; oxidation-reduction reaction – окислительно-восстановительная реакция; ionic compounds – ионные соединения; expected charges of cations of the metal and anions of the nonmetal – ожидаемые заряды катионов металла и анионов неметалла; binary compounds – бинарные соединения; to decompose to constituent elements – разлагаться на составные элементы; upon heating – при нагревании; oxidation number – число окисления; precipitation reactions – реакции осаждения; insoluble salt – нерастворимая соль; to dissolve – растворяться; solid – твердый; precipitate – осадок; solubility rules – правила растворимости.

Ex. 2. Read and discuss text A.

Chemical Nomenclature

A chemical nomenclature is a set of rules to generate systematic names for chemical compounds. Before a newly found element is assigned its final name confirmed by the International Union of Pure and Applied Chemistry (IUPAC), its name is based on a system of temporary names. They use prefixes based on Latin and Greek numerals indicating the atomic number followed by the ending – *(i)um*. Thus, e.g., *livermorium* (atomic number 116), the heaviest element yet and one of the latest products of nuclear fusion, called after the research center in Livermore, USA, was first referred to as ununhexium.

System of prefixes (and their symbols) is as follows: 0 – nil (n), 1 – un (u), 2 – bi (b), 3 – tri (t), 4 – quad (q), 5 – pent (p), 6 – hex (h), 7 – sept (s), 8 – oct (o), 9 – enn (e). For example: the yet unnamed element with atomic number 113 can be theoretically called *ununtrium* (= un+un+tri+um) and the yet unnamed element with atomic number 115 can be theoretically called *ununpentium* (= un+un+pent+ium).

From the point of history, the names of elements can be divided into several groups, reflecting, for example:

– ***the mineral in which they were found***, e.g. *calcium* – from the Latin word calx (= limestone), *silicon* – from the Latin word silex (= rock);

– ***the colour properties***, e.g. *chlorine* – from the Greek word chloros (= yellow-green), *iodine* – from the Greek word ioeidés, its vapours are purple;

– ***the names of planets and stars***, e.g. *helium* – from the Greek word helios (= Sun), *mercury* – from the French word mercure, and the Greek hero *neptunium* – after the name of the planet Neptun and the god;

– ***figures from mythology or history***, e.g. *tantalum* – after the Greek king Tantalos, *promethium* – after the Greek hero Prometheus;

– ***names of famous scientists***, e.g. *fermium* – after E. Fermi, the Italian physicist, *mendelevium* – after D. I. Mendeleev, the Russian chemist, *bohrium* – after N. Bohr, the Danish scientist;

– and ***geohraphical terms***, e.g. *polonium* – after Poland, the country of M. Curie-Sklodowska, *dubnium* – after Dubna, the Russian centre of nuclear research, *livermorium* – after Livermore, the US centre of nuclear research, *gallium* – after Gallia, the Latin word for France.

Symbols of chemical elements are pronounced as letters of the alphabet, e.g. U [ju:], H [eič], S [es]. There are differences in the spelling of some names between British English (BE) and American English (AE), for example:

in BE	*in AE*
aluminium	aluminum
sulphur, sulphate, sulphite	sulfur, sulfate, sulfite

In compounds, some elements use also the Latin version of their name: gold – aurum, iron – ferrum (e.g. ferrum oxide), lead – plumbum, and tin – stannum.

The difference in the valence of sulfuric and sulfurous acids is visible by the endings -ic and -ous. For example, nitric and nitrous acids are inorganic acids of nitrogen, both containing atoms of nitrogen, oxygen, and hydrogen. The key difference between nitr***ic*** acid and nitr***ous*** acid is that nitric acid molecule contains three oxygen atoms bound to a central nitrogen atom whereas nitrous acid molecule contains only two oxygen atoms. The same difference in endings we can find speaking about phosphoric and phosphorous acids, sulphuric and sulphurous acids, and etc., and oxides.

Ex. 3. Answer the following questions.

1. What does chemical nomenclature mean? 2. What valuable information can endings -ic and -ous contain concerning acids? 3. What

system of prefixes exists in chemistry? 4. Into how many groups can be the names of elements divided? And what do they reflect? 5. What organization creates chemical nomenclature? 6. Are there any differences in the spelling of some chemical elements between British English and American English? 7. What is the proper way to pronounce symbols of chemical elements?

Ex. 4. Find Russian equivalents to the following English names.

Nitrous acid; famous scientists; ferrum; valence; sulfuric acid; system of temporary name; nitrous acid; atomic number; nuclear fusion; purple; lead; sulfurous acid.

Свинец; система временных названий; известные ученые; валентность; азотистая кислота; железо; азотная кислота; серная кислота; сернистая кислота; атомный номер; ядерный синтез; фиолетовый; атомное число.

Ex. 5. Are the following statements true or false according to the information in the text? If a statement is false, what is the correct information?

1. Names of elements can reflect the signs of the zodiac. 2. It is the British Scientific Society that confirms the final name of any element. 3. Symbols of chemical elements are pronounced as letters of Latin alphabet. 4. Polonium got its name after famous sport game polo. 5. The final name of ununhexium is Pulkovo after one of the leading observatories of the world. 6. Chlorine is called so due its yellow-green color.

Ex. 6. Read and discuss text B.

Chemical Reactions

A chemical reaction is a process in which one set of chemical substances (reactants) is converted into another (products). It involves making and breaking chemical bonds and the rearrangement of atoms. Chemical reactions are represented by balanced chemical equations, with chemical formulas symbolizing reactants and products.

For specific chemical reactants, two questions may be posed about a possible chemical reaction. Will a reaction occur? And what are the possible products if a reaction occurs? We will focus only on the second question. The most reliable answer is obtained by conducting an experiment – mixing the reactants and then isolating and identifying the products. We can also use periodicity, since elements within the

same group in the Periodic Table undergo similar reactions. Finally, we can use rules to help predict the products of reactions, based on the classification of inorganic chemical reactions into four general categories: combination, decomposition, single-displacement, and double-displacement reactions.

Reactions may also be classified according to whether the oxidation number of one or more elements changes. Those reactions in which a change in oxidation number occurs are called oxidation-reduction reactions. The oxidized element increases its oxidation number while the reduced one decreases its oxidation number.

In *combination reactions*, two substances react to produce a single compound. One type of combination reaction involves two elements. Most metals react with most nonmetals to form ionic compounds. The products can be predicted from the expected charges of cations of the metal and anions of the nonmetal. For example, the product of the reaction between aluminum and bromine can be predicted from the following charges: 3+ for aluminum ion and 1– for bromide ion. Since there is a change in the oxidation numbers of the elements, this type of reaction is an *oxidation-reduction reaction*.

When a compound undergoes a *decomposition reaction*, usually when heated, it breaks down into its component elements or simpler compounds. The products of a decomposition reaction are determined largely by the identity of the anion in the compound. The ammonium ion also has characteristic decomposition reactions. A few binary compounds decompose to their constituent elements upon heating. This is an oxidation-reduction reaction since the elements undergo a change in oxidation number.

Precipitation reactions are those in which the reactants exchange ions to form an insoluble salt – one which does not dissolve in water. Reaction occurs when two ions combine to form an insoluble solid or precipitate. We predict whether such a compound can be formed by consulting solubility rules. If a possible product is insoluble, a precipitation reaction should occur.

Ex. 7. Complete the sentences using the information from the text.

1. … occurs when two ions combine to form an insoluble solid or precipitate. 2. … two substances react to produce a single compound. 3. At … a heated compound breaks down into its component elements or simpler compounds. 4. The classification of inorganic chemical reactions helps to … . 5. Chemical reaction involves making and breaking

… and … . 6. Mixing the reactants and then isolating and identifying the products are important parts of … . 7. If binary compounds decompose to their constituent elements upon heating, the elements undergo a change in … . 8. A … is a process in which one set of reactants are converted into products.

Ex. 8. Translate the following sentences into English.

1. Те реакции, в которых изменяется степень окисления, называются окислительно-восстановительными. 2. Продукты реакции разложения в значительной степени определяются идентичностью аниона в соединении. 3. Если возможный продукт нерастворим, должна произойти реакция осаждения. 4. Химические реакции представлены сбалансированными химическими уравнениями с химическими формулами, символизирующими реагенты и продукты. 5. Это окислительно-восстановительная реакция, когда при нагревании несколько бинарных соединений разлагаются на составляющие их элементы. 6. Мы можем использовать периодичность, так как элементы в пределах одной и той же группы в периодической таблице подвергаются аналогичным реакциям. 7. Большинство металлов вступают в реакцию с большинством неметаллов с образованием ионных соединений.

Ex. 9. Match the reactions with their definitions.

1. Precipitation	a) also known as analysis reaction, a type of chemical reaction in which one reactant yields two or more products
2. Reduction	b) the process of conversion of a chemical substance into a solid from a solution by converting the substance into an insoluble form or a supersaturated solution
3. Combination	c) reaction in which a reactant in a chemical reaction gains one or more electrons; occurs in conjunction with oxidation reactions, in which a reactant loses one or more electrons
4. Decomposition	d) also known as a synthesis reaction; a reaction where two or more elements or compounds (reactants) combine to form a single compound (product)

Ex. 10. Find English equivalents to the following formulas using proper titles of chemical elements from the table in the end of this book according to the model. Give their Russian titles.

Model:

Cu_2O – cuprous oxide (оксид меди 1), CuO – cupric oxide (оксид меди 2), H_2O – dihydrogen oxygen (вода)

1. N_2O, Fe_2O_3, SiO_2, NO, FeO.

2. Silicon dioxide, ferric oxide, nitric oxide, ferrous oxide, nitrous oxide.

Ex. 11. Study rules of reading chemical formulas.

How to Read Chemical Reactions

+ is read: plus, and, together with, react with;

– is not read (it designates one bond);

= is read: give, form, produce;

→ is read: give, pass over, lead to;

↔ is read: forms and is formed from;

$C + O_2 \rightarrow CO_2$ is read: C plus O two give CO two or one atom of carbon reacts with one two-atom molecule of oxygen and produces one molecule of carbon dioxide;

$2H_2 + O_2 \rightarrow 2H_2O$ is read: two molecules of H two plus O two give two molecules of H two O. Another variant: two atom-molecules of hydrogen react with one two-atom molecule of oxygen and produce two molecules of water;

$N_2 + 3H_2 \leftrightarrow 2NH_3$ is read: N two plus three molecules of H two form and are formed from two molecules of NH three.

Reading of an equation: $Zn + H_2SO_4 \leftrightarrow ZnSO_4 + H_2$.

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 sulphuric acid producing one molecule of zinc sulphate and one molecule of hydrogen.”

Ex. 12. Speak on the topic “Chemical Nomenclature and Reactions”.

Part 3
CHEMICAL TECHNOLOGY OF SUBSTSNCES, MATERIALS, AND ARTICLES

3.1. WATER

Ex. 1. Read and memorise the following words.

Surface – поверхность; to exist – существовать; celestial – небесный; feature – черта, особенность; primeval – первобытный, первозданной; abundant – обильный, распространенный, изобилующий; dependent – зависимый; medium – средний, умеренный; transfer – перенос; slightly – слегка, немного, незначительно; solar – солнечный; to transpire – обнаруживаться; fluctuation – колебание; to condense – конденсироваться; droplet – капелька; tiny – крошечный, крохотный, незначительный, мизерный, мельчайший, маленький; particle – частица; to precipitate – осаждаться; particulate – частичный, фракционный; hail – град.

Ex. 2a. Study examples of noun + noun combination.

English allows us very often to put another noun in front of the noun, and sometimes two or three, e.g.: heat transfer, steel bar, and carbon dioxide. The relationship between the two nouns may vary quite a lot, as you can see from these examples:

Steam consumption = the consumption of steam; metal tubes = = tube made of metal; heat treatment = treatment with or by heat; friction losses = losses caused by friction.

Ex. 2b. Expand these [noun + noun] phrases to show the full meaning.

surface water	life cycle
water vapour	mercury thermometer
weather fluctuations	air supply
environment protection	earth crust
energy transfer	cylinder design
sea salt	ice crystals
cloud particles	water droplets
ground water	life forms

Ex. 3. Form the nouns from the verbs given below according to the model.

Model: [v+-*(at)ion* → n], e.g.: demonstrate → demonstration, determine → determination.

Evaporate, condense, concentrate, form, precipitate, accumulate, fluctuate, percolate, estimate, transpire.

Ex. 4. Read and translate the following word combinations.

mass		solar		surface	
heat	**transfer**	natural	**radiation**	ground, sea	**water**
energy		artificial		subsurface	

Ex. 5. Translate the sentences containing the Infinitive Construction (Complex Subject).

Model: Nowadays science is known *to contribute* to every aspect of man's life. – Известно, что в наши дни наука вносит свой вклад во все аспекты жизни человека.

1. In a solution made up of water and alcohol, the water is considered to be the solvent (растворитель) if it is present in the greater amount. 2. As the liquid cools, a point is reached then the liquid is said to have changed to the solid state. 3. Aluminium is known to be the most abundant metal in the crust of the earth. 4. If a deposit of iron contains 20 g of iron in each 100 g of ore, the ore is said to contain 20% iron by mass. 5. The practice of science seems to spring (происходить, давать начало) from the desire of humans to knew about and describe physical reality and to accumulate knowledge. 6. A penny was found to contain about $3 \cdot 10^{22}$ copper atoms. 7. Water is thought to have existed in the celestial materiel from which the earth might have been formed billions of years ago. 8. The waters of the primeval oceans are thought to be the birthplace of primitive life forms.

Ex. 6. Read and translate text A.

Water

Water, the compound that covers nearly three – quarters of the surface of the earth, is thought to have existed in the celestial material from which the earth might have been formed billions of years ago. Water has played a significant part in forming the physical features of the earth. It is the only common substance that exists in the environment in all of the three states of matter: solid, liquid, and gas.

The waters of the primeval oceans are thought to be the birthplace of primitive life forms. All forms of life are dependent on water and, to varying degrees, are composed of water. Ancient civilisations developed in regions of abundant water. Water has served as a source of energy and a medium of energy transfer that has allowed the development of industrial societies.

It is estimated that the total volume of the water of the hydrosphere is 1.5 billion cubic kilometres. Over 97 per cent of water are in the oceans. Slightly more that 2.6 is in the form of ice and snow in the polar icecaps and glaciers. The remainder is made up of the surface and subsurface waters of the lithosphere and the water vapour and clouds of the atmosphere.

The waters of the hydrosphere are continuously being transferred from the oceans to the land areas and back to the oceans in cyclic process called the water cycle.

Water vapour formed by evaporation from the oceans, lakes, rivers, or soil by solar radiation or transpired from the leaves of plants may travel long distances in the atmosphere. Weather fluctuations are accompanied by increasing and decreasing concentrations of atmospheric water vapour. Some of the water vapour condenses into clouds of water droplets or ice crystals. Interestingly, the formation of clouds occurs when condensation occurs on tiny particulates of dust, smoke, and sea salt in the air. Precipitation depends on these particulates that serve as nuclei upon which the cloud particles grow. When the particles are large enough, they fall to the earth as rain, hail, or snow.

A portion of the evaporated waters of the oceans is deposited as fresh water on the land. The water that reaches the lithosphere may almost immediately reevaporate or accumulate in lakes, streams, or rivers as surface water. However, much of the precipitation percolates through the soil and becomes ground water. A portion of the precipitation is captured in the snow packs of mountains and in the polar icecaps and glaciers. Some of the water passes through the life cycle of animals and plants serving as a source of hydrogen in photosynthesis and a component of living cells.

Notes

There are a few words taken over from Latin and Greek that still retain their original plurals.

Latin	medium – media
	stimulus – stimuli
	stratum – strata
	nucleus – nuclei
Greek	analysis – analyses
	crisis – crises
	hypothesis – hypotheses
	phenomenon – phenomena

Ex. 7. Find in the text the English equivalents of the following word combinations.

Космическое вещество (небесный материал); важная роль; распространенное вещество; в различной степени; древняя цивилизация; индустриальное общество; полярные льды; поверхностные воды; подземные воды; солнечная радиация; большие расстояния; увеличивающаяся концентрация; грунтовая вода; плотный снежный покров в горах; живые клетки.

Ex. 8. Find in the right-hand column synonyms to the words in the left-hand column.

significant	the rest
common	very ancient
slightly more	at once
primeval	to take place
the remainder	important
to occur	a bit more
immediately	usual

Ex. 9. Translate the sentences expressing the idea of "dependence".

1. You can depend on the aircraft. 2. The aircraft depends on its wings and engines to provide lift. 3. Sweden is dependent on her hydroelectric resources for power. 4. The size of the motor depends on the amount of power it has to produce. 5. The metal will expand or contract depending on the fact whether the temperature rises or falls. 6. Precipitation depends on particulates that serve as nuclei upon which the cloud particles grow. 7. All forms of life are dependent on water.

Ex. 10. Answer the following questions.

1. What is water? 2. How many states does water exist in? 3. What is the birthplace of primitive life forms? 4. It is estimated that the total volume of the water of the hydrosphere is 1.5 billion cubic kilometres,

isn't it? 5. What process is referred to as the water cycle? 6. May water vapour travel long distances in the atmosphere? 7. What are weather fluctuations accompanied by? 8. How does the formation of clouds occur? 9. Does much or little of the precipitation percolate through the soil? 10. It's interesting to know if water takes part in the process of photosynthesis in living cells?

Ex. 11. Are the following statements true or false according to the information in the text? If a statement is false, what is the correct information?

1. Water has played a significant part in forming the physical features of the earth. 2. Water exists in two states of matter: solid and liquid. 3. The waters of the primeval oceans are considered to be the birthplace of primitive forms of life. 4. Only water serves as a source of energy. 5. Slightly more than 2 per cent of water are in the form of ice and snow in the polar icecaps and glaciers. 6. The formation of clouds occurs when condensation occurs on huge particulates of dust, smoke, and sea salt in the air. 7. Some of the water passes through the life cycle of animals and plants serving as a source of hydrogen.

Ex. 12. Read and translate text B. Answer the questions.

1. What kind of water can be obtained from seawater with the help of an electrodialysis installation?
2. Why do the crews of fishing ships need a great deal of quality fresh water?
3. What does every ship possess?
4. What is the desalting technology described based on?

Spring Water on Board Ship

Water almost spring[1]-like in quality can be obtained from seawater with an electrodialysis installation[2].

The crews[3]of fishing ships staking long cruises need a great deal of quality fresh water, which comes to the fishing areas by tankers and transport ships. Almost every ship has a desalting installation, but the resulting distilled water has very little of the mineral salts needed by the organism. Therefore, the desalting technology has been improved by using ion-exchange membranes, which allow only positive or oily negative ions to pass through. By this

means the specialists are able to regulate the composition of the salts, and now the water obtained is almost spring-like in taste and composition.

Notes

[1]Spring – родник.

[2]Installation – установка.

[3]Crew – команда.

Ex. 13. Speak on the topic "Water".

3.2. METALS AND NONMETALS

Ex. 1. Read and memorise the following words.

A. Lustre – блеск; conductivity – проводимость; hardness – твердость, прочность; density – плотность; ductility – ковкость; viscosity – вязкость, тягучесть; to shape – придавать форму; to melt – таять, плавить; brittle – хрупкий, ломкий; soft – мягкий; to account for – объяснять; shell – оболочка; to reduce – уменьшать, сокращать, восстанавливатъ; agent – действующая сила, агент, вещество; to gain – получать, приобретать; to release – освобождать; alkali – щелочь; acid – кислота.

B. Common – общий, обычный, распространенный; to comprise – составлять, включать; measure – мера; to measure – измерять; alloy – сплав; silver – серебро; specific gravity – удельный вес; pure – чистый; to occur – случаться, встречаться; occurrence – местонахождение, месторождение, залегание; quality – качество; property – свойство; to refine – очищать; to exclude – исключать; to accomplish – выполнять; to alienate – отдалять; bodywork – кузов; constituent – составная часть чего-то.

C. Capacity – способность; pronounced – определенный; excess – избыток, излишек; exceedingly – чрезвычайно; to attest to – свидетельствовать; cohesive force – сила сцепления; diamond – алмаз; lattice – (кристаллическая) решетка; bond – связь; weak – слабый; to give rise to – давать начало, вызывать, приводить к; intrinsic – присущий; semiconductor – полупроводник; silica – оксид кремния, кремнезем; sand – песок; clay – глина; to prepare – приготавливать; furnace – печь; device – устройство; to dilute – разбавлять; brick – кирпич; glass – стекло.

Ex. 2. Find Russian equivalents for each word family.

hard *a*	hardness *n*	harden *v*
oxide *n* oxidation *n*	dioxide *n* an oxidizing agent	oxidize *v*
conductive *a* conductivity *n*	conductor *n* non-conductor *n*	conduct *v*
reduction *n – a*	a reducing agent *n*	reduce *v*
alkaline *a* alkali *n*	alkalinity *n* alkalization *n*	alkalize *v*
acidic *a*	acid *n* acidification *n*	acidify *v*
basic *a*	basicity *n* base *n*	basify *v*

Ex. 3. Read and translate text A.

Metals and Non-Metals

Metals and non-metals differ by their physical and chemical properties.

The general physical characteristics of metals are high luster, good electrical conductivity, hardness, high density, malleability (ability to be shaped), and ductility (ability to be drawn out to a thin wire). While the general properties of the non-metals are opposite to the properties of the metals, they are generally poor conductors of heat and electricity, often have low melting and boiling points, and are not lustrous. Also, if they exist as solids at ordinary temperatures, non-metals are generally brittle and soft.

It should be mentioned that the physical properties of metals vary from metal to metal. For example, mercury is a liquid at room temperature while tungsten (wolfram) melts at 3,416°C. The alkali metals, such as sodium, can be cut with a knife, but most metals are too hard to be cut in this way. Several non-metals exist as gases at ordinary temperatures, such as hydrogen, nitrogen, oxygen, fluorine, and chlorine. The differences in the atomic structure of metals and non-metals account for basic differences in their properties.

Metals have few electrons in the outer shell of the atom, usually less than four. They form ions by losing electrons and are said to be electropositive, since the ions formed are positive and are deposited at

the cathode in electrolysis. That is why metals are good reducing agents, this being their main chemical property. Besides, metals do not combine with each other. Most of them combine with non-metals, however, and for this reason they usually occur in nature combined with such non-metals as oxygen and sulphur. The salts of metals are electrovalent and the oxides are also electrovalent and basic. Metals usually react with acids, to produce hydrogen.

On the other hand, non-metals have four or more electrons in the outer shell of the atom. They form ions by gaining electrons and produce negative ions, which travel to the anode in electrolysis. For this reason they serve as oxidising agents in oxidation-reductions. Non-metals combine with metals, and also some of them combine with each other, such as in compounds of nitrogen and oxygen, hydrogen and sulphur, or carbon and chlorine. The chlorides and oxides are covalent, and oxides are acidic. Non-metals may be oxidised by concentrated acids, but no hydrogen is released.

Ex. 4. Find in the right-hand column opposites to the words in the left-hand column:

hard	non-conductor
malleable	high
conductor	negative
lose	similarity
low	inner
difference	gain
oxidise	brittle
positive	reduce
concentrated	soft
outer	dilute

Ex. 5. Read and translate text B.

Aluminium

It is the commonest metal in the Earth's crust, comprising some 8 per cent of it. But it was not until the early part of this century that aluminium could be produced in large quantities. Now it is one of the six most used metals in industry and technology. This is a measure of the useful properties that aluminium and its alloys possess.

Aluminium is a silvery-white metal. It has an atomic number of 13 and molecular weight of 2.7. The specific gravity is about 2.7.

The melting point of pure metal is about 660°C. Aluminium is produced only from bauxite. Large deposits of bauxite occur in many parts of the world. High-grade bauxite must be first refined to exclude the impurities. This refining operation produces alumina of the high purity, from which pure metallic aluminium is obtained.

Separating the metal from its oxide is accomplished electrolytically by passing the electric current through a solution of alumina. Molten aluminium is deposited on the bottom of the cell.

Aluminium and its alloys are the least dense of all the important metals used for structural purposes. This property makes them particularly useful wherever weight is an important factor. The bodywork of trains, buses, trucks, boats, and especially aeroplanes is now frequently constructed of aluminium or aluminium alloys. And even where lightness is not an essential factor, the attractive appearance of aluminium it a popular choice.

Chemically aluminium has a valence of 3+ and may be either acid-forming or base-forming. Thus, with the common acids it forms salts, such as chloride, nitrate and sulphate, whereas with strong bases, aluminates are formed. In aluminates, the aluminium oxide forms an acid part.

Alumina. The most important compound is the oxide Al_2O_3. It exists in several crystalline forms, of which corundum is the most common and the most important, its extreme hardness makes it useful as an abrasive, for grinding wheels and emery powders. Most of the corundum used in emery powders is made synthetically by smelting bauxite with carbon in an electric furnace. Transparent red and blue corundum crystals are precious stones named ruby and sapphire. Rubies are now obtained artificially by fusing alumina in an electric furnace. They are used not so much for decoration as for the technical purposes such as for the manufacture of precision instrument parts, for the jewels in watches, etc. Non-transparent corundum crystals containing considerable impurities are known as emeries.

Calcinated alumina is available in different degrees of calcination[1] both ground and unground. The most important characteristics of calcinated alumina include high chemical purity, high density, high melting point (2,040°C), relative chemical inertness, good thermal conductivity and heat-shock resistance, and high electric resistivity at normal and elevated temperature. The abrasive industry is one of the largest fields for calcinated alumina. In refractory bricks the introduction of alumina gives higher strength and better stability

trader load at high temperatures, better resistance to corrosion, slags and gases, and reduced porosity and shrinkage. Besides, calcinated alumina is widely used in ceramics, in glass and porcelain electric insulators. *Low-soda alumina* is calcinated alumina with low residual[2] soda content. Ceramics has high dielectrical strength, good resistance to mechanical and thermal shock, and can withstand high voltage at very high frequencies. *Reactive alumina* combines high thermal reactivity and low firing shrinkage. *High-purity alumina* has a purity of 99.92 to 99.95 per cent. It contains less than 0.01 per cent Na_2O for uses in electronics, mechanical and nuclear ceramics and for basic alumina studies.

Notes

[1]Calcination – прокаливание, обжиг.

[2]Residual – остаточный.

Ex. 6. Answer the following questions.

1. What is the commonest metal in the earth's crust? 2. How many per cent of the earth's crust does it comprise? 3. What are characteristic features of aluminium and its alloys? 4. Is aluminium produced only from bauxite or from other ores as well? 5. High-grade bauxite contains from 50 to 60 per cent aluminium oxides, doesn't it? 6. What do we get after the refining operation? 7. What is the method of separating aluminium from its oxide? 5. Why is aluminium so important for structural purposes? 9. Wat does aluminium form with common acids and strong bases?

Ex. 7. Remember the following "constant" words and translate the sentences: *contain, consist, comprise, constitute, compose, include, make up, form, content, content, component, constituent, container, and composition.*

1. The gas contains about 50% of carbon monoxide. 2. The moisture content was about 5 per cent. 5. He emptied out the contents of the box. 4. A tank is a large container for holding liquids. 5. The class consists of twenty five students. 6. The atmosphere comprises a number of gases. 7. The machine is composed of several different parts. 8. Cast-iron is made up of about six different substances. 9. The factory produces components for aircraft. 10. The composition of cast-iron is different for different purposes. 11. Twenty five students constitute the class. 12. A number of gases form the atmosphere. 13. Ferrite and carbon are the constituents of mild steel. 14. The students in the class include three from Germany and four from France.

Ex. 8. Are the following statements true or false according to the information in the text? If a statement is false, what is the correct information?

1. In the 18th and 19th centuries aluminium could be produced in large quantities. 2. Aluminium is a bluish-grey metal. 3. Aluminium has an atomic number of 13 and molecular weight of 27. 4. Aluminium is produced from many ores. 5. High-grade bauxite contains from 50 to 60 per cent aluminium. 6. Separating the metal from its oxide is done electrolytically. 7. Aluminium and its alloys are the densest c of all the important metals.

Ex. 9. Find in the right-hand column opposites to the words in the left-hand column.

common	pleasant-looking
comprise	carry out
produce	take away
occur	aim
exclude	found often
accomplish	make up
purpose	purify
attractive	exist
refine	manufacture

Ex. 10. Which word is not associated with aluminium and its alloys?

pure	metallic	common
molten	important	acid-forming
useful	reddish	attractive

Ex. 11. Look at the table and make up 9 short paragraphs as it is given in the model below.

Model: At ordinary temperatures chromium is a solid. It melts at 1,900°C. It becomes a liquid at this temperature.

Metals	Melting Point	Liquids	Boiling Point	Gases	Boiling Point
Chromium (Cr)	1,900°C	Sulphuric acid (H_2SO_4)	338°C	Carbon monoxide (CO)	191°C
Copper (Cu)	1,083°C	Nitric acid (HNO_3)	83°C	Sulphur dioxide (SO_2)	10°C
Aluminium (Al)	660°C	Carbon tetrachloride (CCl_4)	77°C	Chloride (Cl)	34°C

Ex. 12. Read text C.

Silicon

Silicon is situated in the fourth group of the Periodic Table directly below carbon, being a full analogue of the latter. Like carbon, silicon can both lose and gain electrons, but its capacity for gaining electrons, and therefore its non-metallic properties, are somewhat less pronounced than those of carbon.

Elementary silicon is a grey crystalline substance with a metallic lustre. It is exceedingly brittle. Silicon has a specific gravity of 2.48 and atomic mass of about 28. Its high melting point (1,410°C) and boiling point (2,355°C) attest to the presence of strong cohesive forces within the crystal. Actually, silicon possesses the same crystal structure as diamond. In comparison, diamond melts at temperatures in excess of 3,500°C. From this view, the four bonds holding each silicon atom in its lattice position are considerably weaker than the corresponding bonds in diamond. This gives rise to the intrinsic semiconducting properties of silicon.

Silicon is the second most abundant element in the Earth's crust. It is never found free in nature but only in oxy-compounds, such as silica and the silicates, which compose most of the Earth's crust. Silicon occurs in sand, rocks, clays, asbestos, mica, precious stones, quartz, and etc.

Silicon is prepared by reducing silica (SiO_2) with carbon is electric furnace employing carbon electrodes.

$$SiO_2 + 3C \xrightarrow[\text{Heat}]{\text{Electrode}} Si + 2CO$$

High-purity silicon is prepared by zone refining or thermal decomposition of $HSiCl_3$ (thrichlosilane) in an atmosphere of hydrogen and may be used as the starting material for silicon resins, oils, semiconductor devices, such as diodes, rectifiers, transistors, and solar batteries.

Silicon is relatively inert. At ordinary temperatures it combines directly only with fluorine. When heated, it combines readily with oxygen, sulphur, and the halogens. In addition, useful organosilicon derivatives have been prepared.

Silica. Silicon dioxide, or silica, is one of the most common chemical compounds. Pure SiO_2 crystals are found in nature in three polymorphic forms, the most common of which is quartz. Sand, agate, onyx, opal, amethyst, and flint[1] are silicon dioxide with traces[2] of impurities.

Fused quartz is used to make crucibles and laboratory vessels that must be heated to extremely high temperatures. It has such valuable properties as a high softening point (about 1500°C) and very low coefficient of thermal expansion[3]. When heated quartz expands very little and, therefore, it is not likely to crack even if it is cooled rapidly and unevenly.

The forms of silica are some of the truly important crystal structures, not only because silica itself is such an abundant and useful substance, but also because the (SiO_4) structure is the fundamental unit in most minerals. SiO_2 crystals have two main features: (1) each silicon atom is at the centre of a tetrahedron[4] of four oxygen atoms, (2) each oxygen atom is midway between two silicon atoms. Billions upon billions of such tetrahedral are tightly linked[5], in three dimensions, in each grain of sand[6] on the beach or in desert.

Silicon dioxide is an acidic oxide. Though it is practically insoluble in water, it does dissolve in such bases as sodium hydroxide.

Notes

[1]Flint – кремень.
[2]Traces – следы.
[3]Expansion – расширение.
[4]Tetrahedron – тетраэдр.
[5]Tightly linked – тесно связанный.
[6]Grain of sand – песчинка.

Ex. 13. Find in the right-hand column opposites to the words in the left-hand column.

in excess of	use
possess	inactive
employ	get ready
inert	more than
prepare	have
decompose	component
constituent	combine
force	holding together
unite	be the case of
give rise to	strength
cohesive	separate into parts

Ex. 14. The verb "possess" is often used to replace the "have" in scientific writing. Use the correct form of *possess* in place of *have* in the following sentences.

1. Neutrons do not *have* an electric charge. 2. Since atoms *have* the same number of protons as electrons, the whole atom is electrically neutral. 3. Silicon *has* the same crystal structure as diamond. 4. Urani-

um is an example of an element that *has* a large number of electrons. 5. Isotopes of the same element *have* the same chemical properties but slightly different physical properties. 6. Metals are good electrical conductors, which indicates that the electrons they *have* are mobile. 7. Substances *having* the properties opposite to those of acids are known as bases.

Ex. 15. "That" and "those" are often used to avoid repeating a noun when it occurs more than once in the same sentence, e.g.:

The number of electrons equals ***the number*** *of protons.*

The number of electrons equals ***that*** *of protons.*

Use *that* and *those* in the following sentences.

1. The simplest *atom* is the atom of hydrogen. 2. The *orbits* of electrons may be compared to the orbits of the planets. 3. A *molecule* of water is smaller than the molecule of a protein. 4. The *particles* in a suspension are larger than the particles of a colloid. 5. A *molecule* of water possesses 3 atoms, and the molecule of carbon dioxide also possesses 3. 6. The *ions* of hydrogen combine with the ions of hydroxyl and neutralize their charges. 7. The *electric charge* of a proton is positive, but the electric charge of an electron is negative. 8. *Nonmetallic properties* of silicon are less pronounced, than the nonmetallic properties of carbon.

Ex. 16. Find in the text the English equivalents of the following word combinations.

Неметаллические свойства; несколько менее выраженный; чрезвычайно хрупкий; одинаковое кристаллическое строение; положение в кристаллической решетке; присущие кремнию полупроводниковые свойства; кремний высокой чистоты; зонная очистка; термическое разложение; исходный материал; полупроводниковые устройства; солнечные батареи; кремнийорганические производные.

Ex. 17. Arrange the words so as to obtain meaningful sentences.

1. Silicon, grey, is, a, crystalline, elementary, substance. 2. The same, structure, possesses, silicon, crystal, as, diamond. 3. Nature, never, free, in, silicon, found, in. 4. Silica, prepared, reducing, silicon, is, by. 5. Silicon, ordinary, temperatures, combines, at, with, fluorine. 6. Concrete, silicon, main, the, is, component, of.

Ex. 18. Speak on the topic "Metals and Nonmetals".

3.3. GASES. NITROGEN. RADON

Ex. 1. Read and memorise the following words.

A. Nonliquefied gases – несжиженные газы; ambient temperature – температура окружающей среды; psig (pound-force per square inch gauge) – фунт-сила на квадратный дюйм (т. е. приборное давление, избыточное над атмосферным); nitrous oxide – оксид азота, веселящий газ; dissolved gases – растворенные газы (т. е. баланс, при котором количество растворенного газа пропорционально парциальному давлению в газообразной фазе над поверхностью воды); porous mass – пористая масса; fuel gas – топливный газ, горючий газ, газовое топливо; liquefied petroleum gas (LPG) – сжиженный природный газ; fumigant / sterilant gas – фумигант / стерилизующий газ (т. е. опасные газы, используемые медицинскими и другими учреждениями для стерилизации медицинских принадлежностей, которые нельзя стерилизовать с помощью тепла или пара); vermin – вредитель; sterilize medical supplies – стерилизовать медицинские принадлежности; in contrast to – в отличие от; inactive element – неактивный элемент; odor – запах; dissolve readily – легко растворяется; gunpowder – порох; destructive power of explosives – разрушительная сила взрывчатых веществ; rapid breakdown of molecules – быстрый распад молекул; give off heat – выделять тепло; cause smth to expand – вызывать расширение; rapid combustion – быстрое сгорание; pea – горох; alfalfa – люцерна; nitrogen fixation – фиксация азота; hydride – гидрид; at one extreme – с одной стороны; ammonia – аммиак; nitride – нитрид; electronegativity – электроотрицательность; interstitial – интерстициальный; encountered in protic solution – встречающийся в протонном растворе; nitrate – нитрат; Bismuth oxynitrate – оксинитрат Висмута.

B. Cordite – кордит; smokeless propellant – бездымный заряд боеприпаса; gunpowder – порох; charcoal – древесный уголь; potassium nitrate – нитрат калия; firearms – огнестрельное оружие; fireworks – фейерверки; nitric acid – азотная кислота; consequently – следовательно; low brisance – низкая бризантность; deflagration wave – волна сгорания; detonation wave – взрывная волна; propel a bullet or shell – продвигать пулю или снаряд; routinely – привычно; destroy the barrel of the gun – разрушать ствол пушки;

rifle cartridges – винтовочные патроны; naval guns – морские пушки; ejector seats – катапультируемое кресло; triple based propellant – тройной заряд боеприпаса; double based propellants – двойной заряд боеприпаса.

C. Distribute – распределять, распространять; surroundings – окрестности, окружение, среда; terrestrial – земной; internal – внутренний; external – внешний, наружный; radon – радон; dwelling – жилище, дом; to restrict – ограничивать; outer space – космос; background – фон; double – двойной, усиленный; adverse – неблагоприятный, вредный; health – здоровье; probably – вероятно; chest – грудная клетка; nuclear weapons – ядерное оружие; luminous – светящийся; travel – путешествие, движение; altitude – высота; estimate – оценивать, подсчитывать; annual – ежегодный, годовой; considerable – значительный, важный; occupational – профессиональный; further – добавочный, дальнейший

Ex. 2. Read and translate text A.

Nitrogen as the Most Common Gas of the Air

Classification of Gases. *Nonliquefied gases*, which do not liquefy at ambient temperatures at pressures up to about 2,500 psig. Examples are helium, hydrogen, nitrogen, and oxygen. *Liquefied gases*, which are liquids at ambient temperature under pressures of about 25 to 2,500 psig. Examples are ammonia, carbon dioxide, chlorine, nitrous oxide, propane, and sulfur dioxide. *Dissolved gases*, which are carried as a solution in another material. The common example is acetylene dissolved in acetone. The acetone in turn is adsorbed on a porous mass that fills the interior of a cylinder. *Fuel gases*, intended for burning in air or oxygen. Examples are acetylene, butane, hydrogen, liquefied petroleum gas (LPG), propane, and other hydrocarbons. *Fumigant / sterilant gases*, used to kill vermin or to sterilize medical supplies and equipment. Examples are carbon dioxide, ethylene oxide, methyl bromide, and propylene oxide.

Nitrogen. In contrast to oxygen, nitrogen is a rather inactive element. It does not combine readily with other elements. Like oxygen, nitrogen has no odor, no taste, and no color. Nitrogen does not dissolve readily in water and will not bum. When nitrogen does react with another element, the union is seldom stable and the compound breaks down easily.

Common explosives such as dynamite, gunpowder, and nitroglycerin are compounds of nitrogen. The destructive power of these explosives is due to the rapid breakdown of their molecules. This breakdown, in turn, gives off heat and causes gases to expand quickly, producing rapid combustion.

All living things and all proteins contain compounds of nitrogen. While most crops take nitrogen compounds from the soil, certain other crops such as peas, beans, clover, and alfalfa put nitrogen compounds back into the soil. Bacteria that grow on the roots of these plants change the nitrogen of the air into nitrogen compounds. This process is called nitrogen fixation. Another way of adding nitrogen compounds to the soil is through the use of fertilizers.

Nitrogen Derivatives. In chemistry, a *hydride* is formally the anion of hydrogen, H^-. The term is applied loosely. At one extreme, all compounds containing covalently bound H atoms are called hydrides: water is a hydride of oxygen, ammonia is a hydride of nitrogen, etc.

Nitride is any of a class of chemical compounds in which nitrogen is combined with an element of similar or lower electronegativity, such as boron, silicon, and most metals. Nitrides contain the nitride ion (N^{3-}), and, similar to carbides, nitrides can be classified into three general categories: "salt-like" (mostly ionic), covalent, and metallic (or interstitial). Nitrides are a large class of compounds with a wide range of properties and applications. The nitride ion, N^{3-}, is never encountered in protic solution because it is so basic that it would be protonated immediately.

Nitrate is a polyatomic ion with the chemical formula NO_3. Salts containing this ion are called nitrates. Nitrates are common components of fertilizers and explosives. Almost all inorganic nitrates are soluble in water. An example of an insoluble nitrate is Bismuth oxynitrate. Removal of one electron yields the nitrate radical, also called nitrogen trioxide NO_3.

Ex. 3. Answer the following questions.

1. What is the difference between nitride and nitrate? 2. Are common explosives rare compounds of nitrogen? 4. What properties are typical for both oxygen and nitrogen? 5. What is the difference between nonliquefied gases and dissolved gases? 3. What gas is the most common gas of the air? 6. What nitrogen derivatives can you name? 7. What process is called nitrogen fixation? 8. Is there any classification of gases in chemistry?

Ex. 4. Match two parts of the sentences below.

1. Sterilant gases …	a) are called hydrides
2. All proteins …	b) are liquids at ambient temperature under pressures of about 25 to 2,500 psig
3. Fuel gases …	c) contain compounds of nitrogen
4. The use of fertilizers …	d) sterilize medical supplies and equipment
5. Liquefied gases …	e) helps to add nitrogen compounds to the soil
6. Nitrides are a large class of compounds and …	f) are intended for burning in air or oxygen
7. All compounds containing covalently bound H atoms …	g) can be classified into three general categories

Ex. 5. Read and translate text B.

Cordite

Cordite is a family of smokeless propellants developed and produced in the United Kingdom since 1889 to replace gunpowder as a military propellant.

Gunpowder, an explosive mixture of sulfur, charcoal and potassium nitrate, was the original propellant employed in firearms and fireworks. It was used from about the 10th or 11th century onwards, but it had disadvantages, including the large quantity of smoke it produced. With the 19th-century development of various “nitro explosives”, based on the reaction of nitric acid mixtures on materials such as cellulose and glycerine, a search began for a replacement for gunpowder.

Like gunpowder, cordite is classified as a low explosive because of its slow burning rates and consequently low brisance. These produce a deflagration wave rather than the detonation wave produced by high explosives. The hot gases produced by burning gunpowder or cordite generate sufficient pressure to propel a bullet or shell to its target, but not so quickly as to routinely destroy the barrel of the gun.

Cordite was used initially between 1891 and 1915; shortages of cordite in World War I led to smokeless powders being imported into the UK for use in rifle cartridges. Cordite was also used for large weapons, such as tank guns, artillery, and naval guns. It has been used mainly for this purpose since the late 19th century by the UK and British

Commonwealth countries. Its use was further developed before World War II, and as 2-and-3-inch-diameter (51 and 76 mm). Small cordite rocket charges were also developed for ejector seats made by the Martin-Baker Company. Cordite was also used in the detonation system of the atomic bomb dropped over Hiroshima in August 1945.

The term "cordite" generally disappeared from official publications between the wars. During World War II, double based propellants were very widely used, and there was some use of triple based propellants by artillery. Triple based propellants were used in post-war ammunition designs and remain in production for UK weapons; most double based propellants left service as World War II stocks were expended after the war.

Ex. 6. Fill in the blanks to complete the following sentences.

1. … charges were also developed for ejector seats made by the Martin-Baker Company. 2. An explosive mixture of … was the original propellant employed in firearms and fireworks. 3. … were used in post-war ammunition designs for UK weapons while … left service after World War II. 4. The … produced by burning gunpowder or cordite do not routinely destroy the barrel of the gun. 5. Cordite is a family of … produced to replace gunpowder as a military propellant. 6. Slow burning rates and consequently low brisance of cordite produce … wave. 7. Cordite is classified as a low explosive because of its … and consequently low brisance.

Ex. 7. Read and translate text C.

Radon in Houses

The gaseous element radon (Rn) – the heaviest of the noble gases – has always appeared as a component of the Earth's atmosphere. It's a decay product of uranium.

Radon is produced as uranium-238 decays in the soil and in building materials. Some radon produced in the soil dissolves in groundwater. Many houses have foundation and basement floor cracks that permit radon from rooks, soil, and water to seep in. In a tightly sealed house, the radon gas does not have much chance to escape, and radon is now a problem in some areas because of changes in the way we build and use houses. In older houses, outdoor air enters through doors, windows, and the gaps around them, thus diluting radon or removing it from the house. But air conditioning in new buildings decreases the need to open windows. To conserve the energy, many new houses are built more airtight than older houses were. The net result is that indoor air has little chance

to mix freely with outdoor air and radon levels may reach high levels. Remedies for high radon levels in homes include increased ventilation, sealing cracks in floors, and removing radon from groundwater. Relatively inexpensive radon test kits are available for home use.

The real threat of radon gas occurs after it is inhaled Radon decays to produce, in succession, radioactive isotopes of polonium (Po), bismuth (Bi), and lead (Pb). Thus, if radon gas is inhaled, it enters the body and, through radioactive decay, is transformed to these toxic heavy-metal ions that cannot be exhaled as gas. These radioactive heavy-metal ions also emit potentially damaging alpha particles within the body. In houses with abnormally high radon gas level, inhaled dust can also carry traces of the same heavy-metal isotopes deposited by decaying radon. Estimates indicate that about 6 per cent of houses in the United States have radon levels higher than the exposure level recommended by the EPA. It is estimated that around 10 per cent of deaths from lung cancer annually in the United States are due to the effects of radon gas. These figures, although sobering, should be kept in perspective, however. For example, more than 10 times as many people die each year from lung cancer attributed to cigarette smoking.

Ex. 8. Translate the following sentences into English.

1. Существуют несколько видов естественной радиации: земная, внутренняя и космическая. Вид радиации зависит от местонахождения радиоактивного материала, излучающего радиацию. 2. Космическая радиация – поток ионизирующих частиц, доходящих до Земли из космического пространства. 3. Радиация, излучаемая из окружающей среды (почва, порода, вода, растения), называется земной радиацией. 4. Внутренняя радиация – излучения, испускаемые радиоактивными веществами, присутствующими в нашем организме. 5. Счетчик Гейгера – детектор ионизирующих частиц, применяется в радиологической защите, создан в 1908 г. Х. Гейгером, усовершенствован в 1925 г. В. Мюллером. 6. Радон – радиоактивный химический элемент, атомный номер 86, газ без цвета и запаха, очень опасен при скоплении в плохо вентилируемом помещении.

Ex. 9. Compete the following sentences.

1. There are such natural sources of radiation as … . 2. Terrestrial radiation is the radiation … . 3. Internal radiation is the radiation … . 4. Uranium is … . 5. Cosmic radiation is … . 6. The total radiation dose per person in different countries is … . 7. Man-made radiation is … . 8. The occupational exposure is … .

Ex. 10. Speak on the topic “Gases. Nitrogen”

3.4. BUILDING MATERIALS

Ex. 1. Read and learn the following words.

A. Clay – глина; binder – вяжущий материал; cohesive – связное целое; adhesion – сцепление; cohesion – спаянность; dough-like substance – тестообразное вещество; harden – затвердевать; filler powder – порошок наполнителя; hydraulic – гидравлический; gypsum – гипс; air-cement – воздушный цемент; magnesia – магнезия; hydrated lime – гидратированная известь; hydraulic lime – гидравлическая известь; acid-resistant – кислотостойкий; silicon fluoride cement – кремний-фторидный цемент; autoclavable – автоклавируемый; asphalt pavement – асфальтовое покрытие; clay – глина; wattle-and-daub construction – плетеная конструкция; building material cob – глыба строительного материала; brittle – хрупкий; compressive strength – прочность на сжатие; shrinkage – усадка; shaped articles (e.g. Pots and vases) – фасонные изделия (например, горшки и вазы); bind solid pieces – связывать твердые изделия; concrete – бетон(ный); aggregate – заполнитель; tensile strength – прочность на растяжение; steel rods or bars – стальные стержни или прутья; reinforced concrete – железобетонный; air bubble – воздушный пузырь; vibrator – вибратор; poured around the ironwork – заливается вокруг железобетонных изделий; longevity – долговечность; formability – формуемость; advancement – усовершенствование; insulating concrete forms – изоляция бетонных форм; installation of insulation – монтаж утеплителя.

B. Tetrahedron – тетраэдр; anionic group – анионная группа; brittle – хрупкий; stove, kiln – печь; additive – добавка; bulletproof glass – пуленепробиваемое стекло; glassmaking – стеклоделие; glass panes – стеклянные панели; inclement weather – ненастная погода; architectural buildings – архитектурные сооружения; glass “curtain walls” – стеклянные «навесные стены»; space frame – пространственный каркас; glass bricks – стеклоблоки; heat-resistant – жаропрочный; corrosion-resistant – устойчивый к образованию ржавчины; shaping and firing – формирование и обжиг; clay – глина; earthenware – глиняная посуда, фаянс; mud-bricks – глинобитные кирпичи; air-dried – высушенные на воздухе; fired bricks – обожженные кирпичи; hollow cavities – полости; tiles – плитки; roofing – кровля; siding – сайдинг; flooring – напольные покрытия; pipes – трубы; flue liners – дымовые трубы, дымоход.

Ex. 2. Read and translate text A.

Building Materials. Binders

Building material is a material used for construction. Many naturally occurring substances, such as clay, rocks, sand, and wood, have been used to construct buildings. Apart from naturally occurring materials, many man-made products are in use.

A binder or binding agent is any material or substance that holds or draws other materials together to form a cohesive whole mechanically, chemically, by adhesion or cohesion.

In a more narrow sense, binders are liquid or dough-like substances that harden by a chemical or physical process and bind fibers, filler powder and other particles added into it. Inorganic binders are classified into cement, gypsum, liquid glass, etc.

Based on their chemical resistance, binders are classified by the field of use: non-hydraulic (gypsum, air-cements, magnesia, hydrated lime), hydraulic (Portland cement, hydraulic lime), acid-resistant (silicon fluoride cement, quartz cement), and autoclavable (harden at 170 to 300°C, i.e. 8–16 atmospheric pressure and comprise $CaSiO_3$ materials).

In building concrete uses cement as a binder. Asphalt pavement uses bitumen binder. Traditionally straw and natural fibers are used to strengthen clay in wattle-and-daub construction and in the building material cob which would otherwise become brittle after drying. Sand is added to improve compressive strength, hardness and reduce shrinkage. The binding property of clay is also used widely to prepare shaped articles (e.g. pots and vases) or to bind solid pieces (e.g. bricks).

Concrete is a composite building material made from the combination of aggregate and a binder such as cement. The most common form of concrete is Portland cement concrete, which consists of mineral aggregate (generally gravel and sand), Portland cement and water.

For a concrete construction of any size, as concrete has a rather low tensile strength, it is generally strengthened using steel rods or bars. This strengthened concrete is then referred to as reinforced concrete. To minimize any air bubbles that would weaken the structure a vibrator is used to eliminate any air that has been entrained when the liquid concrete mix is poured around the ironwork. Concrete has been the predominant building material in the modern age due to its longevity, formability, and ease of transport. Recent advancements, such as

insulating concrete forms, combine the concrete forming and other construction steps (installation of insulation). All materials must be taken in required proportions as described in standards.

Ex. 3. Answer the following questions.

1. What naturally occurring substances have been used to construct buildings? Apart from naturally occurring materials, many man-made products are in use. 2. What does binder mean? 3. What inorganic binders do you know? 4. Is there any classification of binders? 5. What material is used to improve compressive strength, hardness and reduce shrinkage? 6. What composite building material is made from the combination of aggregate and a binder? 7. How many materials form Portland cement? 8. What properties of concrete can you list? 9. Why is it important to minimize any air bubbles in concrete?

Ex. 4. Match the terms with their definitions.

1. Acid-resistant binder	a) any material or substance that holds or draws other materials together to form a cohesive whole mechanically, chemically, by adhesion or cohesion
2. Concrete	
3. Shaped article	
4. Non-hydraulic binder	
5. Resistant binder	b) gypsum, air-cements, magnesia, hydrated lime
6. Binder	
7. Hydraulic	c) pots and vases
8. Brick	d) a composite building material made from the combination of aggregate and a binder
	e) silicon fluoride cement, quartz cement
	f) bind solid piece
	g) silicon fluoride cement, quartz cement
	h) Portland cement, hydraulic lime

Ex. 5. Read and translate text B.

Building Materials. Silicates

Silicate is based on the basic chemical unit SiO_4^{4-}, tetrahedron shaped anionic group. The central silicon ion has a charge of positive four while each oxygen has a charge of negative two (–2) and thus each silicon-oxygen bond is equal to one half (S) the total bond energy of oxygen. The most demanded silicates are glass and ceramics.

Glass. Glass is generally is very brittle and made from mixtures of sand and silicates in a very hot fire stove called a kiln.

Additives are often included the mixture used to produce glass with shades of colors or various characteristics (such as bullet-proof glass or light bulbs.

Glassmaking is considered an art form as well as an industrial process or material. Clear windows have been used since the invention of glass to cover small openings in a building. Glass panes provided humans with the ability to both let light into rooms while at the same time keeping inclement weather outside.

The use of glass in architectural buildings has become very popular in the modern culture. Glass "curtain walls" can be used to cover the entire facade of a building, or it can be used to span over a wide roof structure in a "space frame". These uses require some sort of frame to hold sections of glass together, as glass is too brittle by itself and needs an overly large kiln to be used to span such large areas. Glass bricks were invented in the early 20th century.

Ceramics. A ceramic is any of the various hard, brittle, heat-resistant and corrosion-resistant materials made by shaping and then firing a nonmetallic mineral, such as clay, at a high temperature. Common examples are earthenware, porcelain, and brick.

Bricks are made in a similar way to mud-bricks except without the fibrous binder such as straw and are *fired* ("burned" in a brick clamp or kiln) after they have air-dried to permanently harden them. Kiln fired clay bricks are a ceramic material. Fired bricks can be solid or have hollow cavities to make them lighter and easier to transport. Fired brick walls are usually substantially thin and keep vertical strength. They require more energy to create but are easier to transport and store, and are lighter than stone blocks.

Fired clay bricks have been used since the time of the Romans. Special tiles are used for roofing, siding, flooring, ceilings, pipes, flue liners, and more. Romans extensively used fired brick of a shape and type now called Roman bricks. Later, in the mid-18th century and 19th centuries, building with brick gained much popularity. This was due to lower costs with increases in brick manufacturing and fire-safety in the ever crowding cities.

Ex. 6. Fill in the blanks in the sentences below.

1. The most demanded … are glass and ceramics. 2. … is considered an art form as well as an industrial process or material. 3. The use of glass in … has become very popular in the modern culture. 4. … are used to cover the entire facade of a building. 5. … is too brittle by itself

and needs an overly large kiln to be used to span such large areas. 6. Kiln … bricks are solid or easy to transport. 7. … has a rather low tensile strength and it is strengthened using steel rods or bars. 8. Its longevity, formability, and ease of transport make … the predominant building material in the modern age.

Ex. 7. Translate the sentences into English.

1. Наиболее популярны два типа кирпичей: глиняный (красный) и силикатный (белый). 2. Красный кирпич производится из обожженной глины, не требующей добавок. 3. Силикатный кирпич делают из смеси песка и извести (9 частей песка и 1 часть воздушной извести). 4. Готовую известково-песчаную смесь для производства силикатного кирпича подвергают прессованию, в результате чего происходит уплотнение силикатной массы. 5. Для придания необходимой прочности силикатному кирпичу его обрабатывают насыщенным паром. 6. Размеры кирпича зависят от стандарта, принятого в стране: в странах СНГ размер стандартного кирпича – 250×120×65 мм, а в ЕС – 250×88×65 мм. 7. Портландцемент получается при нагревании известняка и глины или других материалов сходного валового состава и достаточной активности до температуры +1450…+1480°С. 8. В современном строительстве весьма заметное место занимает стекло и изделия из него, более того, популярность стекла растет. 9. Стекло известно как экологически чистый материал, который можно повторно перерабатывать.

Ex. 8. Study the following text to give it proper title.

The term “plastics” covers a range of synthetic or semi-synthetic organic condensation or polymerization products that can be molded or extruded into objects, films, or fibers. Their name is derived from the fact that in their semi-liquid state they are malleable, or have the property of plasticity. Plastics vary immensely in heat tolerance, hardness, and resiliency. Combined with this adaptability, the general uniformity of composition and lightness of plastics ensures their use in almost all industrial applications today. High performance plastics have become an ideal building material due to its high abrasion resistance and chemical inertness. Notable buildings that feature it include: the Beijing National Aquatics Center (aquatics center at the Olympic Green in Beijing, China) and the Eden Project (visitor attraction in Cornwall, England) biomes.

Ex. 9. Speak on the topic “Building Materials”.

Part 4
TECHNOLOGY OF ELECTROCHEMICAL PRODUCTION

4.1. ELECTROCHEMISTRY

Ex. 1. Read and learn the following words.

Affinity tables – таблица соответствия; brine-soaked – пропитанный рассолом; coincidence – совпадение; conversely – наоборот; current – ток; to define – определить; dynamo – генератор; to diverge – расходиться, отклоняться; electroplating – гальванопокрытие; gain – усиление; to generate – производить; harnessed – запряженный; intersection – пересечение; moist – влажный; to measure – измерять; oxidation – окисление; predecessors – предшественники; pursuit – стремление; precise – точный, четкий; reduction – восстановление; respiration – дыхание; redox reaction – окислительно-восстановительная реакция; rust – ржавчина; voltaic pile – гальваническая свая; wiring – проводка.

Ex. 2. Read and translate text A.

Electrochemistry

Electrochemistry is a branch within the field of chemistry which involves the intersection between chemical reactions and electrical currents. Some chemical reactions can be catalyzed by the presence of an electrical current, and conversely, it is possible to generate electricity through the process of a chemical reaction. While this pursuit may sound esoteric, chances are very high that you are benefiting from electrochemistry at this very moment, or that you will be at some point today, because it is the underlying process behind a wide range of things, from chemical signaling in your own body to the operation of a car battery.

Modern electrochemistry has diverged significantly from the 18th century roots of this field of study. In addition to inspiring a great deal of pure research, electrochemistry is used in a wide range of industrial processes, and in technology utilized in numerous settings. Earlier researchers were primarily interested in explaining phenomena they didn’t understand, while modern researchers are interested in finding

new applications for electrochemistry, and in understanding complex electrochemical reactions. They are also interested in understanding electrochemical reactions on a very small scale and basic level, now that the technology for precise observations of this type is available.

All living organisms use electrochemistry to one degree or another, from the electric eel to the humble houseplant. Living organisms have noticeable electric fields which are generated by chemical reactions in their bodies, and electrochemical reactions are involved in a number of biological processes. For this reason, some biologists are interested in electrochemistry, as are other people who work in the natural world or are interested in the natural environment.

One of the underlying concepts in electrochemistry is the reduction / oxidation or redox reaction, which describes a situation in which electrons are gained or lost. While a small scale reaction will not generate usable energy, it involves the very same electrons which move through the wiring in a home, and these reactions can be used to generate a usable electrical current. Processes like photosynthesis and respiration involve redox reactions, making them electrochemical in nature. Electrochemistry is also used in scientific laboratories, for processing and analyzing a range of materials. It is also used in processes such as electroplating, in which the property of electrodeposition is harnessed, and in the operation of batteries, which utilize a chemical reaction to generate electrical energy. Another example of a natural electrochemical reaction is corrosion, especially iron oxidation, which is better known as “rust” among lay people. The redox reaction may be used to detect alcohol in drunken drivers or to measure glucose levels in the blood of diabetics.

Electrochemistry has provided valuable tools for the scientific investigator and in the industrial and technological fields. Electrochemical methods of producing industrial chemicals and energy have many advantages in this respect over more conventional methods even though much remains to be done before they can be fully exploited.

Ex. 3. Give English equivalents for the following words and word combinations.

Область химии; электрический ток; производить электричество; область изучения; новые применения; точные наблюдения; электрический угорь; комнатное растение; окружающая среда; полезная энергия; научные лаборатории; окисление железа; измерение уровня глюкозы; двигаться по проводам; масштабная реакция.

Ex. 4. Agree or disagree.

1. Electrochemistry is a branch of chemistry involving the study of interrelationships between electricity and chemical reactions. 2. All living organisms use electrochemistry. 3. The history of electrochemistry begins with Galileo. 4. One of the underlying concepts in electrochemistry is redox reaction. 5. Photosynthesis and respiration involve redox reactions. 6. Einstein published his special theory of electrochemistry.

Ex. 5. Answer the following questions.

1. What is electrochemistry? 2. What does it involve? 3. Where is electrochemistry used? 4. Some biologists are interested in electrochemistry, aren't they? 5. What does redox reaction describe? 6. Is electrochemistry used in scientific laboratories? 7. What do processes like photosynthesis and respiration involve?

Ex. 6. Read and translate the text B.

History of Electrochemistry

The history of electrochemistry is filled with major advances in understanding and technology that helped define both industrial production and daily life in the twenty-first century.

The First Battery. The story of electrochemistry begins with Alessandro Volta, who announced his invention of the voltaic pile, the first modern electrical battery, in 1800. The pile caught the imagination of even the ruler of France, Napoleon Bonaparte, who went so far as to serve as Volta's lab assistant in November of 1801. As Volta described his recent discoveries concerning electricity to the French National Institute, the delighted Napoleon demonstrated them on a voltaic pile. Volta's predecessors, including Benjamin Franklin, had studied what is now called static electricity. The voltaic pile produced a continuous current and thus opened two new areas of study: the chemical production of electricity and the effects of electricity on chemicals.

Volta's "Contact" Theory of Electricity. Volta had built the voltaic pile to challenge Luigi Galvani's claim to have demonstrated that animals produce electricity. According to Volta, Galvani's results came from his use of two dissimilar metals connected by a moist conductor (a frog's leg). Volta reproduced this configuration in his new invention, which consisted of pairs of zinc and silver disks connected by brine-soaked cardboard. In the course of explaining his "contact" theory of electricity, Volta published one of the earliest electromotive series,

which ranked metals and other substances according to the strength of their electrical effects. He placed those materials farthest apart that, when placed in contact, produced the strongest effects. Volta's ranking bore a striking resemblance to the affinity tables that chemists had been organizing for years, tables that showed which substances would displace others in compounds. A few years later Humphry Davy would argue in his electrical theory of chemical affinities that this similarity was no coincidence.

Davy Links Electricity and Chemistry. Sir Humphry Davy of the Royal Institution in London was one of the most important experimenters with the new voltaic battery. He realized that the production of electricity by the voltaic pile depended on the occurrence of chemical reactions, not just on the contact of different kinds of metals, as Volta had thought. Davy used current supplied by the pile to separate compounds into their parts, discovering several new elements. His experiments led him to propose in 1806 an electrical theory of chemical affinity: since electrical current overcame the normal force that held elements together in compounds, he argued, this force must be electrical in nature.

Faraday's "Magneto-electricity" and Electrolysis. Davy's student and successor, Michael Faraday, pursued the relationship between electricity and magnetism. In the course of his research he invented the first electric motor (in 1821) and the first dynamo (in 1831). Faraday's chief electrochemical achievement was to show that "magneto-electricity" had the same chemical effects as electricity generated in other ways. His two laws of electrochemistry, published in 1834, predict how much product results from passing a certain amount of current though a chemical compound or its solution, a process that he named "electrolysis". These laws are still fundamental to industrial electrolytic production of metals and other chemicals.

Electrochemistry is a branch of chemistry involving the study of interrelationships between electricity and chemical reactions. The chemical reactions generally take place in solution, at the interface between an electron conductor (a metal or semiconductor) and an ion conductor (the electrolyte), and involve electron transfer between the electrode and the electrolyte or species in solution. If a chemical reaction is driven by an external applied voltage, as in electrolysis, or if a voltage is generated by a chemical reaction, as in a battery, the reaction is called an electrochemical reaction. Chemical reactions where electrons are transferred between molecules are called oxidation / reduction (redox) reactions.

Ex. 7. Find synonyms.

Diverge; intersection; conversely; precise; gain; generate; to measure; to define; moist; predecessors; coincidence; rust; respiration.

Pitting; wet; breath; to set; separate; precursor; produce; exact; crossing; strengthening; backwards; to determine; conjunction.

Ex. 8. Fill in the blanks with a suitable word.

1. Volta described his recent discoveries concerning … to the French National Institute. 2. The voltaic … produced a continuous current. 3. He opened two new areas of study: the chemical production of … and the effects of electricity on … . 4. Humphry Davy would argue in his … theory of chemical affinities that this similarity was no coincidence. 5. Davy was one of the most important … with the new voltaic battery. 6. Davy used … supplied by the pile to separate compounds into their parts. 7. Faraday invented the first … motor and the first dynamo. 8. Laws of electrochemistry are fundamental to industrial electrolytic production of … and other chemicals.

Ex. 9. Answer the following questions.

1. What did A. Volta invent? 2. Where did he describe his discoveries? 3. What Volta's predecessors had studied? 4. Who was one of the most important experimenters with the new voltaic battery? 5. What theory did Davy propose? 6. What did Faraday invent? 7. When was Faraday's laws published?

Ex. 10. Read and translate text B.

Electric Current

The question is often asked: What is an electric current? No one has ever seen it. We only know of the existence of a current owing to its effects. A current can heat a conductor, it can have a chemical action when passing through a solution, or it can produce a magnetic effect. We can measure currents by observing their heating, chemical or magnetic effects. The practical unit of current is called the Ampere. Two things are necessary to cause an electric current to flow: first – a complete circuit, second – a driving force called the electromotive force (e.m.f.).

If you put free electrons on an insulated copper ball, what would they do? In this case they would try to repel each other. In case you connected this charge ball to another ball of equal size by a copper wire, what would be the result? The electrons would move along the

copper wire until the number of electrons on each ball was the same. This is an example of electromotive force causing a current to flow.

A battery has a surplus of electrons on one of its two plates; so you say that a battery furnishes an e.m.f. If a copper wire is run from one plate to the other, current flows in the complete circuit thus made. If a small bulb is placed in the circuit, it will light up, giving evidence to a current flow. If the battery was disconnected and a generator substituted for it, we should have a typical lighting system. Both batteries and generators are the most common sources of electromotive force. The practical unit of e.m.f. is the Volt.

Currents will flow more readily in some substances than in others, that it, various substances offer lesser or greater resistance to the flow of current. Such substances as ebonite, rubber, glass and like having extremely high resistance are known as insulators. The practical unit of resistance is the Ohm.

Substances whose properties lie between those of conductors and insulators are called semiconductors.

Ex. 11. Speak on the topic "Electrochemistry".

4.2. METALS AND NONMETALS

Ex. 1. Read and memorise the following words.

A. Lustre – блеск; conductivity – проводимость; hardness – твердость, прочность; density – плотность; ductility – ковкость; viscosity – вязкость, тягучесть; to shape – придавать форму; to melt – таять, плавить; brittle – хрупкий, ломкий; soft – мягкий; to account for – объяснять; shell – оболочка; to reduce – уменьшать, сокращать, восстанавливать; agent – действующая сила, агент, вещество; to gain – получать, приобретать; to release – освобождать; alkali – щелочь; acid – кислота.

B. Common – общий, обычный, распространенный; to comprise – составлять, включать; measure – мера, to measure – измерять; alloy – сплав; silver – серебро; specific gravity – удельный вес; pure – чистый; to occur – случаться, встречаться; occurrence – местонахождение, месторождение, залегание; quality – качество; property – свойство; to refine – очищать; to exclude – исключать; to accomplish – выполнять; to alienate – отдалять; bodywork – кузов; constituent – составная часть чего-то.

Ex. 2. Find Russian equivalents for each word family.

hard *a*	hardness *n*	harden *v*
oxide *n* oxidation *n*	dioxide *n* an oxidizing agent	oxidize *v*
conductive *a* conductivity *n*	conductor *n* non-conductor *n*	conduct *v*
reduction *n – a*	a reducing agent *n*	reduce *v*
alkaline *a* alkali *n*	alkalinity *n* alkalization *n*	alkalize *v*
acidic *a*	acid *n* acidification *n*	acidify *v*
basic *a*	basicity *n* base *n*	basify *v*

Ex. 3. Read and translate text A.

Metals and Non-Metals

Metals and non-metals differ by their physical and chemical properties.

The general physical characteristics of metals are high luster, good electrical conductivity, hardness, high density, malleability (ability to be shaped), and ductility (ability to be drawn out to a thin wire). While the general properties of the non-metals are opposite to the properties of the metals, they are generally poor conductors of heat and electricity, often have low melting and boiling points, and are not lustrous. Also, if they exist as solids at ordinary temperatures, non-metals are generally brittle and soft.

It should be mentioned that the physical properties of metals vary from metal to metal. For example, mercury is a liquid at room temperature while tungsten (wolfram) melts at 3416°C. The alkali metals, such as sodium, can be cut with a knife, but most metals are too hard to be cut in this way. Several non-metals exist as gases at ordinary temperatures, such as hydrogen, nitrogen, oxygen, fluorine, and chlorine. The differences in the atomic structure of metals and non-metals account for basic differences in their properties.

Metals have few electrons in the outer shell of the atom, usually less than four. They form ions by losing electrons and are said to be electropositive, since the ions formed are positive and are deposited at

the cathode in electrolysis. That is why metals are good reducing agents, this being their main chemical property. Besides, metals do not combine with each other. Most of them combine with non-metals, however, and for this reason they usually occur in nature combined with such non-metals as oxygen and sulphur. The salts of metals are electrovalent and the oxides are also electrovalent and basic. Metals usually react with acids, to produce hydrogen.

On the other hand, non-metals have four or more electrons in the outer shell of the atom. They form ions by gaining electrons and produce negative ions, which travel to the anode in electrolysis. For this reason they serve as oxidising agents in oxidation-reductions. Non-metals combine with metals, and also some of them combine with each other, such as in compounds of nitrogen and oxygen, hydrogen and sulphur, or carbon and chlorine. The chlorides and oxides are covalent, and oxides are acidic. Non-metals may be oxidised by concentrated acids, but no hydrogen is released.

Ex. 4. Find in the right-hand column opposites to the words in the left-hand column:

hard	non-conductor
malleable	high
conductor	negative
lose	similarity
low	inner
difference	gain
oxidise	brittle
positive	reduce
concentrated	soft
outer	dilute

Ex. 5. Read and translate text B.

Aluminium

It is the commonest metal in the Earth's crust, comprising some 8 per cent of it. But it was not until the early part of this century that aluminium could be produced in large quantities. Now it is one of the six most used metals in industry and technology. This is a measure of the useful properties that aluminium and its alloys possess.

Aluminium is a silvery-white metal. It has an atomic number of 13 and molecular weight of 2.7. The specific gravity is about 2.7.

The melting point of pure metal is about 660°C. Aluminium is produced only from bauxite. Large deposits of bauxite occur in many parts of the world. High-grade bauxite must be first refined to exclude the impurities. This refining operation produces alumina of the high purity, from which pure metallic aluminium is obtained.

Separating the metal from its oxide is accomplished electrolytically by passing the electric current through a solution of alumina. Molten aluminium is deposited on the bottom of the cell.

Aluminium and its alloys are the least dense of all the important metals used for structural purposes. This property makes them particularly useful wherever weight is an important factor. The bodywork of trains, buses, trucks, boats, and especially aeroplanes is now frequently constructed of aluminium or aluminium alloys. And even where lightness is not an essential factor, the attractive appearance of aluminium it a popular choice.

Chemically aluminium has a valence of 3+ and may be either acid-forming or base-forming. Thus, with the common acids it forms salts, such as chloride, nitrate and sulphate, whereas with strong bases, aluminates are formed. In aluminates, the aluminium oxide forms an acid part.

Alumina. The most important compound is the oxide Al_2O_3. It exists in several crystalline forms, of which corundum is the most common and the most important, its extreme hardness makes it useful as an abrasive, for grinding wheels and emery powders. Most of the corundum used in emery powders is made synthetically by smelting bauxite with carbon in an electric furnace. Transparent red and blue corundum crystals are precious stones named ruby and sapphire. Rubies are now obtained artificially by fusing alumina in an electric furnace. They are used not so much for decoration as for the technical purposes such as for the manufacture of precision instrument parts, for the jewels in watches, etc. Non-transparent corundum crystals containing considerable impurities are known as emeries.

Calcinated alumina is available in different degrees of calcination[1] both ground and unground. The most important characteristics of calcinated alumina include high chemical purity, high density, high melting point (2,040°C), relative chemical inertness, good thermal conductivity and heat-shock resistance, and high electric resistivity at normal and elevated temperature. The abrasive industry is one of the largest fields for calcinated alumina. In refractory bricks the introduction of alumina

gives higher strength and better stability trader load at high temperatures, better resistance to corrosion, slags and gases, and reduced porosity and shrinkage. Besides, calcinated alumina is widely used in ceramics, in glass and porcelain electric insulators. *Low-soda alumina* is calcinated alumina with low residual[2] soda content. Ceramics has high dielectrical strength, good resistance to mechanical and thermal shock, and can withstand high voltage at very high frequencies. *Reactive alumina* combines high thermal reactivity and low firing shrinkage. *High-purity alumina* has a purity of 99.92 to 99.95 per cent. It contains less than 0.01 per cent Na_2O for uses in electronics, mechanical and nuclear ceramics and for basic alumina studies.

Notes

[1]Calcination – прокаливание, обжиг.

[2]Residual – остаточный.

Ex. 6. Answer the following questions.

1. What is the commonest metal in the earth's crust? 2. How many per cent of the earth's crust does it comprise? 3. What are characteristic features of aluminium and its alloys? 4. Is aluminium produced only from bauxite or from other ores as well? 5. High-grade bauxite contains from 50 to 60 per cent aluminium oxides, doesn't it? 6. What do we get after the refining operation? 7. What is the method of separating aluminium from its oxide? 5. Why is aluminium so important for structural purposes? 9. Wat does aluminium form with common acids and strong bases?

Ex. 7. Remember the following "constant" words and translate the sentences: *contain, consist, comprise, constitute, compose, include, make up, form, content, content, component, constituent, container, and composition.*

1. The gas contains about 50% of carbon monoxide. 2. The moisture content was about 5 per cent. 5. He emptied out the contents of the box. 4. A tank is a large container for holding liquids. 5. The class consists of twenty five students. 6. The atmosphere comprises a number of gases. 7. The machine is composed of several different parts. 8. Cast-iron is made up of about six different substances. 9. The factory produces components for aircraft. 10. The composition of cast-iron is different for different purposes. 11. Twenty five students constitute the class. 12. A number of gases form the atmosphere. 13. Ferrite and carbon are the constituents of mild steel. 14. The students in the class include three from Germany and four from France.

Ex. 8. Are the following statements true or false according to the information in the text? If a statement is false, what is the correct information?

1. In the 18th and 19th centuries aluminium could be produced in large quantities. 2. Aluminium is a bluish-grey metal. 3. Aluminium has an atomic number of 13 and molecular weight of 27. 4. Aluminium is produced from many ores. 5. High-grade bauxite contains from 50 to 60 per cent aluminium. 6. Separating the metal from its oxide is done electrolytically. 7. Aluminium and its alloys are the densest c of all the important metals.

Ex. 9. Find in the right-hand column opposites to the words in the left-hand column.

common	pleasant-looking
comprise	carry out
produce	take away
occur	aim
exclude	found often
accomplish	make up
purpose	purify
attractive	exist
refine	manufacture

Ex. 10. Which word is not associated with aluminium and its alloys?

pure	metallic	common
molten	important	acid-forming
useful	reddish	attractive

Ex. 11. Look at the table and make up 9 short paragraphs as it is given in the model below.

Model: At ordinary temperatures chromium is a solid. It melts at 1,900°C. It becomes a liquid at this temperature.

Metals	Melting Point	Liquids	Boiling Point	Gases	Boiling Point
Chromium (Cr)	1,900°C	Sulphuric acid (H_2SO_4)	338°C	Carbon monoxide (CO)	191°C
Copper (Cu)	1,083°C	Nitric acid (HNO_3)	83°C	Sulphur dioxide (SO_2)	10°C
Aluminium (Al)	660°C	Carbon tetrachloride (CCl_4)	77°C	Chloride (Cl)	34°C

Ex. 12. Speak on the topic "Metals and Nonmetals".

4.3. CONDUCTORS. SEMICONDUTORS

Ex. 1. Read and learn the following words.

Asbestos – асбест; bare – неизолированный, голый; conductors – проводники; to conduct – проводить; charge – заряд; copper – медь; circuit – цепь; cord – шнур; ease – простота; counter – счетчик; converting – преобразование; flowing – текущий, проточный; insulators – изоляторы; length – длина; leaking off – утечка; opposition – противодействие, сопротивление; pipe – труба; to pull – вытаскивать; poles – полюса; path – путь, линия; to resist – сопротивляться; resistance – сопротивление; rubber – резина; semiconductor – полупроводник; string – струна; socket – розетка; to suspend – приостановить, вешать; transmission – передача; to transmit – передавать; voltage – напряжение; wire – провод.

Ex. 2. Read and translate text A.

Conductors and Insulators

All substances have some ability of conducting the electric current, however, they differ greatly in the ease with which the current can pass through them. Metals, for example, conduct electricity with ease while rubber does not allow it to flow freely. Thus, we have conductors and insulators. What do the terms “conductors” and “insulators” mean? Substances through which electricity is easily transmitted are called conductors. Any material that strongly resists the electric current flow is known as an insulator. Let us first turn our attention to conductance, that is the conductor’s ability of passing electric charges. The four factors conductance depends on are: the size of the wire used, its length and temperature as well as the kind of material to be employed. It is not difficult to understand that a large water pipe can pass more water than a small one. In the same manner, a large conductor will carry the current more readily than a thinner one.

It is quite understandable, too, that to flow through a short conductor is certainly easier for the current than through a long one in spite of their being made of similar material. Hence, the longer the wire, the greater is its opposition. As mentioned above, there is a great difference in the conducting ability of various substances. For example,

almost, all metals are good electric current conductors. Nevertheless copper carries the current more freely than iron; and silver, in its turn, is a better conductor than copper. Generally speaking, copper is the most widely used conductor. That is why the electrically operated devices in your home are connected to the wall socket by copper wires. Indeed, if you are reading the book by an electric lamp light and somebody pulls the metal wire out of the socket, the light will go out at once. The electricity has not been turned off but it has no path to travel from the socket to your electric lamp. The flowing electrons cannot travel through space and get into an electrically operated device when the circuit is broken. If we use a piece of string instead of a metal wire, we shall also find that the current stops flowing. A material like string which resists the flow of the electric current is called an insulator.

There are many kinds of insulation used to cover the wires. The kind used depends upon the purposes the wire or cord is meant for. The insulating materials we generally use to cover the wires are rubber, asbestos, glass, plastics and others. Rubber covered with cotton, or rubber alone is the insulating material usually used to cover desk lamp cords and radio cords. Glass is the insulator to be often seen on the poles that carry the telephone wires in city streets. Glass insulator strings are usually suspended from the towers of high voltage transmission lines. One of the almost insulators of all, however, is air. That is why power transmission line wires are bare wires depending on air to keep the current from leaking off.

Conducting materials are by no means the only materials to play an important part in electrical engineering. There must certainly be a conductor, that is a path, along which electricity is to travel and there must be insulators keeping it from leaking off the conductor.

Ex. 3. Find synonyms.

Voltage; pipe; to resist; to transmit; socket; flowing; to pull; bare; string; substance; various; to allow.

Running; to transfer; tension; tube; jack; to fight back; cord; to get out; naked; to permit; matter; different.

Ex. 4. Guess what is it?

1. Used to cover desk lamp cords. 2. One of the most important insulators of all. 3. The most widely used conductor. 4. A better

conductor than copper. 5. Not so good conductor as copper. 6. The insulator usually used on the city street poles and high voltage transmission lines.

Ex. 5. Give Russian equivalents for the following words and word combinations.

Conductors; insulators; transmit; resistance; passage of current; socket; to connect to; cord; high voltage transmission line; leak off; line wires; strongly resists; various substances.

Ex. 6. Put the questions to the words in italics.

1. Solid metals conduct electricity *with ease*. 2. Conductance depends on the *four* factors. 3. There are many kinds of insulation used *to cover the wires*. 4. Insulators keep electricity *from leaking off the conductor.* 5. Conductors play an important role in *electrical engineering.*

Ex. 7. Fill in the blanks with a suitable word and phrases.

A bare wire, poles, electrical engineering, insulation, opposition, to resist, similar, turned off, air, cord, covers, glasses, leak off, rubber, socket, is transmitted.

1. A … is a small insulated cable. 2. We need … for a chemical experiment. 3. When the temperature rises … to the passing current increases. 4. … is a perfect insulator. 5. If the switch is … the current does not flow. 6. … is a poor conductor electricity. 7. … is a wire not covered with insulated material. 8. We study … . 9. If a wire is covered with … it is called an insulated wire. 10. Any magnet has two … . 11. Some liquids have … properties. 12. Electricity … by wires. 13. The train … a great distance from Minsk to Sevastopol. 14. If there is no insulation the current can … the conductor. 15. We shall consider the ability of insulators … the current flow. 16. Copper wires connect electrical devices to the … .

Ex. 8. Agree or disagree.

1. Electrical conductivity of a body depends upon its atomic constitution. 2. There is no difference in the conducting ability of various substances. 3. The longer the wire is the weaker its opposition is. 4. The kind of the insulating material depends upon the purpose it is meant for. 5. Conductors are substances through which electricity is easily transmitted. 6. Insulators do not allow the electric current to flow freely.

Ex. 9. Read and translate the text B.

Semiconductors

Materials that behave like conductors or insulators under different conditions are known as semiconductors. Their conductivity lies between that of conductors and insulators (nonconductors). The term "semiconductor" means "half-conductor", that is, a material whose conductivity ranges between that of conductors and non-conductors or insulators. They include a great variety of elements (silicon, germanium, selenium, phosphorus and others), many chemical compounds (oxides, sulphides) as well as numerous ores and minerals. While the conductivity of metals is very little influenced by temperature, the conductivity of semiconductors sharply increases with heating and falls with cooling. This dependence has opened great prospects for employing semiconductors in measuring techniques. Light as well as heat increases the conductivity of semiconducting materials, this principle is used in creating photo resistances. It is also widely applied for switching on engines, for counting parts on a conveyer belt, as well as for various systems of emergency signals and for reproducing sound in cinematography. Besides reacting to light, semiconductors react to all kinds of radiations and are therefore employed in designing electronic counters. Engineers and physicists turned their attention to semiconductors many years ago, seeing in them the way of solving complicated engineering problems. Converting heat into electricity without using boilers or other machines was one of them. This could be done by means of metal thermocouples, but in this way it was impossible to convert more than a few tenths of one per cent of the heat into electricity. The thermocouples made later of semiconductors generated ten times as much electricity as the metal ones. Sunlight like heat can feed our electric circuits. Photocells made of semi-conducting materials are capable of transforming ten per cent of sun-ray energy into electric power. By burning wood which has accumulated the same amount of solar energy, we obtain only fractions of one per cent of electric power. The electricity generated by semiconductor thermocouples can produce not only heat but also cold, this principle is used in manufacturing refrigerators. Semiconducting materials are also excellent means of maintaining a constant temperature irrespective of the surrounding temperature changes. The latter can vary over a wide range, for example, from 50°C below zero to 100°C above zero.

Semiconductors are used in making various electronic devices like transistors, integrated circuits and diodes. These devices are reliable,

inexpensive, easy to use, powerful, and efficient. Germanium, Silicon, Tellurium, Tin and other metal oxides are a few examples of semiconductors.

Semiconductors are used in power devices, light emitters (including solid-state lasers), optical sensors. As they have voltage and current handling capabilities, they are used in the manufacture of electronic devices like industrial-control equipment, communication with data-processing, etc.

Ex. 10. Answer the following questions.

1. What does the term "semiconductor" mean? 2. What elements do they include? 3. When does the conductivity of semiconductors sharply increase and fall? 4. Where is it widely used? 5. What principle is used in creating photo resistances? 6. Why are semiconductors employed in designing electronic counters? 7. Why did engineers and physicists turn their attention to semiconductors? 8. What principle has been used in manufacturing refrigerators? 9. What temperature can semiconducting materials maintain irrespective of the surrounding temperature changes?

Ex. 11. Give Russian equivalents for the following words and word combinations.

Chemical; dependence; numerous; sharply; radiation; electronic; physicist; possible; electricity; widely; emergency; electric circuits; a great variety of elements; semiconducting materials; to maintain a constant temperature; measuring techniques; emergency signals; a conveyer belt; to reproduce sound; to design electronic counters; to solve complicated engineering problems; to manufacture refrigerators; to generate electricity; the surrounding temperature changes.

Ex. 12. Translate the text C.

Semiconductor Laser

Semiconductor quantum generators occupy a special place among the optical quantum generators. The size of a ruby crystal laser comes to tens of centimeters while a gas generator is about a meter long. A semiconductor laser is a few lengths of a millimeter long. Whereas the density of its radiation is hundreds of thousands of times as great as that of the best ruby lasers. All previous solid-state lasers needed energy supplied from external light sources, usually an intense burst of light from a flash-tube. In the new gallium-arsenide injection lasers, pump energy is sup-

plied directly by injecting electrons into the diode. Now modulation of the laser beam can be achieved by modulating the input current source. Semiconductor lasers operate under pulse and permanent regimes.

Ex. 13. Translate the following sentences.

1. Semiconductors are neither good conductors nor good insulators. 2. Energy can neither be created nor destroyed. 3. Matter can neither appear nor disappear by itself.4. The greatest part of matter on the Earth is either liquid or gas. 5. Some sixty or seventy years ago semiconductors didn't exist either in electric industry or in radio engineering. 6. Silicon and germanium can be made either p-type or n-type semi-conductors.

Ex. 14. Speak on the topic "Conductors and Semiconductors".

4.4. ELECTROLYSIS

Ex. 1. Read and learn the following words.

Cation – катион; coulomb – кулон; cell – ячейка, элемент; customary – обычный; cation – катион; complete – замкнутая; constituent – составная часть, элемент; to charge – заряжать; to discharge – разряжать; to diffuse – распространять; to determine – определять; decomposition – разложение; designation – обозначение, знак; electrode – электрод; extent – степень; to impart – наделять; to mingle – смешивать; notwithstanding – несмотря на; neutral – нейтральный; net result – конечный результат; overall – общий, суммарный; reduction – понижение, восстановление; resultant – проистекающий; stable – постоянный; species – вид; transfer – перенос; tiny – крошечный; in the vicinity – близ чего-либо; voltaic – гальванический, электрический; whole – целый, единый.

Ex. 2. Read and translate text A.

Electrolysis

The term electrolysis was first popularized in the 19th century by Michael Faraday. It was a process that helped in the study of chemical reactions in obtaining pure elements. Today, this process is commercially important as it is used widely in separating or obtaining pure elements from naturally occurring sources such as ores. When a current

is passed through a solution of an electrolyte the ions move towards the electrodes. When they arrive they gain or lose electrons and chemical change occurs. Chemical change brought by passing a current through an electrode is called electrolysis. Faraday showed that the extent of the reaction was proportional to the amount of electricity passed. He also showed that 96,500 coulombs would liberate one gram equivalent of any substance from solution. This amount of electricity is known as the faraday. These two results are known as Faraday's laws of electrolysis. They follow from the fact that that all ions carry small whole numbers of the basic unit of electricity. When ions reach the relevant electrode they may be discharged, losing or gaining electrons. In some cases the resultant neutral particle is stable. This is the case with metal ions which are converted into atoms. In other cases, even when the discharged ion becomes an atom, it is not stable and reacts with other similar atoms to give molecules, e.g.

$H + e - H$ followed by $H + H - H_2$

In many cases the ion is not based on one atom, but on a number of covalently bonded atoms, and chemical reactions occur between the resultant particles on discharge, e.g.

$OH - OH + e$, $2OH - H_2O + O$, $O + O - O_2$

The reactions of the discharged ions may involve the material of the electrode, or other substances present. In some cases the ions are not discharged on the on the arrival at the electrode. This can occur if solution of a metal salt is electrolyzed between electrodes of the metal. Metal ions are discharged at one electrode, while metal goes into solution as ions at the other, instead of other ionic species being discharged.

The chemical changes which occur at the electrodes lead to concentration changes in the solution. There is a steady change in the overall concentration if the ions species are discharged. There are also changes in the local concentrations in the region of the electrodes. For a given amount of electricity passing through the solution, the number of electrons taken up by the positive ions at the cathode must be equal to the number of electrons given up by the negative ions at the anode. Consider the simple idealized case of a solution which contains two types of ion, both positive and negative ion carrying a single charge, both travelling at the same speed through the solution, and both being discharged on the arrival at the electrode. If n electrons enter the solution at the cathode, n positive ions will be discharged. The same number of electrons must leave the solution at the anode, and n negative

ions must also be discharged. The passage of the current through the solutions involves the movement of n charged particles. As the ions move at the same speed, this will involve a movement of n/2 positive ions in one direction, and n/2 negative ions in the other direction. In the vicinity of the cathode the following changes occur: n positive ions out discharge, n/2 positive ions in current carrying, n/2 negative ions out.

The net result is a reduction in the number of both ions by n/2. This is a reduction in the concentration of the electrolyte. A similar reduction in the concentration of the electrolyte occurs in the vicinity of the anode. At each electrode n ions are discharged, but only n/2 arrive as a result of current carrying. If a steady current is flowing the process is continuous. Initially, the concentration of the electrolyte in the vicinities of both electrodes is reduced, but then ions of both types diffuse into these regions under the influence of the concentration gradients. This involves no charge transfer. A steady state is reached when the number of ions reaching the electrode by both mechanisms is equal to the number discharged.

If the electrolyte had been a metal salt, and the electrodes had been of the same metal, negative ions arriving at the anode would not be discharged by giving up their electrons. Instead, the metal would ionize, leaving electrons on the metal electrode. This would produce a local increase in concentration of the electrolyte, and ions of both types would then diffuse away from the electrode.

Ex. 3. Answer the following questions.

1. What is called electrolysis? 2. What is it based on? 3. What is known as Faraday's laws of electrolysis? 4. Under what conditions is there a steady change in the overall concentration? 5. Are there changes in the local concentrations? 6. What changes occur in the vicinity of the cathode? 7. Who popularized the term electrolysis?

Ex. 4. Find antonyms.

Absent; to lose; to arrive; small; overall; increase.

Local; to leave; to gain; large; present; decrease.

Ex. 5. Fill in the blanks with a suitable word.

1. Electrolysis was a process that helped in the study of chemical … in obtaining pure elements. 2. When a … is passed through a solution of an electrolyte the ions move towards the electrodes. 3. Chemical change brought by passing a current through an … is called electrolysis. 4. The chemical changes which occur at the … lead to concentration changes in the solution. 5. The passage of the … through the solutions involves the movement of n charged particles.

Ex. 6. Give Russian equivalents for the following words and word combinations.

Neutral particle; to gain and lose electrons; basic unit; metal ions; discharged ion; similar atoms; covalently bonded atoms; ionic species; overall concentration; positive ions; a single charge; movement of particles; a steady current; to involve.

Ex. 7. Read and translate text B.

The Laws of Electrolysis

Electrochemistry is the study of the chemical effects of electricity. The main manifestation of electrochemistry is the phenomenon of electrolysis, which take place when a chemical reaction proceeds under the direct influence of an electric current.

For example, if the ends of two copper wires connected to a source of direct current are dipped into a solution of copper sulphate in water, the electric circuit is completed and an electric current flows. Clearly, copper sulphate solution is electrically conducting, a property which neither water nor copper sulphate possesses to any significant degree. There is a consequence of the flow of current through the solution, for in time the immersed end of the wire attached to the positive terminal of the electricity supply obviously becomes thinned, whereas the other immersed wire grows in size. If the solution remains unstirred while the current is flowing, the solution around the positive wire deepens in colour and that around the negative wire becomes paler. The influence to be drawn from these observations is that positive wire is dissolving and making the solution stronger in the vicinity, while the negative wire is receiving a depthe posit of copper taken from the salt in the adjacent solution.

This process is one of numerous examples of electrolysis, which may lead either to the decomposition or the formation of chemical substances. In the terminology of electrolysis the conducting solution or fluid is known as the electrolyte, and the parts of the negative and the positive conductors immersed in the electrolyte are the cathode and the anode, respectively, each being termed an electrode. That part of the electrolyte in the immediate vicinity of the anode is the anolyte, and analogously the catholyte is the electrolyte surrounding the cathode. The processes which take place at the electrodes may be referred to as the anodic and cathodic reactions

or processes. The system of electrodes and electrolyte constitutes an electrolytic cell, and the net chemical change taking place in the system as a result of the electrode processes is expressed by the overall cell reaction.

The above description of electrolysis shows that there are two types of electrical conduction. On the one hand there is metallic conduction which occurs in the external connecting wires and in the electrodes of the electrolytic cell; and on the other, there is electrolytic electricity associated with the deposition of the same unit quantity of copper conduction by which electricity passes through the electrolyte between the electrodes.

Terms Related to Electrolysis. *Electrolytes* are the chemical compound whose atoms are closely bounded but when dissolved in solvents like water ionizes and splits into two ions namely cations and anions. For eg: NaCl.

Electrodes are the conductors of electricity which are used to make contact of the circuit with the electrolytic solution.

Anode is the positively charged electrode.

Cathode is the negatively charged electrode.

Cation is an ion or charged atom or particle which has fewer electrons than protons or is positively charged and thus attracted to the negative terminal or cathode during electrolysis.

Anion is an ion or charged atom or particle which has fewer protons than electrons and is negatively charged thus attracted to the positive terminal or anode during electrolysis.

Ex. 8. Answer the following questions.

1. What is the main manifestation of electrochemistry? 2. When is the electric circuit completed? 3. Copper sulphate solution is not electrically conducting, is it? 4. What is conducting solution known? 5. What does the description of electrolysis show?

Ex. 9. Give Russian equivalents for the following words and word combinations.

Effects of electricity; phenomenon of electrolysis; electric current; copper wires; direct current; significant degree; the flow of current; overall amount; conducting solution; electrolytic cell; electrical conduction; external connecting wires; adjacent solution.

Ex. 10. Make sentences to explain the main differences between cation and anion using the table below.

Characteristics	Cation	Anion
Charge	Positive	Negative
Electrode attracted to	Cathode (negative)	Anode (positive)
Formed by	Metal atoms	Non-metal atoms
Examples	Sodium (Na^+), Iron (Fe^{2+}), Ammonium (NH_4^+)	Chloride (Cl^-), Bromide (Br), Sulfate (SO_4^{2-})

Ex. 11. Fill in the blanks with a suitable word.

1. Electrochemistry is the study of the … effects of electricity. 2. Copper sulphate solution is … conducting. 3. Positive wire is dissolving and making the … stronger in the vicinity. 4. The system of … and electrolyte constitutes an electrolytic cell. 5. The description of … shows that there are two types of electrical conduction.

Ex. 12. Read and translate text C.

Electrolytic Conduction

Solid and liquid substances which are able to conduct the electric current can be divided roughly into two categories. There are, first, the metallic conductors or electronic conductors in which the electricity is carried by the electrons.

A metal consists of a relatively rigid lattice of positive ions, i.e., atoms which have lost some electrons, and a system of mobile electrons removed from the atoms. When an electrical potential is applied, the electrons are forced to stream in one direction, while the positive ions remain stationary. The flow of electricity is thus not accompanied by any appreciable movement of matter. Since the electrons carry negative charges the direction in which they stream is opposite to that conventionally regarded as the direction of the positive current.

Conducting materials of the second type are known to be electrolytic conductors or electrolytes, and the properties of these conductors will be given detailed consideration. Electrolytes are distinguished from metallic conductors by the fact that the current is carried by ions and not by electrons. As is already seen, ions consist of atoms or groups of atoms which have lost or gained electrons, thus acquiring positive or negative charges, respectively.

Ex. 13. Speak on the topic “Electrolysis”.

Part 5
INDUSTRIAL WATER TREATMENT AND PURIFICATION

5.1. WATER-SUPPLY ENGINEERING

Ex. 1. Read and memorise the following words.

Construction and operation – конструирование и эксплуатация; engine – двигатель; to apply – применять, использовать; civil engineering – гражданское строительство; mechanical engineering – машиностроение; chemical engineering – химическое машиностроение; electrical engineering – электротехника; materials engineering – материаловедение; activity – деятельность; water supply system – система водоснабжения; management of water resources – управление водными ресурсами; flood control – регулирование паводков; irrigation system – система орошения; hydroelectric power plant – гидроэлектростанция; sewerage system – канализационно-очистная система; water-supply engineering – инженерные средства и методы водоснабжения; consumer – потребитель; acquisition – сбор; treatment – подготовка (очистка); delivery of water – водоснабжение; transmission – система подачи; storage – хранение; distribution – распределение; sewage disposal – очистка сточных вод; wastewater – сточные воды; disposal – сброс, утилизация; wastewater treatment plant – станция очистки сточных вод; discharge – сброс.

Ex. 2. Read and translate text.

Water-Supply Engineering

Engineering is a science which deals with design, construction and operation of structures, machines, engines and other devices used in industry and everyday life. Engineering applies scientific and technical knowledge to solve human problems.

Engineering is divided into many branches. The most important of them are civil engineering, industrial engineering, mechanical engineering, chemical engineering, electrical engineering, sanitary engineering, materials engineering, etc. The field of engineering includes a wide variety of activities.

Civil engineering is the oldest of the main branches of engineering. Civil engineers cooperate with architects to design and build all types of constructions. They plan and supervise large construction projects such as bridges, canals, dams, tunnels and water supply systems. A number of civil engineers focus on the management of water resources, including the construction of flood control and irrigation systems, hydroelectric power plants, water supply and sewerage systems.

Water-supply engineering is a branch of civil engineering. It is a complex of activities concerned with the supply of water to its various consumers – community, industrial enterprises, transport, etc.

This discipline based on various branches of technical sciences and has a complex character. The complex character is determined by the necessity of solving a complex of complicated engineering tasks connected with design, construction and operation of water supply systems. These systems include various facilities providing acquisition, treatment and delivery of water in demanded quantities and of adequate quality to water consumers.

So, a ***water supply system*** is a complex of engineering structures or a system of engineered hydrologic and hydraulic components which are aimed at providing water supply for various water uses. These structures carry out the supply of water including acquisition of water from a variety of natural water sources, its treatment, transmission, storage, and distribution to the water consumers.

1. ***Water acquisition*** is collection of water from a variety of natural water sources (both surface and underground ones).

2. ***Water treatment*** is purification of water to make it suitable for human consumption or for any other purpose. It is any of several processes (or their combination) in which undesirable impurities or pollutants are removed or neutralized.

3. ***Water transmission*** is transportation of water over long distances, especially in those areas where there is a significant mismatch between water supply and water demand.

4. ***Water storage*** is conservation of water in a variety of water storage facilities for future use.

5. A ***water distribution*** system is an elaborate network of pumps, pipelines, storage tanks, and other appurtenances. It must deliver adequate quantities of water at pressures sufficient for operating plumbing fixtures and firefighting equipment.

The study of the course in water-supply engineering is based on the knowledge of a number of general technical and specialized disciplines.

1. Hydrology, hydrogeology (groundwater hydrology), hydrotechnics (hydraulic engineering).

2. Water chemistry and hydrobiology.

3. Hydraulics.

4. Building disciplines.

Sewage disposal (also called waste disposal) is a complex of sanitary activities as well as a complex of engineering structures and facilities intended for the collection of wastewater, its disposal outside the city limits or industrial enterprises, its delivery to wastewater treatment plants, as well as its treatment, sanitation and disinfection before recycling or discharge into a body of water.

Ex. 3. Answer the following questions.

1. What is engineering? 2. What are the main branches of engineering? 3. Civil engineering is the oldest of the main branches of engineering, isn't it? 4. What does the work of civil engineers include? 5. What is water-supply engineering? 6. What facilities do water supply systems include? 7. What is a water supply system? 8. What does a water supply system include? 9. What is sewage disposal?

Ex. 4. Choose the right variant according to the text.

1. Water-supply engineering is …

a) complex of complicated engineering tasks connected with design, construction and operation of water supply systems;

b) complex of activities concerned with the supply of water to its various consumers;

c) a complex of sanitary activities intended for the collection and treatment of sewage;

d) a complex of engineering structures and facilities intended for the collection and treatment of wastewater.

2. Water supply systems include various facilities providing … (several answers possible)

a) acquisition of water from a variety of natural water sources;

b) treatment of water;

c) design, construction and operation of water supply systems;

d) delivery of water to water consumers.

3. The study of the course in water-supply engineering is based on the knowledge of the following general technical and specialized disciplines: … (several answers possible)

a) hydrology, hydrogeology (groundwater hydrology), hydrotechnics (hydraulic engineering) and drilling technology;

b) water treatment technology;

c) water chemistry, hydrobiology and hydraulics;

d) building disciplines.

4. Sewage disposal is a complex of sanitary activities as well as a complex of engineering structures and facilities intended for … (several answers possible)

a) water treatment and purification;

b) wastewater collection;

c) disposal of wastewater outside the city limits or industrial enterprises, its delivery to wastewater treatment plants and its treatment;

d) sewage sanitation and disinfection.

Ex. 5. Fill in the blanks with suitable words.

1. Engineering is a science which deals with …, … and operation of structures, machines. 2. A number of civil engineers focus on the management of … …, including the construction of flood control and irrigation systems. 3. Water supply systems include various facilities providing acquisition, … and … of water in demanded quantities and of adequate quality to water consumers. 4. Acquisition of water from a variety of natural … … . 5. The study of the course in water-supply engineering is based on the knowledge of a number of general technical and specialized … .

Ex. 6. Give Russian equivalents for the following words and word combinations.

To solve human problems; the field of engineering; to supervise large construction projects; water supply and sewerage system; focus on the management; a complex of activities concerned with; to be determined by the necessity; facilities providing acquisition; treatment and delivery of water.

Ex. 7. Find English equivalents for the following word combinations.

1. Устройства, используемые в промышленности и повседневной жизни.

2. Применять научные и технические знания для решения задач.

3. Включает в себя широкий спектр видов деятельности.

4. Проектирование и строительство всех типов сооружений.

5. Управление водными ресурсами.

6. Эксплуатация систем водоснабжения.

7. Забор воды из различных природных источников.

8. Сооружения, предназначенные для сбора сточных вод.

9. Обеззараживание воды.

Ex. 8. Complete the sentences with a word, noun or adjective, coming from the word in brackets in order to give the sentence its correct meaning.

Water (*supplies*) system is the infrastructure for the (*collect*), (*transmit*), (*treat*), storage, and (*distribute*) of water for homes, commercial establishments, (*industrial*), and (*irrigate*), as well as for such public needs as firefighting and street flushing. Of all municipal (*service*), provision of potable water is perhaps the most vital. People (*depending*) on water for (*drink*), cooking, washing, carrying away wastes, and other domestic needs. Water (*supplies*) systems must also meet (*require*) for public, commercial, and industrial (*active*). In all cases, the water must fulfill both quality and quantity requirements.

Water (*treat*) is the alteration of a water source in order to achieve a quality that meets specified goals. At the end of the 19th century and the beginning of the 20th, the main goal was (*eliminate*) of deadly waterborne diseases. The (*treat*) of public (*drink*) water to remove pathogenic, or disease-causing, microorganisms began about that time. (*Treat*) methods included sand filtration as well as the use of chlorine for (*disinfect*). The virtual (*eliminate*) of diseases such as cholera and typhoid in developed countries proved the success of this water-(*treat*) technology. In developing countries, waterborne disease is still the principal water (*qualitative*) concern.

5.2. WATER POLLUTION

Ex. 1. Read and memorize the following words.

Acid mine drainage – кислотный шахтный дренаж; acidity – кислотность; algae bloom – цветение морских водорослей; anaerobic lagoons – анаэробные лагуны; anoxia (oxygen depletion) – кислородное голодание (кислородное истощение); anthropogenic substance – антропогенное вещество; aquifers – водоносные слои; bioassays – биоприборы; biosurveys (population counts) – биообзоры (количество населения); biotic communities – биологические виды; bush debris from logging operations – обрезки древесины с лесозаготовок; cadmium – кадмий; cloudiness – мутность; containment – удерживание;

cooling ponds – охлаждение водоемов; cumulative effect – суммарный эффект; dense liquids – плотные жидкости; detergents – моющие средства; discarded trash – хлам, от которого отказываются; ditch – сажать в аварийном режиме; domestic sewage – бытовые сточные воды; rubbish – мусор; drain – утечка; earthquake – землетрясение; effluent – сточные воды; electrical conductivity – электрическая проводимость; eutrophication – эвтрофикация (цветение воды в результате повышенной концентрации в ней биогенных веществ, т. е. азота и фосфора); floatables – плавающие твердые частицы; fuel combustion byproducts – побочные продукты сжигания топлива; fuel oil – горючее; garbage – отбросы; grab samples – взятые образцы / пробы; grease – жир, смазывать жиром; hydraulic capacity – гидравлическая способность; to implement – реализовывать; in situ – на месте; individual aquifers and wells – отдельные водоносные слои и колодцы; industrial solvents – промышленные растворители; irrelevant – несоответствующий, неважный; jet fuel – реактивное топливо; lead – свинец; leaky sewage collection system – прохудившаяся система сбора сточных вод; lubricant – смазка; nonpoint source pollution – рассредоточенные источники загрязнения; nutrient runoff – питательный сток; ocean acidification – подкисление океана; oxygen depletion – кислородное истощение; oxygen-depleting substances – исчерпывающие кислород вещества; personal hygiene – личная гигиена; pipe – перекачивать по трубопроводу; point source pollution – локальное загрязнение; pollution prevention – предотвращение загрязнения; publicity owned treatment works – принадлежащее государству очистное сооружение; pump – качать; radionuclide contaminant – радионуклидный загрязнитель; release of water – выпуск воды; residential use – жилое использование; riparian buffers – прибрежные буфера; sampling of water – забор проб воды; sanitary sewer overflow – санитарное переполнение коллектора; sensory changes – сенсорные изменения; severe reductions – серьезные сокращения; sewage treatment plant – станция очистки сточных вод; sheet flow – технологическая схема; sludge – ил; slurries – жидкие растворы; thermal pollution – тепловое загрязнение; thermophilic species – теплолюбивые разновидности; to diffuse contamination – распространять загрязнение; to eliminate – устранение; to facilitate – способствовать; to impair – вредить; to validate – проверять; toxic pollutants – токсичные загрязнители; toxicity – токсичность; trickle – струйка; turbidity – помутнение; valve – клапан; via urban storm water runoff – через городскую ливневую канализацию; volatile organic

compounds – изменчивые органические соединения; vs. (лат.) – против; wetlands – заболоченные места

Ex. 2. Match the words combinations to their Russian equivalents.

Fuel; groundwater pollution; microbial testing of drinking water; processing waste; toxic substances.

Топливо; микробиологический анализ питьевой воды; загрязнение подземных вод; токсичные вещества; обработка отходов.

Ex. 3. Compose word combinations matching the words below.

Pollution; species; drinking; algae; runoff; contaminants; toxin; prevention; individual; water; blooms; nutrient; radionuclide; plume.

Ex. 4. Find derivatives and give their Russian equivalents.

Phenomena; bacteria; identification; nutrient; acidity; identifiable; susceptible; nutrient; soil.

Ex. 5. Read and translate text A. Say what water pollution categories are known.

Water Pollution

Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans, aquifers and groundwater). Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds. Water pollution affects plants and organisms living in these bodies of water. In almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities. Water is typically referred to as polluted when it is impaired by anthropogenic contaminants and either does not support a human use, such as drinking water drinking water, or undergoes a marked shift in its ability to support its constituent biotic communities, such as fish. Natural phenomena such as volcanoes, algae blooms, storms, and earthquakes also cause major changes in water quality and its ecological status.

Water pollution is a major global problem which requires ongoing evaluation and revision of water resource policy at all levels (international down to individual aquifers and wells). It has been suggested that it is the leading worldwide cause of deaths and diseases, and that it accounts for the deaths of more than 14,000 people daily.

Water Pollution Categories. Surface water and groundwater have often been studied and managed as separate resources, although they are interrelated. Surface water seeps through the soil and becomes

groundwater. Conversely, groundwater can also feed surface water sources. Sources of surface water pollution are generally grouped into two categories based on their origin.

Point source water pollution refers to contaminants that enter a waterway from a single, identifiable source, such as a pipe or ditch. Examples of sources in this category include discharges from a sewage treatment plant, a factory, or a city storm drain.

Nonpoint source (NPS) pollution refers to diffuse contamination that does not originate from a single discrete source. This pollution is often the cumulative effect of small amounts of contaminants gathered from a large area. A common example is the leaching out of nitrogen compounds from fertilized agricultural lands. Nutrient runoff in stormwater from "sheet flow" over an agricultural field or forest is also cited as examples of NPS pollution.

Groundwater Pollution. Interactions between groundwater and surface water are complex. Consequently, groundwater pollution, sometimes referred to as groundwater contamination, is not as easily classified as surface water pollution. By its very nature, groundwater aquifers are susceptible to contamination from sources that may not directly affect surface water bodies, and the distinction of point vs. non-point source may be irrelevant. A spill or ongoing releases of chemical or radionuclide contaminants into soil (located away from a surface water body) may not create point source or non-point source pollution, but can contaminate the aquifer below, defined as a toxin plume. The movement of the plume, called a plume front, may be analyzed through a hydrological transport model or groundwater model. Analysis of groundwater contamination may focus on the soil characteristics and site geology, hydrogeology, and the nature of the contaminants.

Ex. 6. Read and translate text B. Match pollution causes to their effects according to it.

Causes:	*Effects:*
1) anthropogenic substances;	a) fish and other animal populations;
2) coliform bacteria, i.e. a used bacterial indicator of water pollution;	b) waterborne diseases in either human or animal hosts;
3) industrial discharges (especially sulfur dioxide from power plants);	c) although not an actual cause of disease;
4) leaky sewage collection systems (pipes, pumps, valves);	d) turbidity blocks light, disrupts plant growth, and clogs the gills of some fish species;
5) oxygen depletion and severe reductions in water quality;	e) sanitary sewer overflows;
6) pathogens.	f) acidity.

Ex. 7. Read and translate text.

Water Pollution Causes

The specific contaminants leading to pollution in water include a wide spectrum of chemicals, pathogens, and physical or sensory changes such as elevated temperature and discoloration. While many of the chemicals and substances that are regulated may be naturally occurring (calcium, sodium, iron, manganese, etc.) the concentration is often the key in determining what is a natural component of water, and what is a contaminant. High concentrations of naturally occurring substances can have negative impacts on aquatic flora and fauna. Oxygen-depleting substances may be natural materials, such as plant matter (e.g. leaves and grass) as well as man-made chemicals. Other natural and anthropogenic substances may cause turbidity (cloudiness) which blocks light and disrupts plant growth, and clogs the gills of some fish species.

Many of the chemical substances are toxic. Pathogens can produce waterborne diseases in either human or animal hosts. Alteration of water's physical chemistry includes acidity (change in pH), electrical conductivity, temperature, and eutrophication. Eutrophication is an increase in the concentration of chemical nutrients in an ecosystem to an extent that increases in the primary productivity of the ecosystem. Depending on the degree of eutrophication, subsequent negative environmental effects such as anoxia (oxygen depletion) and severe reductions in water quality may occur, affecting fish and other animal populations.

Pathogens. Coliform bacteria are a commonly used bacterial indicator of water pollution, although not an actual cause of disease. Other microorganisms sometimes found in surface waters which have caused human health problems include: *Burkholderia pseudomallei, Giardia lamblia, Salmonella, Novovirus* and other viruses, parasitic worms.

High levels of pathogens may result from inadequately treated sewage discharges. This can be caused by a sewage plant designed with less than secondary treatment (more typical in less-developed countries). In many countries, older cities with aging infrastructure may have leaky sewage collection systems (pipes, pumps, valves), which can cause sanitary sewer overflows. Some cities also have combined sewers, which may discharge untreated sewage during rain storms. Pathogen discharges may also be caused by poorly managed livestock operations.

Chemical and Other Contaminants. Contaminants may include organic and inorganic substances. *Organic water pollutants* include: 1) detergents; 2) disinfection by products found in chemically disinfected drinking water, such as chloroform; 3) food processing waste, which can include oxygen-demanding substances, fats and grease; 4) insecticides and herbicides, a huge range of organohalides and other chemical compounds; 5) petroleum hydrocarbons, including fuels (gasoline, diesel fuel, jet fuels, and fuel oil), lubricants (motor oil), and fuel combustion byproducts from stormwater runoff; 4) tree and bush debris from logging operations; 5) volatile organic compounds, such as industrial solvents, from improper storage; 6) various chemical compounds found in personal hygiene and cosmetic products. Chlorinated solvents, which are dense non-aqueous phase liquids, may fall to the bottom of reservoirs, since they don't mix well with water and are denser (polychlorinated biphenyl, trichloroethylene).

Inorganic water pollutants include: 1) acidity caused by industrial discharges (especially sulfur dioxide from power plants); 2) ammonia from food processing waste; 3) fertilizers containing nutrients – nitrates and phosphates – which are found in stormwater runoff from agriculture, as well as commercial and residential use; 4) heavy metals from motor vehicles (via urban stormwater runoff) and acid mine drainage; 5) sediment in runoff from construction sites, logging, slash and burn practices or land clearing sites.

Thermal Pollution. Thermal pollution is the rise or fall in the temperature of a natural body of water caused by human influence. Unlike chemical pollution, it results in a change in the physical properties of water. A common cause of thermal pollution is the use of water as a coolant by power plants and industrial manufacturers. Elevated water temperatures decreases oxygen levels (which can kill fish) and affects ecosystem composition, such as invasion by new thermophilic species. Urban runoff may also elevate temperature in surface waters. Thermal pollution can also be caused by the release of very cold water from the base of reservoirs into warmer rivers.

Macroscopic Pollution. Macroscopic pollution, i.e. large visible items, polluting the urban stormwater, or marine debris when found on the open seas, can include such items as: trash or garbage (e.g. paper, plastic, or food waste) discarded by people on the ground, along with accidental or intentional dumping of rubbish, that are washed by rainfall into storm drains and eventually discharged into surface waters.

Ex. 8. Work in pares with the cards "Measurement" to make up dialogues.

I. Water pollution may be analyzed through several broad categories of methods: physical, chemical and biological. Most involve collection of samples, followed by specialized analytical tests. Some methods may be conducted *in situ*, without sampling, such as temperature. Government agencies and research organizations have published standardized, validated analytical test methods to facilitate the comparability of results from disparate testing events.

II. *Sampling* of water for physical or chemical testing can be done by several methods, depending on the accuracy needed and the characteristics of the contaminant. Many contamination events are sharply restricted in time, most commonly in association with rain events. For this reason "grab" samples are often inadequate for fully quantifying contaminant levels. Scientists gathering this type of data often employ auto-sampler devices that pump increments of water at either time or discharge intervals. Sampling for biological testing involves collection of plants and / or animals from the surface water body. Depending on the type of assessment, the organisms may be identified for biosurveys (population counts) and returned to the water body, or they may be dissected for bioassays to determine toxicity.

III. *Chemical testing* (i.e. water chemistry analysis and environmental chemistry). Water samples may be examined using the principles of analytical chemistry. Many published test methods are available for both organic and inorganic compounds. Frequently used methods include pH, biochemical oxygen demand (BOD), chemical oxygen demand (COD), nutrients (nitrate and phosphorus compounds), metals (including copper, zinc, cadmium, lead and mercury), oil and grease, total petroleum hydrocarbons (TPH), and pesticides.

IV. *Biological testing* (Bioindicator) involves the use of plant, animal, and / or microbial indicators to monitor the health of an aquatic ecosystem. Bacteriological water analysis is for microbial testing of drinking water. Common *physical tests* of water include temperature, solids concentrations (e.g., total suspended solids (TSS)) and turbidity.

Ex. 9. Read and translate text C. Say what of three water pollution monitoring treatments is the most important to your point of view.

Control of Water Pollution

Domestic Sewage. Domestic sewage is 99.9 per cent pure water, while the other 0.1 per cent is pollutants. Although found in low concentrations, these pollutants pose risk on a large scale. In urban areas, domestic sewage is typically treated by centralized sewage treatment plants. All over the world, most of these plants are operated by local government agencies, frequently referred to as publicly owned treatment works. Municipal treatment plants are designed to control conventional pollutants: BOD and suspended solids. Well-designed and operated systems (i.e., secondary treatment or better) can remove 90 per cent or more of these pollutants. Some plants have additional sub-systems to treat nutrients and pathogens. Most municipal plants are not designed to treat toxic pollutants found in industrial wastewater.

Cities with sanitary sewer overflows or combined sewer overflows employ one or more engineering approaches to reduce discharges of untreated sewage, including: 1) utilizing a green infrastructure approach to improve stormwater management capacity throughout the system, and reduce the hydraulic overloading of the treatment plant; 2) repair and replacement of leaking and malfunctioning equipment; 3) increasing overall hydraulic capacity of the sewage collection system. A household or business not served by a municipal treatment plant may have an individual septic tank, which treats the wastewater on site and discharges into the soil. Alternatively, domestic wastewater may be sent to a nearby privately owned treatment system.

Industrial Wastewater. Some industrial facilities generate ordinary domestic sewage that can be treated by municipal facilities. Industries that generate wastewater with high concentrations of conventional pollutants (e.g. oil and grease), toxic pollutants (e.g. heavy metals, volatile organic compounds) or other nonconventional pollutants such as ammonia, need specialized treatment systems. Some of these facilities can install a pre-treatment system to remove the toxic components, and then send the partially treated wastewater to the municipal system. Industries generating large volumes of wastewater typically operate their own complete on-site treatment systems. Some industries have been successful at redesigning their manufacturing processes to reduce or eliminate pollutants, through a process called pollution prevention. Heated water generated by power plants or manufacturing plants may be controlled with: 1) cooling ponds, man-made bodies of water

designed for cooling by evaporation, convection, and radiation; 2) cooling towers, which transfer waste heat to the atmosphere through evaporation and / or heat transfer; 3) cogeneration, a process where waste heat is recycled for domestic and / or industrial heating purposes.

Agricultural Wastewater. There are two types of agricultural wastewater treatment.

Nonpoint Source Wastewater Treatment. Sediment (loose soil) washed off fields is the largest source of agricultural pollution. Farmers may utilize erosion controls to reduce runoff flows and retain soil on their fields. Common techniques include contour plowing, crop mulching, crop rotation, planting perennial crops and installing riparian buffers. Nutrients (nitrogen and phosphorus) are typically applied to farmland as commercial fertilizer; animal manure; or spraying of municipal or industrial wastewater (effluent) or sludge. Nutrients may also enter runoff from crop residues, irrigation water, wildlife, and atmospheric deposition. Farmers can develop and implement nutrient management plans to reduce excess application of nutrients.

Point Source Wastewater Treatment. Farms with large livestock and poultry operations, such as factory farms, are called concentrated animal feeding operations or feedlots and are subject to increasing government regulation. Animal slurries are usually treated by containment in anaerobic lagoons before disposal by spray or trickle application to grassland. Constructed wetlands are sometimes used to facilitate treatment of animal wastes.

Ex. 10. Answer the following questions.

1. What industries need specialized treatment systems? 2. What is the agricultural application of nutrients (nitrogen and phosphorus)? 3. Food processing waste can include oxygen-demanding substances, fats and grease, and herbicides. What of this list is false? 4. Chemical pollution, unlike thermal, results in a change in the physical properties of water, doesn't it? 5. Why is groundwater pollution not easily classified, unlike surface water pollution?

Ex. 11. Translate the following sentences. Point out the "-ing constructions"; state functions of verbals.

1. Reducing consumption or usage of a polluting product is one of the approaches to reduce pollution. 2. Waste treatment can only be effective if pollution is coming from a defined and accessible source. 3. Biological processing with the appropriate microbes should be used to reduce toxicity of very reactive ions. 4. If there are no colonies

preserved from pre-pollution eras and classical mechanisms of transport have been destroyed for organisms occupying important niches in the ecosystems, careful human intervention may be needed to introduce necessary species. 5. Strong industrial presence can pollute environments, but will also lead to urbanization and habitat fragmentation due to workers living nearby. 6. Macroorganism travel may be significantly impaired by habitat fragmentation through urbanization, pollution of river biomes all the way to their sources, or an extinction or large reduction in numbers of transporting species such as waterfowl. 7. Biome is a large naturally occurring community of flora and fauna occupying a major habitat. 8. If sufficient space were available, constructing degrading wetlands could be a cost-effective alternative.

Ex. 12. Speak on the topic "Water Pollution".

5.3. WATER TREATMENT AND PURIFICATION

Ex. 1. Read and memorise the following words.

Water quality – качество воды; in respect of – что касается; suitability – соответствие, пригодность; measurement – измерение; pure – чистый; impure – неочищенный, грязный; interconnection – взаимосвязь; to take into account – принимать во внимание; to assess – определять, оценивать; turbidity – мутность; odor – запах; foamability – пенообразование; acidity – кислотность; alkalinity – щелочность; hardness – жесткость; corrosiveness – коррозионная стойкость; to refer – относить, ссылаться; protozoan – простейшее животное; dimension – размер, измерение, аспект; extent – степень, предел; water purification – очистка воды; chemicals (pl.) – химикалии, химические препараты; contaminant – загрязняющее вещество; to purify – очищать; to disinfect – дезинфицировать; consumption – потребление; potable – питьевой, годный для питья; coagulation – коагуляция; flocculation – флокуляция; sedimentation – осаждение, оседание; flotation – флотация; softening – умягчение; aeration – аэрация; carbon adsorption – адсорбция углем; deferrization – обезжелезивание; desalination – опреснение; fluoridation – фторирование; reverse osmosis – обратный осмос.

Ex. 2. Read and translate text.

Water Quality and Water Treatment

"Water quality" is a term used to describe the chemical, physical, and biological characteristics of water, usually in respect of its suitability for a particular purpose (for drinking, industrial purposes, irrigation, recreation, etc.) Although scientific measurements are used to define water quality, it's not a simple thing to say "this water is good / pure", or "this water is bad / impure". There are complex interconnections among factors such as surface and ground water, atmospheric and climatic factors, natural landscape features (such as geology, topography, and soils), human activities, and aquatic health which must be taken into account in analyzing water quality.

Water quality is determined by assessing three classes of characteristics: physical, chemical, and biological. The physical characteristics include turbidity, colour, taste, odor, temperature, and foamability. The chemical characteristics of water are its acidity, alkalinity, pH, hardness, and corrosiveness (corrosivity). The biological characteristics of a water body refer to a variety of living organisms that can be found in water, including microscopic viruses, bacteria and protozoans, as well as phytoplankton (microscopic algae), zooplankton (tiny water animals), insects and so on. Water quality has a microbiological and a physicochemical dimension. There are thousands of parameters of water quality. The type and extent of water treatment depends on the quality of the water source. The better the quality, the less treatment is needed.

Water treatment is the process of water purification from undesirable chemicals, biological contaminants, and gases. The goal is to produce water fit for specific purposes. Most water is purified and disinfected for human consumption (drinking water), but water purification may also be carried out for a variety of other purposes, including medical, pharmacological, chemical, and industrial applications.

There are many methods used in the purification of water from potable tap water to a standard suitable for use as a laboratory reagent.

The conventional water purification processes of greatest importance are ***coagulation*** and ***flocculation***, ***sedimentation*** and ***flotation***, ***filtration***, ***disinfection***, as well as some additional treatment

methods (***softening***, ***aeration***, ***carbon adsorption***, ***distillation***, ***deferrization***, ***desalination***, ***fluoridation***, ***reverse osmosis***, etc.). Each of these has different capabilities in terms of which contaminants it will remove effectively and each is subject to its own advantages and disadvantages in terms of cost, ease of use etc.

Ex. 3. Answer the following questions.

1. What does the term "water quality" describe? 2. Is it easy to say "this water is good / pure" or "this water is bad / impure"? Why? Why not? 3. What are physical, chemical, and biological characteristics of water? 4. What are the factors which must be taken into account in analyzing water quality? 5. What is water treatment? 6. What is the primary objective of water treatment? 7. Why do many industries provide special water treatment on their own premises? 8. What are the most important conventional water treatment processes?

Ex. 4. Transform as in the models.

Model 1: verb 1 noun (to pollute water – pollution of water).

To treat water; to purify water; to remove undesirable impurities; to neutralize an impurity; to contaminate water resources; to divide into types; to deteriorate water quality; to describe the characteristics of water; to protect the health of the community; to provide special treatment; to classify pollutants; to disinfect water; to purify water; to consume drinking water.

Model 2: noun 1 noun (quality of water – water quality).

Treatment of water; purification of water; contamination of water resources; pollution of a water source; removal or neutralization of impurities; properties of water; water on the surface; water in the ground; features of landscape; life of plants and animals; characteristics of water; requirements for water quality; sampling and analyses of water.

Ex. 5. Match the words with their definitions.

1. Water quality	a) having sediment or foreign particles stirred up or suspended
2. Suitability	b) the chemical, physical, biological, and radiological characteristics of water
3. Impure	c) subsurface water, often between saturated soil and rock, that supplies wells and springs
4. Ground water	d) the process of removing impurities
5. Purification	e) the quality of having the properties that are right for a specific purpose
6. Turbidity	f) not clean; contaminated

Ex. 6. Complete the sentences with the words from the table below.

Consumption, systems, development, water, demand, transport, industrial water, chemical industry, users

Industrial Water Supply

Water supply … must also meet requirements for commercial and industrial activities. Water has always played a critical part in implementation of every industrial process. It is estimated that now about 22 per cent of world-wide … use is industrial. The … for water is sure to increase in future. Though water … depends on the region, as a whole, industrial water usage is lower than agricultural use.

The most important purposes of … consumption are cooling, scouring, washing, dampening, steam generation, hydraulic transport, etc. The use of water for cooling exceeds all other kinds of water consumption as it is used in such branches of industry as metallurgy, oil-refining industry, … , etc. In general, the largest water … are enterprises of metallurgical, chemical, oil-refining, petrochemical, and machine-building industry, as well as thermal power stations.

Industry also uses water to dissipate and … waste materials. In fact, many streams are now overused for this purpose, especially watercourses in urban centres.

Ex. 7. Translate the words and word combinations in brackets.

Water is called the "universal (*растворитель)*" because of its strong tendency to dissolve other (*вещества*). Since (*чистая / очищенная вода*) is not found in nature (i.e., outside chemical laboratories), any distinction between clean water and (*загрязненная вода*) (*зависит от*) the type and (*концентрация*) of (*примеси*) found in the water as well as on its intended use*. Water is said to be polluted when it contains enough (*примеси*) to make it (непригодный) for a particular use, such as drinking, swimming, or fishing. Although the (*качество*) of water is affected by natural (*условий*), the word "pollution" usually implies (*деятельность человека*) as the source of (*загрязнение*). Water pollution is caused primarily by the drainage of contaminated waters into (*поверхностные воды*) or (*грунтовые воды*). (*Охрана водных ресурсов*), therefore, primarily involves the (*удаление*) of impurities before they reach natural (*водоемы)* or aquifers.

*intended use – использование по назначению; предполагаемое использование

Ex. 8. Speak on the topic "Water quality and water treatment".

5.4. WATER PURIFICATION METHODS

Ex. 1. Read and memorise the following words.

A. Preliminary treatment – предварительная очистка; to undergo – подвергаться; coarse – грубый, крупный; fine – мелкий; screen – сито, решетка; strainer – сетчатый фильтр; to remove – удалять; debris – обломки, остатки, мусор; screening – отбор, просеивание; presedimentation basin – предварительный отстойник; to settle out – осаждать, выпадать; to occur – происходить; to accomplish – выполнять; treatment plants – очистные сооружения; settling basin – отстойники; plain sedimentation – механическое отстаивание; colloidal material – коллоидное вещество; algae – водоросли; dispersed – диспергированный, рассеянный; silt – ил, осадок; suspended material – вещество во взвешенном состоянии, суспендированный материал; mass – груда, скопление, большое количество; flocs – вещества, оставшиеся в сточных водах после отстаивания (хлопья); clumping of the bacteria – скопление бактерий; alum – квасцы; rapid – быстрый; to disperse – рассеивать, распределять; particle collisions – столкновение частиц; enhancing – увеличение; sediment – осадок, отстой; quiescent settlement – осаждение в спокойном состоянии; flow – поток; continuous flow extended – продленный, увеличенный; retention time – время пребывания в очистной установке, время отстаивания воды; sediment content – содержание твердых частиц в воде; radial flow – радиальный поток (от центра к периферии); hopper-bottomed tank – отстойники с коническим дном; upward flow – восходящий поток; sludge – шлам, осадок; buoyancy – плавучесть; rising – поднятие, подъем; skimmer – гребок; complete removal – полное удаление.

B. Turbidity – мутность; filter bed – фильтрующий слой; granular material – гранулированный материал; filter media – среда (наполнение) фильтра; related substances – аналогичные (соответствующие) вещества; dual-media filters – двойные фильтры; in-depth filtration – глубинная фильтрация; mixed-media filter – фильтр смешанного действия; garnet – гранат (минерал); backwashing – промывка фильтра обратной струей; обратная промывка фильтра; clogged filter – засоренный (забитый) фильтр; chlorination – хлорирование; residual – остаток; excess salt – избыток соли.

Ex. 2. Read and translate text A.

Water Purification Methods. Preliminary Treatment. Coagulation. Sedimentation. Flotation

Preliminary treatment **(*pretreatment*)** is any physical, chemical or mechanical process used before water undergoes the main treatment process. During pretreatment:

- coarse and fine screens or micro strainers may be used to remove rocks, sticks, leaves and other debris (***screening***);
- ***presedimentation*** settles out sand, grit and gravel from raw water. Sedimentation occurs naturally in reservoirs and is accomplished in treatment plants by settling basins (also called sedimentation basins or settling tanks). Plain sedimentation will not remove extremely fine or colloidal material within a reasonable time, and the process is used principally as a preliminary to other treatment methods;
- ***adding of chemicals*** may be added to control the growth of algae.

Coagulation is a separation or precipitation from a dispersed state of suspension particles. Coagulation removes small particles made up of microbes, silt, and other suspended material in the water. By adding chemicals called coagulants (coagulating agents) to the water, fine non-settling particles and colloidal material form larger, heavier masses of solids by coagulation. These masses, called floc, are large enough to settle in basins and to be caught on the surface of filters. A precipitate forms and causes a clumping of the bacteria and other foreign particles which then settle out during the several hours of sedimentation. In this way about 85 per cent of the bacteria and suspended particles, as well as some of the mineral elements (such as certain forms of iron) can be removed.

The 3 main types of coagulants are inorganic electrolytes (alum, lime, ferric chloride, ferrous sulfate), organic polymers, and synthetic polyelectrolytes. Their application may have serious disadvantages because of possible negative effect on water consumers' health.

Coagulation is usually accomplished in 2 stages: rapid mixing and slow mixing.

- rapid mixing serves to disperse the coagulants evenly throughout the water and to ensure a complete chemical reaction.
- slow mixing (also called ***flocculation***) is longer gentle mixing for promoting particle collisions and enhancing the growth of flocs. A flocculant (flocculating agent) is a reagent added to a dispersion of

solids in water to bring together the fine particles to form flocs. After flocculation the water flows into the sedimentation tanks where sedimentation or flotation is accomplished.

Sedimentation is the process of precipitation of sediment (matter that settles to the bottom of a liquid under the force of gravity) which is accomplished in the sedimentation tank. A settling [sedimentation / precipitation] tank is a tank where suspended matter is removed either by quiescent settlement or by continuous flow and extended retention time to allow deposition. Sedimentation is used to remove settleable suspended solids from waters which are high in sediment content after coagulation and flocculation processes. Types of sedimentation tanks include:

- rectangular with horizontal flow;
- circular with radial flow;
- hopper-bottomed with upward flow.

The amount of floc settling out of the water depends on the retention time of the water in the basin (minimum 4 hours) and the depth of the basin (there are shallow or deep basins). As particles settle, a layer of sludge is formed at the bottom of the tank. Sludge is thick, soft, wet mud or a similar viscous mixture of liquid and solid components which is then removed and treated. The amount of sludge is usually 3–5 per cent of the total volume of water treated.

An alternative technique to sedimentation is ***flotation***. It is the use of gas bubbles for increasing the buoyancy of suspended solids and rising the particles through the water to float on the surface of the water to be collected by a skimmer. The advantage of flotation over sedimentation is more complete removal of small or light particles in a shorter time.

Ex. 3. Answer the following questions.

1. What is pretreatment (preliminary treatment)? 2. What is used to remove debris during pretreatment? How is this process called? 3. What is the purpose of presedimentation? 4. Where is sedimentation accomplished in water treatment plants? 5. Why is presedimentation used as a preliminary to other treatment methods? 6. What may be added to control the growth of algae during pretreatment? 7. What is coagulation? What is the purpose of this method? 8. What are coagulants (coagulating agents)? 9. What are the three main types of coagulants? 10. How are heavier masses of solids formed by coagulation called? 11. What are two stages of coagulation? How is slow mixing called? 12. Why is a flocculant (flocculating agent) added?

Ex. 4. Choose the correct word.

1. Coagulation / coagulants / to coagulate

… is clumping together of very fine particles into larger particles using chemicals … that neutralize the electrical charges of the fine particles and destabilize the particles. During …, different chemical additives cause particles … and thus to settle.

2. Flocculation / flocculants / to flocculate

… is the process in which small particles clump together through gentle stirring. Independently of the water origin, aluminum sulfate is added to the water, to allow particles in suspension … . … are added to a dispersion of solids in a liquid to bring together the fine particles to form flocs.

Ex. 5. Match the words with their definitions.

1. Water treatment	a) produced from the treatment of raw water to render it potable comes from the extractions undertaken during sedimentation (or flotation)
2. Settling basin	b) is a reagent added to a dispersion of solids in water to bring together the fine particles to form flocs
3. To remove	c) a type of the structure, usually a man-made tank that is designed for the purpose of removing sediment and other particulates from water
4. Coagulants	d) to move to a lower level and stay there; to drop
5. Flocculant	e) is any process that improves the quality of water to make it appropriate for a specific end-use
6. Debris	f) are a key component for any wastewater treatment program that handles suspend solids, as they consolidate those particles for easy and thorough removal
7. Sludge	g) is a calculated quantity expressing the mean time that water (or some dissolved substance) spends in a particular basin
8. To settle	h) to take something away from somewhere, or off something
9. Retention time	i) broken or torn pieces of something larger

Ex. 6. Find in the text the English equivalents of the following word combinations.

Обработка; использовать для удаления камней, палок, листьев и другого мусора; осаждение происходит естественным образом; чрезвычайно мелкий материал; добавление химических веществ; удалять мелкие частицы; образуется осадок; неорганические элек-

тролиты; органические полимеры; применение; иметь недостатки; вода поступает в отстойники; по мере оседания; образуется слой шлама; смесь жидких и твердых компонентов; альтернативой седиментации является; увеличения плавучести взвешенных твердых частиц; преимущество флотации перед седиментацией.

Ex. 7. Translate the words and word combinations in brackets.

Various (*методы очистки воды*) are used to take water (*безопасной*) and attractive to the consumer. The method selected depends mostly on the character of the (*сырая, необработанная вода*).

Much of the (*взвешенного вещества*) can be (*удалить*) in a (отстойниках), where the larger particles will (*оседать*) (*под действием*) of gravity. This process is called (*механическое отстаивание*).

(*Резервуары для хранения*) serve as rudimentary sedimentation basins, but because of density (*потоков*), disturbances caused by wind, and other factors they cannot always be relied upon to give proper clarification. Sedimentation basins (*построенные*) for the specific purpose of removing (*взвешенных веществ*) from the water are generally of reinforced cement concrete and may be (*прямоугольными или круглыми*) in plan.

The (*эффективность*) of sedimentation may be increased by (*смешивания химических веществ*) with the water to form a flocculent (*осадка*) which carries the suspended particles down (*по мере оседания*). This process is called (*химической коагуляцией*).

The (*коагулянты*) (*вступают в реакцию с*) the (*загрязняющими*) particles to form a flocculent precipitate. The most common (*коагулянтом*) is alum [$Al_2(SO_4)_3$, $14H_2O$] which (*реагирует*) with the alkalinity in the water c (*образованием*) an aluminum-hydroxide floc.

Ex. 8. Read and translate text B.

Water Purification Methods. Filtration. Disinfection. Chlorination. Ozonation

Filtration is the process of separating particles from a liquid by passing the liquid through a filter that will not pass the particles.

Even after coagulation and flocculation, sedimentation does not remove all suspended impurities from the water to make it crystal clear and safe. The remaining non-settling floc still causes turbidity and contains micro-organisms. Suspended solids, colloidal material (algae, silt, iron, manganese), bacteria, germs, and other microorganisms are filtered out by passing the water through a bed (a layer) of granular mate-

rial (usually fine sand, gravel, garnet, pulverized coal or related substances. However, soluble materials such as salts and metals in ionic form are not removed by filtration.

There are several ***classifications of filters***:

- according to the direction of flow through the filter bed (downflow, upflow, biflow, radial flow, horizontal flow);
- according to the type of filter media used (sand, coal, anthracite, coal-sand, multilayered);
- according to flow rate (slow, rapid).

Most modern water treatment plants now use rapid dual-media filters following coagulation and sedimentation. A dual-media filter consists of a layer of anthracite coal (for trapping most of the large floc) above a layer of fine sand (for trapping smaller impurities). This process is called in-depth filtration. In order to enhance in-depth filtration, mixed-media filters (with a third layer of fine-grained, dense mineral called garnet at the bottom of the bed) are used in some treatment plants. Rapid filters have certain advantages over slow filters: they require much less surface area, they are easier to clean and more reliable. Backwashing [backwash / back-flushing] is the reverse of the direction of flow through the filter for cleaning the filter bed clogged by particles removed from the water.

The development in filter technology doesn't stand still. Membrane filtration is increasingly becoming popular as an advanced water and wastewater treatment process. There are various possibilities of membrane filtration: microfiltration; ultrafiltration; reverse osmosis; nanofiltration.

Disinfection is the complex of measures for destroying agents of infection in the water with the help of various disinfectants. It is accomplished both by filtering out harmful microorganisms and by adding disinfectant chemicals for killing any pathogens which pass through the filters.

There are several methods of treatment of water to kill living organisms, particularly pathogenic bacteria; ***chlorination*** (the application of chlorine or chlorine compounds – chloramine and chlorine dioxide) is the most common. Chlorine is a strong oxidant and a toxic gas. Chlorine dioxide has more recently been found effective as a destroyer of bacteria, as well as a means of removing undesirable tastes and odours. Chlorine has limited effectiveness against protozoans that form cysts in the water.

Less frequently used methods include the use of ozone, ultraviolet light, or silver ions. Boiling is the favored household emergency measure.

The advantage of ***ozonation*** over chlorination is the production of fewer dangerous by-products and the absence of taste and odour. Ozone gas is a colourless toxic gas with powerful oxidizing properties, formed from oxygen by electrical discharges or ultraviolet light. It is an effective method to destroy harmful protozoans. Ozone is a very strong, broad spectrum disinfectant widely used in Europe.

The main disadvantage of ozonation and ***UV radiation*** **(*light*)** radiation is that they leave no disinfectant residual in the water, and it is sometimes necessary to add a residual disinfectant afterwards.

Some additional treatment methods include.

1. ***Softening*** (the process of removing the dissolved calcium and magnesium salts that cause hardness in water, either by adding chemicals or by ion exchange).

2. ***Aeration*** (the process of spraying water into the air used for taste and odour control and for removal of dissolved iron and manganee).

3. **(*Activated*) *carbon adsorption*** (the process of adsorption impurities by activated carbon (saturation carbon with impurities) used for removing dissolved organic substances that cause tastes, odours, or colours).

4. ***Distillation*** (the separation of dissolved solids from water by evaporation and condensation).

5. ***Deferrization*** (the removal of iron from water).

6. ***Desalination*** **(*desalinization*)** (any of several processes that remove excess salt and other minerals from water).

7. ***Fluoridation*** (the addition of sodium fluoride or other fluorine compounds to filtered water for reducing tooth decay).

8. ***Reverse osmosis*** (a process by which water passes through a porous membrane which passes the water, but does not pass the impurities dissolved in it).

Water treatment plants employ a variety of treatment methods. These processes are used in varying combinations, depending on the characteristics of water and on its intended use.

Ex. 9. Answer the following questions.

1. What is filtration? 2. What kind of filters are used in water treatment plants? 3. What is the purpose of disinfection? 4. What is the advantage of ozonation over chlorination? 5. What are the main disadvantage of ozonation? 6. What is the process of removing the dissolved calcium and magnesium salts? 7. Why do water treatment plants employ a variety of treatment methods?

Ex. 10. Choose the correct word.

1. Filtration / filters / to filtrate

… is the process in which particulate matter in water is removed by passage through porous media. … through beds of fine sand or through crushed anthracite coal can trap the suspended matter.

2. Disinfection / disinfectants / to disinfect

… is the process designed to kill most microorganisms in water, including essentially all disease-causing bacteria. … destroy harmful bacteria and deactivate viruses.

3. Aeration / aerator / air / to aerate

… mixes air with water either by spraying the water into the air or by forcing small … bubbles through the water and is used primarily to reduce unpleasant odours and tastes.

4. Softening / softener / to soften

… is the process of removing calcium and magnesium from the water either by chemical precipitation or by ion exchange.

Ex. 11. Match the words with their definitions.

1. Filter	a) a water purification process in which chlorine is added to water for disinfection, for the control of present microrganisms
2. Turbidity	b) any substance consisting of particles substantially larger than atoms or ordinary molecules but too small to be visible to the unaided eye
3. Colloid	c) any of several types of equipment or devices for removing solids from liquids or gases, or for removing particular types of light
4. Bed	d) to catch and prevent particles from moving
5. In-depth filtration	e) a substance that contains chemicals that kill bacteria
6. Odour	f) (of a liquid) the quality or state of being cloudy because a lot of small pieces of matter are held in it
7. Disinfectant	g) resulting or left from something that was previously present
8. Chlorination	h) a level of material, such as a type of rock or gas, that is different from the material above or below it, or a thin sheet of a substance
9. To trap	i) the separation of a suspended particle or liquid droplet from its carrying fluid within the depth (thickness) of the filter medium
10. Residual	j) particular and distinctive smell

Ex. 12. Find in the text the English equivalents of the following word combinations.

Пропускание жидкости через фильтр; растворимые вещества; неоседающие частицы; нисходящий поток; восходящий поток; скорости потока; очистка фильтрующего слоя, засоренного частицами; мембранная фильтрация; комплекс мер; дезинфекция выполняется; добавление дезинфицирующих химикатов; в частности; окислитель; удаления нежелательных вкусов и запахов; не так часто используемые методы; широко используемое в Европе; адсорбция примесей активированным углем; избыток соли; целевое использование.

Ex. 13. Translate the words and word combinations in brackets.

The usual (*фильтр*) consists of a (*слоя песка*) or crushed coal supported on a (*слой гравия*). When water (*проходит через фильтр*), (*взвешенные частицы и флокулянт*) come in contact with the sand grains and adhere to them. Bacteria are effectively (*удаляются фильтрацией*).

In time, more and more material is (*попадает*) in the sand bed, the pores (*засоряются*), and the hydraulic head loss through the bed becomes excessive.

The filter is then (*обратно промывается*) to (*удалить*) the trapped material. During (*промывки фильтра обратной струей; обратной промывиа фильтра*), the (*слой песка*) expands about 50 per cent.

(*Дезинфекция*) is yet another procedure used in (*очистка воды*) methods. More than 50 per cent of the pathogens in water will die within 2 days, and 90 per cent will be dead at the end of the week.

(*Хлор*) is an (*дезинфицирующее средство*). It (образует) hypochlorite when (*при добавлении в воду*), and this has an immediate and disastrous effect on most forms of microscopic life.

(*Вкусы и запахи*) in water are caused by

– (*растворенные газы*) such as hydrogen sulfide,

– living organic material such as (*водоросли*),

– (*разлагающийся органический материал*),

– industrial wastes, and

– chlorine either (*в виде остатка*) or in combination with phenol or decomposing organic matters.

(*Аэрация*), usually (*осуществляемая путем распыления воды*) from special nozzles or by permitting it to trickle over cascades, breaks the water into droplets and permits the escape of (растворенных газов).

(*Активированный уголь*) can be used effectively (*использовать для удаления вкусов и запахов*). It is made by heating paper-mill

waste or sawdust in a closed retort and oxidizing it by means of air or steam to remove the hydrocarbons.

Ex. 14. Speak on the topic "Water Purification Methods".

5.5. APPROACHES TO REDUCING POLLUTION

Ex. 1. Read and memorize the following words.

A. Approach – подход; treatment – обработка; fungi (pl) – грибы; threshold – пороговый; facility – средства; оборудование, аппаратура; lack – недостаток, нехватка; restriction – ограничение; to prevent – предотвращать; levy – сбор, налогообложение; to underestimate – недооценивать; to eliminate – устранять, удалять; to warrant – подтверждать, гарантировать; incentive – побуждение, стимул; sewage – сточные воды; consumption – потребление; accessible – доступный, достижимый; discharge – выброс, слив, спуск; disposal – избавление, устранение; significant – важный, значительный; to shift – сдвигать, смещать; mining – горный, горнодобывающий; awareness – осведомленность; benefit – польза, выгода; noncompliance – неподчинение, несоблюдение.

B. Space – пространство; proximity – близость, близкое расположение; pond – пруд, запруда; mammal – млекопитающее; to impair – ухудшать, портить; extinction – исчезновение; waterfowl – водоплавающая птица; obstacle – препятствие; to be rid of smth – избавляться от чего-либо; availability – пригодность, полезность; to refill – заполнить, восстановить; habitat – среда, место обитания, распространения, ареал животного или растения.

C. To tailor – специально приспосабливать для чьих-либо нужд; to pose – ставить, налагать; rate – скорость, уровень; inevitable – неизбежный; precious – ценный; processing – обработка; alkaline – щелочной; to precipitate – выпадать в осадок, осаждаться; application – применение; to lead – вести куда-либо, приводить; excessively – избыточно, крайне; to secure – обеспечивать, страховать; irreversible – необратимый; appropriate – соответствующий.

Ex. 2. Read and translate the following international words. Use a dictionary if necessary.

Priority; degrade; cause; corporation; base; preference; technique; per cent; private; regulation; production; exploit; alternative; result in; counseling; polluter; biomimicry; transition; generate; integrate; urban.

Ex. 3. Read and translate text A.

Approaches to Reducing Pollution

There are two approaches through which pollution can be reduced: 1) reduction of consumption or usage of a polluting product; and 2) treatment of wastes, discharges and disposals of a pollutant.

Yet waste treatment can only be effective if pollution is coming from a defined and accessible source (point source). There are effectively implemented systems that treat waste water for most chemicals, yet significant improvement in methods are possible. In such improvements, priority should be given to considering the use of microbes or fungi for cleanup of heavy metals and organic compounds that are hard to degrade because of their high efficiency relative to chemical or physical methods.

Most developing and threshold countries lack treatment facilities, meaning waste waters in these countries are significantly more toxic per unit mass then waste water in developed countries, which is also a result of companies shifting pollution-intensive production to countries with fewer environmental restrictions. This is especially observed in the mining industry, where treatment of waste is often very expensive and pollutants are very toxic.

It is often assumed that governmental restrictions or strong consumer pressure are necessary to cause significant reduction in the production of polluting goods, because there is usually no short-term internal benefit to reducing pollution for corporations. The reasons corporations reduce their pollution are based on consumer preference for low-pollution goods and the high cost of noncompliance with environmental regulations. But reducing pollution does not only mean treating waste or paying for waste removal, which only raises costs. Research suggests that preventing pollution during the production process by reducing use of pollutants or implementing low-use techniques actually increases efficiency and financial performance of private corporations by an additional 5 to 8 per cent over five years.

To implement standards throughout a pollution-intensive industry, a government agency must implement environmental regulations. Regulations could include a levy or tax plan which would make polluters pay a fixed amount of money for pollution, a cap-and-trade system which would fix the amount of emissions, prescription of maximum releases, or minimum waste reduction techniques.

Such regulations might come with a high cost to production if no comparable alternatives are available and efficiency measures are already exploited.

However, efficiency measures are underestimated by at least 30 per cent of managers. The potential for development of efficiency has resulted in a small industry of efficiency counseling, which could be helpful in eliminating unnecessary pollution from industrial processes. In general, government regulations need to be stronger in order to eliminate such industrial overuse of pollutants and provide incentives for research and implementation of more efficient techniques. The exact guidelines must be determined by case, as different pollutants have different effects and can be reduced by different measures, which warrants different approaches.

A long-term solution that could reduce pollution from agricultural chemicals is research into more sustainable methods of farming large amounts of food, such as ecosystem engineering or biomimicry (design and production of materials, structures, and systems that are modeled on biological entities and processes). This research focus is necessary for an eventual transition to non-polluting agriculture, which is not feasible now because current methods don't work. However, non-polluting agriculture will eventually become necessary, because all pesticides are by definition poisons; indefinitely relying on them is not a solution that will generate integrated ecosystems, which are necessary to eventually increase biodiversity while keeping high yields.

Organic solvents can also have high toxicity values, making them ecologically significant as well. Unlike agrochemical pollution, which occupies too much area and includes too many possibilities for runoffs to be modeled as a point source, most other organic chemicals released to the environment are gathered in waste disposals of urban or industrial sewage systems and can theoretically be treated.

For effective treatment, the proper degrading microbes as well as enough time are necessary, which means that extensive treatment plants should be developed for many countries. This treatment could take the form of microbial degradation plants commonly used in industrialized countries or, if sufficient space were available, constructing degrading wetlands could be a cost-effective alternative.

Ex. 4. Answer the following questions.

1. What are two approaches through which pollution can be reduced? 2. What improvements are introduced to make waste treatment

system work more efficiently? 3. What difficulties do developing and threshold countries encounter? 4. What is necessary to reduce the production of polluting goods? 5. What is the advantage for producers to reduce use of pollutants? 6. What do governmental regulations include? 7. What is the potential for development of efficiency of environment protection measures? 8. What is biomimicry? 9. How are proper degrading microbes commonly used in industrialized countries?

Ex. 5. Guess the meaning of the international words.

Toxicity; intolerant; recolonization; reconstruction; isolated; biome; fragmentation; urbanization; era; niche; intervention.

Ex. 6. Read and translate text B.

Recolonization

After a site has been rid of its toxicity and offers a space in which normal, pollution-intolerant organisms can live, recolonization and reconstruction of the ecosystem need to occur. This recolonization depends on the availability of organisms to refill the parts of the ecosystem that have been destroyed. If a distinct and isolated environment were destroyed, such as pond ecosystem, not all species may be available in close proximity.

Macroorganisms, like mammals, amphibians, or fish, often have their own mechanisms of travel, yet even many of them need connected biomes (a large naturally occurring community of flora and fauna occupying a major habitat). On the other hand, many smaller organisms that are essential to the ecosystem, such as small insects or microbes, cannot travel on their own and rely on wind, rain, drift, or transportation by other organisms to change places. Macroorganism travel may be significantly impaired by habitat fragmentation through urbanization, pollution of river biomes all the way to their sources, or an extinction or large reduction in numbers of transporting species such as waterfowl.

These obstacles are also often directly correlated to the pollution or the cause of pollution. For instance, strong industrial presence can pollute environments, but will also lead to urbanization and habitat fragmentation due to workers living nearby. If there are no colonies preserved from pre-pollution eras and classical mechanisms of transport have been destroyed for organisms occupying important niches in the ecosystems, careful human intervention may be needed to introduce necessary species.

Ex. 7. Read and translate text C.

Action Plan

Any action plan to reduce industrial pollution will need to be tailored toward specific pollutants to work well and not pose undue risks on either the economy or the environment. A slightly generalized plan based on the different kinds of solutions available can be proposed for the different pollutants:

Reduction of Pollution. Toxic metals should have a restriction on maximum environmental release based on relative toxicity levels and accumulation rates in ecosystems. If it is inevitable that heavy metals will be released in waste, treatment is necessary before the waste is to be released into the environment. In a series of steps, electrolysis should be used to reduce precious metals (Cu, Ag), which can then be refined and sold. Then, biological processing with the appropriate microbes should be used to reduce toxicity of very reactive ions (Hg, Cd, Mn). Last, the waste solution should be made slightly alkaline to precipitate as much metal hydroxides as possible before release into the environment.

Toxic organic compound emissions that are not pesticide applications should be reduced by setting a fixed standard of emissions and ecotoxicity in a cap-and-trade system which can gradually be lowered. Ideally, this would eventually lead to zero emissions, as most organic compounds can be degraded by microbes and thus treated effectively. If compounds are found to be excessively toxic, a blanket ban should be introduced. *Agrochemicals* should be subject to a taxation system in which the ecotoxicity of the compound determines the levy. However, some dangerous pesticides such as atrazine should be incorporated in a cap-and-trade system of dangerous agrochemicals that would gradually be lowered to allow time for transition to less dangerous chemicals. Again, excessively toxic compounds will need to be removed from the market by a blanket ban.

Detoxification and Recolonization. Research is necessary for more advanced treatment plans, systems of production that do not use polluting agents and remediation technology. Research should be influenced by key concepts such as integration of ecosystems and biomimicry.

Strongly polluted sites should be cleaned up through programs such as the U.S. Superfund, though bioremediation and in-site cleanup should

be the preferential treatment options. *Physical and chemical reductions to bioavailability* will need to be secured additionally, preferably by an irreversible degradation, so that pollutants cannot be released again.

Ex. 8. Pay attention to the facts to be able to answer the following questions.

1. What is the purpose of the action plan? 2. What treatment of waste is necessary if it is inevitable that heavy metals will be released? 3. When should a fixed standard of emissions and ecotoxicity be set? 4. When is a blanket ban introduced? 5. What is bioremediation? 6. What is research necessary to conduct for to reduce industrial pollution?

Ex. 9. Find synonyms in the following list of the words.

Research; treatment; secure; remediation; influence; notion; levy; decrease; abundantly; incorporate; refine; precious; difficulty; impair; deteriorate; excessively; reduction; valuable; investigation; provide; lower; tax; concept; obstacle; processing; affect; introduce; purify.

Ex. 10. Translate the sentences into English.

1. Восстановление колоний зависит от возможностей организмов заполнить те части экосистемы, которые были разрушены. 2. Биом – это крупное, встречающееся в природе сообщество животного и растительного мира в естественной среде. 3. Снижение потребления в целом или потребления загрязняющих товаров – это возможность уменьшить загрязнение окружающей среды. 4. На исследование должны оказывать влияние ключевые понятия, такие как интеграция (объединение) экосистем и биомимикрия. 5. Токсичные металлы должны иметь ограничения на выброс в окружающую среду, в зависимости от уровня их токсичности и скорости накопления в окружающей среде. 6. Эти исследования необходимы для окончательного перехода к сельскому хозяйству, которое не загрязняет окружающую среду. 7. Агрохимикаты должны облагаться налогом, где степень токсичности определяет величину налога. 8. Многие малые организмы, необходимые для экосистемы, не могут перемещаться самостоятельно, и зависят от ветра, дождя и т. п.

Ex. 11. Speak on the topic “Approaches to Reducing Pollution”.

Part 6
ENVIRONMENTAL PROTECTION

6.1. ENVIRONMENTAL POLLUTION

Ex. 1. Read and memorize the following pollutants, substances and diseases they cause, that are described in the units below.

Pollutants (загрязняющие вещества / загрязнители): carbon dioxide emissions – выбросы диоксида углерода; chlorofluorocarbon (CFCs) – хлорфторуглероды; dense non-aqueous phase liquids (DNAPLs) – жидкости плотной неводной фазы; dichloro diphenyl trichloroethane (DDT) / organochlorine insecticide – дихлордифенилтрихлорэтан / хлорорганический инсектицид; diesel exhaust (DE) – дизельный выхлоп; Environmental Persistent Pharmaceutical Pollutants (EPPP) – экологически стойкие фармацевтические загрязнители; non-methane volatile organic compounds (NMVOCs) – несодержащие метан летучие органические соединения; persistent organic pollutants (POP) – стойкие органические загрязнители; point source pollution (PS) – точечный источник загрязнения; polychlorinated biphenyl (PCB) – полихлорированный бифенил; total suspended solids (TSS) – общее содержание взвешенных твердых частиц; volatile organic compounds (VOCs) – летучие органические соединения.

Substances (примеси): ammonia (NH_3) – аммиак; carbon dioxide (CO_2) – углекислый газ, углекислота; carbon monoxide (CO) – окись углерода, угарный газ; chlorinated hydrocarbons – хлорсодержащий углеводород; petroleum hydrocarbons – нефтяные углеводороды; methane (CH_4) – метан; naphthalene ($C_{10}H_8$) – нафталин; nitrogen dioxide (NO_2) – двуокись азота; polychlorinated biphenyl – полихлорированный бифенил; polycyclic aromatic hydrocarbons – полициклические ароматические углеводороды; sulfur compounds – сернистые соединения; sulphur dioxide (SO_2) – диоксид серы (сернистый газ); trichloroethylene – трихлорэтилен.

Polynuclear aromatic hydrocarbons (полициклические ароматические углеводороды): anthracene – антрацен; benzo(a)anthracene – бензоантрацен; benzo(a)pyrene – бензопирен; benzo(b)fluoranthene – бензофлуорантен; benzo(k)fluoranthene – бензофлуорантен; indeno(cd)pyrene – инденопирен; phenanthrene – фенантрен.

Microorganisms found in surface waters (микроорганизмы, найденные в поверхностных водах): viruses that cause human diseases (вирусы, вызывающие заболевания человека): Burkholderia pseudomallei – патогенная грамотрицательная подвижная палочковидная бактерия рода Burkholderia; Coliform – кишечная палочка; Cryptosporidium parvum – криптоспоридия парвум; Giardia lamblia – лямблия; Novovirus – нововирус; Parasitic worms (helminths) – паразитические черви (гельминты); Salmonella – сальмонелла.

Diseases (заболевания): birth defects – врожденный порок, дефект, порок развития; death by exposure via direct contact – смерть от воздействия через прямой контакт; depression of the central nervous system – поражение центральной нервной системы; eye irritation – раздражение глаз; fatigue – усталость, утомление, апатия; headache – головная боль; heart or lung disorders – расстройство работы сердца или легких; inhalation – аспирация; kidney changes – изменения в почках; leukemia – лейкоз, лейкемия, белокровие; liver changes – изменения печени; lung cancer – рак легких; nausea – тошнота; neurologic symptoms – неврологические симптомы; neuromuscular blockage – нервно-мышечная блокада; skin rash – высыпание на коже; to develop cancer – заболевать раком.

Respiratory diseases (заболевания дыхательных путей): cardiovascular disease (affected by high blood pressure) – сердечно-сосудистое заболевание, протекающее с высоким артериальным давлением; chest pain – боль в груди; congestion (syn. flushing, hyperemia) – прилив крови, гиперемия; pulmonary congestion – легочная гиперемия; throat inflammation – воспаление горла.

Ex. 2. Read and memorize the following words of this unit.

Absorptive capacity – поглощающая способность; acidity of ocean waters – кислотность океана; adverse air quality – негативные качества воздуха; biodegradable – разлагаемый микроорганизмами (о пластмассах), портящийся под действием микроорганизмов; chemicals – химикалии, химикаты; contamination – загрязнение, заражение; degradation products (DP) – продукты распада; diluted – разбавленный, разжиженный; discharge of wastewater – сброс сточных вод; domestic sewage – бытовые сточные воды; electrostatic precipitator (ESP) – электростатический фильтр / осадитель; emission source – источник загрязнения (воздуха); eutrophication – эвтрофикация (зарастание водоема); pollutants – загрязняющие вещества; human amenities – удобства для человека; inappropriate

objects – неподходящие объекты; infertile soil – бесплодные почвы; Integrated Pest Management (IPM) techniques – методы комплексной борьбы с сельскохозяйственными вредителями; invasive species – инвазивные (захватнические) виды; littering / roadside litter – замусоривание / мусор на обочинах дороги; marine ecosystem – морская экосистема; ongoing decrease – продолжающееся снижение; particular contaminant – редкое, конкретное загрязняющее вещество; pollutants – загрязняющие вещества; pollution – загрязнение; public and private properties – государственная и частная собственность; relevant to – относящийся к; surface runoff – поверхностный сток; to alter soil – (видо)изменять почву; to reduce biodiversity – снижать разнообразие биологических видов; to release particulates – выбрасывать твердые частицы / взвесь; trespass – злоупотребление; turbidity (cloudiness) – мутность; xenobiotics – ксенобиотики.

Ex. 3. Find synonyms to the words in the list below.

To affect; contamination; types; water; damage; capacity; control; primary treatment; aqua; monitoring; property; the first time harm; treatment; kinds; to influence / to cause effect; pollution.

Ex. 4. Match the words, which can be both a noun and a verb, to their Russian equivalents.

Cause; discharge; list; subject; litter.

Причина; мусорить; подвергать; перечислять; освобождать / разряжать.

Ex. 5. Match verbs to their nouns and give their Russian equivalents.

To pollute; ozone; effect; pollution; to subject; to affect; to ozonize; object.

Ex. 6. Read and translate text A.

Forms of Pollution

The major forms of pollution are listed below along with the particular contaminant relevant to each of them.

Air pollution means the release of chemicals and particulates into the atmosphere. Common gaseous pollutants include carbon monoxide, sulfur dioxide, chlorofluorocarbons (CFCs) and nitrogen oxides produced by industry and motor vehicles. Photochemical ozone and smog are created as nitrogen oxides and hydrocarbons react to sunlight.

Soil contamination occurs when chemicals are released by spill or underground leakage. Among the most significant soil contaminants

are hydrocarbons, heavy metals, herbicides, pesticides and chlorinated hydrocarbons.

Water pollution, by the discharge of wastewater from commercial and industrial waste (intentionally or through spills) into surface waters; discharges of untreated domestic sewage, and chemical contaminants, such as chlorine, from treated sewage; release of waste and contaminants into surface runoff flowing to surface waters (including urban runoff and agricultural runoff, which may contain chemical fertilizers and pesticides); waste disposal and leaching into groundwater; eutrophication and littering.

Thermal pollution is a temperature change in natural water bodies caused by human influence, such as use of water as coolant in a power plant.

Light pollution includes light trespass, over-illumination and astronomical interference. Littering means the criminal throwing of inappropriate man-made objects, unremoved, onto public and private properties.

Noise pollution includes encompasses roadway noise, aircraft noise, industrial noise as well as high-intensity sonar.

Visual pollution, which can refer to the presence of overhead power lines, motorway billboards, scarred landforms (as from strip mining), open storage of trash, municipal solid waste or space debris.

Radioactive contamination, resulting from 20th century activities in atomic physics, such as nuclear power generation and nuclear weapons research, manufacture and deployment.

Ex. 7. Work in pares with the cards "Pollutants" to make up dialogues.

I. A pollutant is substance or energy introduced into the environment that has undesired effects, or adversely affects the usefulness of a resource. A pollutant may cause long- or short-term damage by changing the growth rate of plant or animal species, or by interfering with human amenities, comfort, health, or property values. Some pollutants are biodegradable and therefore will not persist in the environment in the long term. A pollutant is a waste material that pollutes air, water or soil. Three factors determine the severity of a pollutant: its chemical nature, the concentration and the persistence. There are different types of pollutants by absorptive capacity.

II. *Stock Pollutants*. Pollutants that the environment has little or no absorptive capacity are called stock pollutants (e.g. persistent synthetic chemicals, non-biodegradable plastics, and heavy metals). Stock pollutants accumulate in the environment over time. The damage they cause

increases as more pollutant is emitted, and persists as the pollutant accumulates. Stock pollutants can create a burden for future generations by passing on damage that persists well after the benefits received from incurring that damage have been forgotten.

III. *Fund Pollutants*. Fund pollutants are those for which the environment has some absorptive capacity. Fund pollutants do not cause damage to the environment unless the emission rate exceeds the receiving environment's absorptive capacity (e.g. carbon dioxide, which is absorbed by plants and oceans). Fund pollutants are not destroyed, but rather converted into less harmful substances, or diluted / dispersed to non-harmful concentrations. Notable pollutants include the following groups: heavy metals, persistent organic pollutants, environmental persistent pharmaceutical pollutants, polycyclic aromatic hydrocarbons, volatile organic compounds, and environmental xenobiotics.

IV. *Zones of Influence*. Pollutants can also be defined by their zones of influence, both horizontally and vertically. The horizontal zone refers to the area that is damaged by a pollutant. Local pollutants cause damage near the emission source. Regional pollutants cause damage further from the emission source. The vertical zone is referred to whether the damage is ground-level or atmospheric. Surface pollutants cause damage by concentrations of the pollutant accumulating near the Earth's surface Global pollutants cause damage by concentrations in the atmosphere.

Ex. 8. Read and translate text B. Match pollution causes to their health effects according to it.

Causes:	*Effects:*
1) air pollution;	a) skin irritations and rashes;
2) chemical and radioactive substances;	b) hearing loss, high blood pressure, and sleep disturbance;
3) lead and other heavy metals;	c) neurologic symptom;
4) mercury;	d) lung disorders and heart diseases;
5) noise pollution;	e) neurological problems;
6) oil spills.	f) cancer and birth defects.

Environmental Pollution Effects

Effects on Human Health. Adverse air quality can kill many organisms including humans. Ozone pollution can cause respiratory disease, cardiovascular disease, throat inflammation, chest pain, and

congestion. Water pollution causes approximately 14,000 deaths per day, mostly due to contamination of drinking water by untreated sewage in developing countries. An estimated 700 million Indians have no access to a proper toilet, and 1,000 Indian children die of diarrhea every day. Nearly 500 million Chinese lack access to safe drinking water. 656,000 people die prematurely each year in China because of air pollution. In India, air pollution is believed to cause 527,700 fatalities a year. Studies have estimated that the number of people killed annually in the UK could be over 50,000.

Oil spills can cause skin irritations and rashes. Noise pollution induces hearing loss, high blood pressure, stress, and sleep disturbance. Mercury has been linked to developmental deficits in children and neurologic symptoms. Older people are majorly exposed to diseases induced by air pollution. Those with heart or lung disorders are under additional risk. Children and infants are also at serious risk. Lead and other heavy metals have been shown to cause neurological problems. Chemical and radioactive substances can cause cancer and as well as birth defects.

Effects on Environment. Pollution has been found to be present widely in the environment. There are a number of effects of this. Carbon dioxide emissions cause ocean acidification, the ongoing decrease in the pH of the Earth's oceans as CO_2 becomes dissolved. The emission of greenhouse gases leads to global warming which affects ecosystems in many ways. Invasive species can out compete native species and reduce biodiversity. Invasive plants can contribute debris and biomolecules (allelopathy) that can alter soil and chemical compositions of an environment, often reducing native species competitiveness. Nitrogen oxides are removed from the air by rain and fertilise land which can change the species composition of ecosystems. Smog and haze can reduce the amount of sunlight received by plants to carry out photosynthesis and leads to the production of tropospheric ozone which damages plants. Soil can become infertile and unsuitable for plants. Sulfur dioxide and nitrogen oxides can cause acid rain which lowers the pH value of soil.

Greenhouse Gases and Global Warming. Carbon dioxide, while vital for photosynthesis, is sometimes referred to as pollution, because raised levels of the gas in the atmosphere are affecting the Earth's climate. Disruption of the environment can also highlight the connection between areas of pollution that would normally be classified separately, such as those of water and air. Recent studies have investigated the potential for long-term rising levels of atmospheric carbon dioxide to

cause slight but critical increases in the acidity of ocean waters, and the possible effects of this on marine ecosystems.

Ex. 9. Read and translate the text C. Say what practice of pollution control is the most effective to your point of view.

Regulation and Monitoring of Pollution

Pollution control is a term used in environmental management. It means the control of emissions and effluents into air, water or soil. Without pollution control, the waste products from consumption, heating, agriculture, mining, manufacturing, transportation and other human activities, whether they accumulate or disperse, will degrade the environment. In the hierarchy of controls, pollution prevention and waste minimization are more desirable than pollution control. In the field of land development, low impact development is a similar technique for the prevention of urban runoff.

Pollution control practices recycling, reusing, reducing, mitigating, preventing, compost. Its devices are dust collection systems (baghouses, cyclones, electrostatic precipitators), scrubbers (baffle spray scrubber, cyclonic spray scrubber, venturi scrubber, mechanically aided scrubber, spray tower, wet scrubber), sewage treatment (sedimentation (primary treatment), activated sludge biotreaters (secondary treatment; also used for industrial wastewater), aerated lagoons, constructed wetlands (also used for urban runoff)), and industrial wastewater treatment (oil-water separators, biofilters, dissolved air flotation).

To protect the environment from the adverse effects of pollution, many nations worldwide have enacted legislation to regulate various types of pollution as well as to mitigate the adverse effects of pollution. Pollutants can cross international borders and therefore international regulations are needed for their control.

The Stockholm Convention on Persistent Organic Pollutants (2004) is an international legally binding agreement for the control of persistent organic pollutants.

Pollutant Release and Transfer Registers (PRTR) are systems to collect and disseminate information on environmental releases and transfers of toxic chemicals from industrial and other facilities.

The European Pollutant Emission Register is a type of PRTR providing access to information on the annual emissions of industrial facilities in the Member States of the European Union, as well as Norway.

The Resource Conservation and Recovery Act (RCRA) regulates the management, transport and disposal of municipal solid waste, hazardous waste and underground storage tanks.

Ex. 10. Answer the following questions.

1. What types of pollutants by absorptive capacity do you know? 2. What is the main difference between light and noise pollution? 3. How many factors determine the severity of a pollutant? 4. Persistent synthetic chemicals, non-biodegradable plastics, and heavy metals are known to be stock pollutants, aren't they? 5. For which pollutants the environment has some absorptive capacity?

Ex. 11. Math sentences below with their Russian equivalents.

1. *Venturi scrubber* is a device for cleaning gases from impurities. Its operation is based on the crushing of water by a turbulent gas flow, the capture of dust particles by water droplets, the coagulation of these particles with subsequent precipitation in an inertial type drop catcher.

2. *Baffle spray scrubber* is a technology for air pollution control. They are very similar to spray towers in design and operation. However, in addition to using the energy provided by the spray nozzles, baffles are added to allow the gas stream to atomize some liquid as it passes over them.

3. A *baghouse*, also known as a fabric filter is an air pollution control device and dust collector that removes particulates or gas released from commercial processes out of the air.

4. *Persistent organic pollutants* (POPs), sometimes known as "forever chemicals" are organic compounds that are resistant

A. Рукавный фильтр, также известный как тканевый фильтр, представляет собой устройство для контроля загрязнения воздуха и пылеуловитель, который удаляет из воздуха твердые частицы или газ, выделяющиеся в результате коммерческих процессов.

B. Стойкие органические загрязнители (СОЗ), также известные как «вечные химикаты», представляют собой органические соединения, устойчивые к деградации окружающей среды в результате химических и биологических процессов.

C. Флотация растворенного воздуха – это процесс очистки воды (сточной и пр.) путем удаления взвешенных веществ, таких как нефть или твердые частицы. Удаление достигается растворением воздуха в воде под давлением.

D. Скруббер Вентури – устройство для очистки газов от примесей. Работа его основана на дроблении воды турбулентным

to environmental degradation through chemical, and biological processes.

5. *Dissolved air flotation* (DAF) is a water treatment process that clarifies wastewaters (or other waters) by the removal of suspended matter such as oil or solids. The removal is achieved by dissolving air in the water under pressure.

потоком газа, захвате каплями воды частиц пыли, коагуляции этих частиц с последующим осаждением в каплеуловителе инерционного типа.

Е. Дефлекторный распылительный скруббер – это технология борьбы с загрязнением воздуха. Они очень похожи на распылительные башни по конструкции и эксплуатации. Однако в дополнение к использованию энергии, обеспечиваемой распылительными форсунками, добавляются дефлекторы, позволяющие потоку газа распылять некоторую жидкость, когда он проходит над ними.

Ex. 12. Speak on the topic "Environmental Pollution".

6.2. AIR POLLUTION

Ex. 1. Read and memorize the following words.

Abatement – борьба; acid rain – кислотный дождь; acidification – окисление; ambient air – температура воздуха; animal tissue – животная ткань; anthropogenic pollutants – антропогенные загрязнители; anthropogenic sources – антропогенные источники; asphyxiant – удушающий газ; attainment – достижение; averaged – усредненный; basement – подвал; biting odor – едкий запах; blower – вентилятор; carcinogens – канцерогены; caustic – каустик; chlorofluorocarbons – хлорфторуглероды; controlled fire – управление огнем; conversion to cleaner fuels – преобразование в экологически чистые виды топлива; crop waste – отходы земледелия; displacement – перемещение; disposable – одноразовый; dung – навоз; duration of activity – продолжительность деятельности; electrostatic precipitators – электрофильтры; enhanced – расширенный; flammable – горючее, воспламенимый; flue gas – дымовой газ; fossil fuel – ископаемое топливо; fume – дым;

furnaces – печи; germination – прорастание; greenhouse effect – парниковый эффект; hazardous – опасный; haze – дымка; health hazard – опасность для здоровья; heavy dust loads – тяжелый мусор; landfills – свалки; liquid droplets – капли жидкости; multicyclones – мультициклоны; natural sources – природные источники; noble gas – благородный газ; nuclear explosions – ядерные взрывы; nutritional needs of terrestrial organisms – пищевые потребности живых организмов; ozone depletion – истощение озонового слоя; persistent free radicals – устойчивые свободные радикалы; photochemical smog – фотохимический смог; photolytic process – фотолитический процесс (процесс разрушения под воздействием светового излучения); plume downwind of cities – шлейф с подветренной стороны города; portmanteau – производное; prairie restoration – восстановление прерий; precursor to foodstuffs – предшественник пищевых продуктов; primary pollutants release – выброс загрязняющих веществ; prolonged exposure – длительное воздействие; prominent pollutants – видимые загрязняющие вещества; pungent odor – резкий запах; radioactive decay of radon – радиоактивный распад радона; schematic drawing – чертеж; smoke stacks of power plants – дымовые трубы электростанций; stationary sources – стационарные источники; suffocation – удушье; sulphur dioxide – двуокись серы (сернистый газ); synthesis of pharmaceuticals – синтез лекарственных средств; tiny particles of solid – крошечные частицы твердого вещества; to bioaccumulate – накапливать биологически; to biomagnify in food chains – усиливаться биологически в пищевых цепях; to burn fuel – сжигать топливо; to persist in – существовать в; to remove a pollutant – удалять загрязняющее вещество; toluene – толуол; UV radiation – ультрафиолетовое излучение; vehicular and industrial emissions – автомобильные и промышленные выбросы; vehicular exhaust – автомобильный выхлоп; volatile organic compounds – летучие органические соединения; waste incinerators – установки для сжигания отходов; xylene – ксилол.

Ex. 2. Match substances to their chemical formulas.

Ammonia; carbon monoxide; carbon dioxide; methane; nitrogen dioxide; sulphur dioxide; CH_4; CO; CO_2; NH_3; NO_2; SO_2.

Ex. 3. Compose word combinations matching the words in rows.

Coal; sprays; deposition; contamination; schematic; impact; ocean; wet.

Burning; aerosol; waste; particulate; drawing; environmental; acidification; scrubber.

Ex. 4. Match adjectives to their nouns and give their Russian equivalents.

Responsible; sulfuric; hazardous; gaseous; asphyxiant; response; sulfur; hazard; gas; asphyxia.

Ex. 5. Read and translate text A. Analyse sources of air pollution that refer to the various locations, activities or factors which are responsible for the releasing of pollutants into the atmosphere. Explain the difference between their two major categories presented below.

Anthropogenic Sources of Air Pollution

Anthropogenic (or man-made) sources of air pollution *related to burning different kinds of fuel* include stationary sources (smoke stacks of power plants, manufacturing facilities or factories, waste incinerators, furnaces, and other types of fuel-burning heating devices), mobile sources (motor vehicles, marine vessels, aircraft, and the effect of sound), and chemical products of controlled / prescribed combustion in agriculture, forest management, farming, prairie restoration, and greenhouse gas abatement. It should be mentioned that controlled burning stimulates the germination of some desirable forest trees, thus renewing the forest.

Anthropogenic (or man-made) Sources of Air Pollution *related to processes other than combustion* include fumes (from paint, hair spray, varnish, aerosol sprays and other solvents), waste deposition (in landfills, which generate methane). It should be mentioned that methane, being non-toxic, is a suffocating gas and can displace oxygen in a confined space, is highly flammable and can form explosive mixtures with air. Asphyxia or suffocation may result if the oxygen concentration is reduced to below 19.5 per cent by displacement.

Natural Sources of Air Pollution

Natural sources are related to dust from natural sources, usually large areas of land with little or no vegetation. They include methane (emitted by the digestion of food by animals), radon (from radioactive decay within the Earth's crust), smoke and carbon monoxide (from wildfires), vegetation (emitting environmentally significant amounts of volatile organic compounds (VOCs) on warmer days), volcanic activity (producing sulfur, chlorine, and ash particulates).

It is important to understand that radon is a colorless, odorless, naturally occurring, radioactive noble gas that is formed from the decay of radium. Radon gas, a health hazard, from natural sources can accumulate in buildings and it is the second most frequent cause of lung cancer, after cigarette smoking.

What concerns VOCs, they react with primary anthropogenic pollutants – specifically, NO_2, SO_2, and anthropogenic organic carbon compounds – to produce a seasonal haze of secondary pollutants.

Ex. 6 Read and translate the text B. Match air pollution causes to their effects according to it.

Causes:	*Effects:*
1) emission from products currently banned from use;	a) discomfort, disease, or death to humans, damage other living organisms such as food crops, or damage the natural environment or built environment;
2) vehicular and industrial emissions that are acted on in the atmosphere by ultraviolet light from the sun to form secondary pollutants that also combine with the primary emissions;	b) greenhouse effect, particulate contamination, acid rain, increased ground level ozone concentration, increased levels of nitrogen oxides;
3) introduction into the atmosphere of chemicals;	c) acid rain;
4) oxidation of sulphur dioxide in the presence of a catalyst;	d) smoke and fog;
5) large amounts of coal burning in an area caused by a mixture of smoke and sulfur dioxide;	e) photochemical smog;
6) schematic drawing.	f) chlorofluorocarbons.

Air Pollutants

Air pollution is the introduction into the atmosphere of chemicals, particulates, or biological materials that cause discomfort, disease, or death to humans, damage other living organisms such as food crops, or damage the natural environment or built environment. The atmosphere is a complex dynamic natural gaseous system that is essential to support life on planet Earth. Stratospheric ozone depletion due to air pollution has long been recognized as a threat to human health as well as to the Earth's ecosystem. Schematic drawing, causes and effects of air pollution are greenhouse effect, particulate contamination, increased

UV radiation, acid rain, increased ground level ozone concentration, increased levels of nitrogen oxides.

A substance in the air that can be harmful to humans and the environment is known as an air pollutant. Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made. Pollutants can be classified as primary or secondary. Usually, primary pollutants are directly emitted from a process, such as ash from a volcanic eruption, the carbon monoxide gas from a motor vehicle exhaust or sulphur dioxide released from factories. Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. An important example of a secondary pollutant is ground level ozone – one of the many secondary pollutants that make up photochemical smog. Some pollutants may be both primary and secondary: that is, they are both emitted directly and formed from other primary pollutants.

Primary Air Pollutants. Major primary pollutants produced by human activity include the following substances. *Sulfur oxides* (SO_x) – especially sulphur dioxide, a chemical compound with the formula SO_2. SO_2 is produced by volcanoes and in various industrial processes. Since coal and petroleum often contain sulfur compounds, their combustion generates sulfur dioxide. Further oxidation of SO_2, usually in the presence of a catalyst such as NO_2, forms H_2SO_4, and thus acid rain. This is one of the causes for concern over the environmental impact of the use of these fuels as power sources. *Nitrogen oxides* (NO_x), especially nitrogen dioxide, are emitted from high temperature combustion, and are also produced naturally during thunderstorms by electric discharge. They can be seen as the brown haze dome above or plume downwind of cities. Nitrogen dioxide is the chemical compound with the formula NO_2. It is one of the several nitrogen oxides. This reddish-brown toxic gas has a characteristic sharp, biting odor. NO_2 is one of the most prominent air pollutants. *Carbon monoxide* (CO) is a colorless, odorless, non-irritating but very poisonous gas. It is produced by incomplete combustion of fuel such as natural gas, coal or wood. Vehicular exhaust is a major source of carbon monoxide. *Carbon dioxide* (CO_2) – a colorless, odorless, non-toxic greenhouse gas also associated with ocean acidification, emitted from sources such as combustion, cement production, and respiration. It is otherwise recycled in the atmosphere in the carbon cycle. *Volatile organic compounds* (VOCs) are an important outdoor air pollutant. Methane is an extremely efficient

greenhouse gas which contributes to enhance global warming. Other hydrocarbon VOCs are also significant greenhouse gases via their role in creating ozone and in prolonging the life of methane in the atmosphere, although the effect varies depending on local air quality. Within the NMVOCs, the aromatic compounds benzene, toluene and xylene are suspected carcinogens and may lead to leukemia through prolonged exposure, 1,3-butadiene is another dangerous compound which is often associated with industrial uses. *Particulates*, alternatively referred to as particulate matter (PM), atmospheric particulate matter, or fine particles, are tiny particles of solid or liquid suspended in a gas. In contrast, aerosol refers to particles and the gas together. Sources of particulates can be man-made or natural. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols. Averaged over the globe, anthropogenic aerosols – those made by human activities – currently account for about 10 per cent of the total amount of aerosols in our atmosphere. Increased levels of fine particles in the air are linked to health hazards such as heart disease, altered lung function and lung cancer. *Persistent free radicals* connected to airborne fine particles could cause cardiopulmonary disease. *Toxic metals*, such as lead, cadmium, and copper are harmful. *Chlorofluorocarbons* (CFCs) are harmful to the ozone layer emitted from products currently banned from use. *Ammonia,* a compound with the formula NH_3, is emitted from agricultural processes. It is normally encountered as a gas with a characteristic pungent odor. Ammonia contributes significantly to the nutritional needs of terrestrial organisms by serving as a precursor to foodstuffs and fertilizers. Ammonia, either directly or indirectly, is also a building block for the synthesis of many pharmaceuticals. Although in wide use, ammonia is both caustic and hazardous. *Radioactive pollutants* are produced by nuclear explosions, nuclear events, war explosives, and natural processes such as the radioactive decay of radon.

Secondary Air Pollutants. Secondary pollutants include the following substances. *Particulates* created from gaseous primary pollutants and compounds in photochemical smog. Smog is a kind of air pollution; the word “smog” is a portmanteau of smoke and fog. Classic smog results from large amounts of coal burning in an area caused by a mixture of smoke and sulfur dioxide. Modern smog does not usually

come from coal but from vehicular and industrial emissions that are acted on in the atmosphere by ultraviolet light from the sun to form secondary pollutants that also combine with the primary emissions to form photochemical smog.

Minor Air Pollutants. Minor air pollutants include the following substances. A large number of *minor hazardous air pollutants*. A variety of *persistent organic pollutants* can attach to particulates. *Persistent organic pollutants* (POPs) are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes. Because of this, they have been observed to persist in the environment, to be capable of long-range transport, bioaccumulate in human and animal tissue, biomagnify in food chains, and to have potential significant impacts on human health and the environment.

Ex. 7. Work in pares with the cards "Health Effects" to make up dialogues.

I. Air pollution is a significant risk factor for multiple health conditions including respiratory infections, heart disease, and lung cancer. The health effects caused by air pollution may include difficulty in breathing, wheezing, coughing and aggravation of existing respiratory and cardiac conditions. These effects can result in increased medication use, increased doctor or emergency room visits, more hospital admissions and premature death.

II. The human health effects of poor air quality are far reaching, but principally affect the body's respiratory system and the cardiovascular system. Individual reactions to air pollutants depend on the type of pollutant a person is exposed to, the degree of exposure, the individual's health status and genetics.

III. The most common sources of air pollution include particulates, ozone, nitrogen dioxide, and sulfur dioxide. Both indoor and outdoor air pollution have caused approximately 3.3 million deaths worldwide. Children aged less than five years that live in developing countries are the most vulnerable population in terms of total deaths attributable to indoor and outdoor air pollution.

IV. The World Health Organization states that 2.4 million people die each year from causes directly attributable to air pollution, with 1.5 million of these deaths attributable to indoor air pollution. A study by the University of Birmingham has shown a strong correlation between pneumonia related deaths and air pollution from motor vehicles. Worldwide more deaths per year are linked to air pollution than to

automobile accidents. A 2019 study by the European Commission calculated that air pollution reduces life expectancy by an average of almost nine months across the European Union. Causes of deaths include aggravated asthma, emphysema, lung and heart diseases, and respiratory allergies.

V. The number of annual premature deaths is considerably higher than the fatalities related to auto collisions in the same area, which average fewer than 2,000 per year. Diesel exhaust (DE) is a major contributor to combustion derived particulate matter air pollution. In several human experimental studies, using a well validated exposure chamber setup, DE has been linked to acute vascular dysfunction and increased thrombus formation.

Ex. 8. Read and translate the text C. Say what factors are the most harmful to your point of view.

Monitoring Air Pollution

Air Pollutant Emission Factors. Air pollutant emission factors are representative values that people attempt to relate the quantity of a pollutant released to the ambient air with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kilograms of particulate emitted per ton of coal burned). Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages.

Air Pollution Reduction Efforts. There are various air pollution control technologies and land use planning strategies available to reduce air pollution. At its most basic level land use planning is likely to involve zoning and transport infrastructure planning. In most developed countries, land use planning is an important part of social policy, ensuring that land is used efficiently for the benefit of the wider economy and population as well as to protect the environment. Efforts to reduce pollution from mobile sources includes primary regulation (many developing countries have permissive regulations), expanding regulation to new sources (such as transport ships, farm equipment, and small gas-powered equipment such as lawn trimmers, chainsaws, and snowmobiles), increased fuel efficiency (such as through the use of hybrid

vehicles), conversion to cleaner fuels (such as bioethanol, biodiesel, or conversion to electric vehicles).

Air Pollution Control Devices. The following items are commonly used as pollution control devices by industry or transportation devices. They can either destroy contaminants or remove them from an exhaust stream before it is emitted into the atmosphere.

1. Particulate control

Mechanical collectors. The most common are dust cyclones and multicyclones. *Electrostatic precipitators*. An electrostatic precipitator (ESP), or electrostatic air cleaner is a particulate collection device that removes particles from a flowing gas (such as air) using the force of an induced electrostatic charge. Electrostatic precipitators are highly efficient filtration devices that minimally impede the flow of gases through the device, and can easily remove fine particulates such as dust and smoke from the air stream. *Bag houses*. Designed to handle heavy dust loads, a dust collector consists of a blower, dust filter, a filter-cleaning system, and a dust receptacle or dust removal system (distinguished from air cleaners which utilize disposable filters to remove the dust). *Particulate scrubbers*. Wet scrubber is a form of pollution control technology. The term describes a variety of devices that use pollutants from a furnace flue gas or from other gas streams. In a wet scrubber, the polluted gas stream is brought into contact with the scrubbing liquid, by spraying it with the liquid, by forcing it through a pool of liquid, or by some other contact method, so as to remove the pollutants.

2. Legal regulation

In general, there are two types of air quality standards. The first class of standards, like the E.U. Air Quality Directive, sets maximum atmospheric concentrations for specific pollutants. Environmental agencies enact regulations which are intended to result in attainment of these target levels. The second class, like The North American Air Quality Index, is used to communicate to the public the relative risk of outdoor activity. The scale may or may not distinguish between different pollutants.

Ex. 9. Answer the following questions.

1. What are air pollutant emission factors representative to? 2. What activity is the release of air pollutant associated with? 3. The weight of pollutant divided by a unit weight, speed, distance, or duration of the activity emitting the pollutant are regarded as air pollutant emission factors. What factor of this list is false? 4. Which class of air

quality standards is used to communicate to the public the relative risk of outdoor activity? 5. Why has stratospheric ozone depletion been recognized as a threat to human health?

Ex. 10. Speak on the topic "Air Pollution".

6.3. SOIL CONTAMINATION

Ex. 1. Read and memorize the following words.

Arsenic – мышьяк; arthropods resident – членистоногие; auxins – ауксины; avian consumers – потребители птицы; to biodegrade – разлагать биологически; bioremediation – биологическое восстановление; biosolids – твердые вещества биологического происхождения; biostimulation – биостимуляция; capping – укупоривание; carcinogenic – канцерогенный; hazardous waste – опасные отходы; chick mortality – детская смертность; chlorinated solvents – хлорированные растворители; chronic exposure – хроническое облучение; coal ash – угольная зола; coal slag bubbly – угольный пенящийся шлак; contaminated surface water – загрязненные поверхностные воды; deleterious consequences – пагубные последствия; disposal site – захоронения; drainage – дренаж, канализация; dredging of bay muds – дноуглубительные работы в заливных грязях; electrical resistance heating – электрические нагревательные сопротивления; endemic microorganism – эндемичный микроорганизм; environmental remediation (clean up) – восстановление окружающей среды, очистка; extinction of species – вымирание видов; extractable lead – извлекаемый свинец; food chain – пищевая цепочка; gray heterogeneous soil – серая однородная почва; incidence – сфера, наклон; infiltration – инфильтрация; ingestion of contaminants – прием загрязняющих веществ; landfills – закапывание мусора; languishing crops – вялые зерновые культуры; leaching – выщелачивание; long half-lives – длительный период полураспада; mammals – млекопитающие; mapping – картография; microbial digestion – микробное переваривание; mollusk – моллюск; nematode (roundworm) – нематода (круглый червь); pavement – покрытие; persistent materials – стойкие материалы; pests – вредители; phytoremediation – фиторемедиации (комплекс методов очистки грунтов, сточных вод и атмосферного воздуха с использованием зеленых растений);

piping – трубопровод; pathogen – болезнетворный микроорганизм; potential extinction of species – потенциальное исчезновение разновидностей; predator – хищник; reduction in crop yields – снижение урожайности; soil contamination – загрязнение почвы; soil conservation – сохранение почвы; storage tanks – резервуары для хранения; to alter plant metabolism – изменить метаболизм растения; to be a vector for disease – быть вектором для болезни; to cause a nuisance – вызвать неприятность; to manifest in the alteration of metabolism – проявляться в изменении метаболизма; to shield soil from erosion – оградить почву от эрозии; to volatilize – испаряться; vesicular pebble-sized grains – везикулярное зерно размером с гальку; virtual eradication – фактическая ликвидация; weed – сорняк; white grains – белые зерна; weakening of egg shells – ослабление яичной скорлупы; willow – ива.

Ex. 2. Match the words combinations to their Russian equivalents.

Intensity of chemical usage; leaching from landfills; bay muds containing toxins; hazardous waste; microbial digestion of organic chemicals.

Ex. 3. Complete word combinations with the prepositions: *against, by, for, for, of, out of*.

Strategies … remediation, used … residential and industrial heating, application … fertilizers, caused … corrosion, to volatize chemical contaminants … the soil, used … any pest.

Ex. 4. Give Russian equivalents for the following terms.

Environmental remediation; phytoremediation; extinction of species; virtual eradication.

Ex. 5. Read and translate text A. Give your definition of soil contamination and say what strategies for environmental remediation are the most effective to your point of view.

Soil Contamination

Soil contamination or soil pollution is caused by the presence of xenobiotic (human-made) chemicals or other alteration in the natural soil environment. It is typically caused by industrial activity, agricultural chemicals, or improper disposal of waste. The most common chemicals involved are petroleum hydrocarbons, polynuclear aromatic hydrocarbons (such as naphthalene), solvents, pesticides, lead, and

other heavy metals. Contamination is correlated with the degree of industrialization and intensity of chemical usage.

The concern over soil contamination stems primarily from health risks, from direct contact with the contaminated soil, vapors from the contaminants, and from secondary contamination of water supplies within and underlying the soil. Mapping of contaminated soil sites and the resulting cleanup are time consuming and expensive tasks, requiring extensive amounts of geology, hydrology, chemistry, computer modeling skills, as well as an appreciation of the history of industrial chemistry.

Soil contamination can be caused by: 1) corrosion of underground storage tanks (including piping used to transmit the contents); 2) application of pesticides and fertilizers; mining; 3) oil and fuel dumping; 4) disposal of coal ash; 5) leaching from landfills; 6) direct discharge of industrial wastes to the soil; 7) drainage of contaminated surface water into the soil. The most common chemicals involved are petroleum hydrocarbons, solvents, pesticides, lead, and other heavy metals.

Clean up or environmental remediation is analyzed by environmental scientists who utilize field measurement of soil chemicals and also apply computer models for analyzing transport and fate of soil chemicals.

There are several principal strategies for remediation. 1. Excavate soil and take it to a disposal site away from ready pathways for human or sensitive ecosystem contact. This technique also applies to dredging of bay muds containing toxins. 2. Aeration of soils at the contaminated site (with attendant risk of creating air pollution). 3. Thermal remediation by introduction of heat to raise subsurface temperatures sufficiently high to volatize chemical contaminants out of the soil for vapour extraction. Technologies include electrical resistance heating (ERH). 4. Bioremediation, involving microbial digestion of certain organic chemicals. Techniques used in bioremediation include landfarming, biostimulation with commercially available microflora. 5. Extraction of groundwater or soil vapor with an active electromechanical system, with subsequent stripping of the contaminants from the extract. 6. Containment of the soil contaminants. 7. Phytoremediation, or using plants (such as willow) to extract heavy metals.

Ex. 6. Answer the following questions.

1. What can soil pollution be caused by? 2. Give the examples of the most common chemicals. 3. Who deals with the environmental

remediation? 4. How many strategies for remediation are there? 5. What technologies are used for cleaning up soil? 6. What do ecologists need for mapping of contaminated soil sites and the resulting cleanup?

Ex. 7. Read and translate the text "Soil Contamination Causes" and make up dialogues.

I. *Coal ash*. Historical deposition of coal ash used for residential, commercial, and industrial heating, as well as for industrial processes such as ore smelting, were a common source of contamination in areas that were industrialized. Coal naturally concentrates lead and zinc during its formation, as well as other heavy metals to a lesser degree. When the coal is burned, most of these metals become concentrated in the ash (the principal exception being mercury). Coal ash and slag may contain sufficient lead to qualify as a "characteristic hazardous waste" because they contain more than 5 mg/L of extractable lead.

II. In addition to lead, coal ash typically contains variable but significant concentrations of polynuclear aromatic hydrocarbons (PAHs) e.g., phenanthrene, anthracene, and etc. These PAHs are known human carcinogens and the acceptable concentrations of them in soil are typically around 1 mg/kg. Coal ash and slag can be recognized by the presence of off white grains in soil, gray heterogeneous soil, or (coal slag) bubbly, vesicular pebble-sized grains.

III. *Sewage*. Treated sewage sludge, known in the industry as biosolids, has become controversial as a fertilizer to the land. As it is the byproduct of sewage treatment, it generally contains more contaminants such as organisms, pesticides, and heavy metals than other soil.

IV. *Pesticides*. A pesticide is a substance or mixture of substances used to kill a pest. A pesticide may be a chemical substance, biological agent (such as a virus or bacteria), antimicrobial, disinfectant or device used against any pest. Pests include insects, plant pathogens, weeds, mollusks, birds, mammals, fish, nematodes (roundworms) and microbes that compete with humans for food, destroy property, spread or are a vector for disease or cause a nuisance. Although there are benefits to the use of pesticides, there are also drawbacks, such as potential toxicity to humans and other organisms.

V. *Herbicides* are used to kill weeds, especially on pavements and railways. They are similar to auxins and most are biodegrade by soil bacteria. Another herbicide is Paraquat. It is highly toxic but it rapidly degrades in soil due to the action of bacteria and does not kill soil fauna. Insecticides are used to rid farms of pests which damage crops.

The insects damage not only standing crops but also stored ones. And in the tropics it is reckoned that one third of the total production is lost during food storage. As with fungicides, the first insecticides used in the nineteenth century were inorganic, e.g. compounds of arsenic. Nicotine has also been used since the late eighteenth century

Ex. 8. Read and translate text B and match pollution causes to their effects according to it.

Causes:	*Effects:*
1) the concentration of persistent DDT materials for avian consumers;	a) chronic carcinogenic exposure, congenital disorders or other chronic health conditions;
2) sufficient dosages of a large number of soil contaminants;	b) higher incidence of leukemia;
3) organophosphates and carbomates;	c) high incidences of kidney damage, some irreversible;
4) mercury and cyclodienes;	d) neuromuscular blockage;
5) chronic exposure to benzene at sufficient concentrations;	e) liver changes, kidney changes and depression of the central nervous system;
6) chromium, lead and other metals, petroleum, solvents, and many pesticide and herbicide formulations;	f) death by exposure via direct contact, inhalation or ingestion of contaminants in groundwater contaminated through soil;
7) chlorinated solvents.	g) weakening of egg shells, increased chick mortality and potential extinction of species.

Soil Contamination Effects

Health Effects. Contaminated or polluted soil directly affects human health through direct contact with soil or via inhalation of soil contaminants which have vaporized; potentially greater threats are posed by the infiltration of soil contamination into groundwater aquifers used for human consumption, sometimes in areas apparently far removed from any apparent source of above ground contamination.

Health consequences from exposure to soil contamination vary greatly depending on pollutant type, pathway of attack and vulnerability of the exposed population. Chronic exposure to chromium, lead and other metals, petroleum, solvents, and many pesticide and herbicide formulations can be carcinogenic; can cause congenital disorders or other chronic health conditions. Industrial or man-made concentrations

of naturally occurring substances, such as nitrate and ammonia associated with livestock manure from agricultural operations, have also been identified as health hazards in soil and groundwater.

Chronic exposure to benzene at sufficient concentrations is known to be associated with higher incidence of leukemia. Mercury and cyclodienes are known to induce higher incidences of kidney damage, some irreversible. Organophosphates and carbonates can induce a chain of responses leading to neuromuscular blockage. Many chlorinated solvents induce liver changes, kidney changes and depression of the central nervous system. There is an entire spectrum of further health effects such as headache, nausea, fatigue, eye irritation and skin rash for the above cited and other chemicals. At sufficient dosages a large number of soil contaminants can cause death by exposure via direct contact, inhalation or ingestion of contaminants in groundwater contaminated through soil.

Ecosystem Effects. Not unexpectedly, soil contaminants can have significant deleterious consequences for ecosystems. There are radical soil chemistry changes which can arise from the presence of many hazardous chemicals even at low concentration of the contaminant species. These changes can manifest in the alteration of metabolism of endemic microorganisms and arthropods resident in a given soil environment. The result can be virtual eradication of some of the primary food chain, which in turn could have major consequences for predator or consumer species. Even if the chemical effect on lower life forms is small, the lower pyramid levels of the food chain may ingest alien chemicals, which normally become more concentrated for each consuming rung of the food chain. Many of these effects are now well known, such as the concentration of persistent dichloro-diphenyl-trichloroethane (DDT) materials for avian consumers, leading to weakening of egg shells, increased chick mortality and potential extinction of species.

Effects occur to agricultural lands which have certain types of soil contamination. Contaminants typically alter plant metabolism, often causing a reduction in crop yields. This has a secondary effect upon soil conservation, since the languishing crops cannot shield the Earth's soil from erosion. Some of these chemical contaminants have long half-lives.

Ex. 9. Answer the following questions.

1. What makes health consequences from exposure to soil contamination vary? 2. What plant metabolism can soil contamination alter? 3. Are industrial or man-made concentrations of naturally occurring

substances identified as health hazards? 4. Nicotine and compounds of arsenic are proved to have been used as the first herbicides, aren't they? 5. What several principal strategies for remediation were offered by environmental scientists who utilize field measurement of soil chemicals and apply computer models for analyzing transport and fate of soil chemicals? 6. Environmental scientists study chemical effect on lower life forms, utilize field measurement of soil chemicals, and apply computer models for analyzing transport. What activity of this list is false?

Ex. 10. Put the following adjectives in a correct order according to the rule, described in the dialogue below: *weakening egg awful shells, organic unknown chemical, health difficult consequences, soil Italian contamination, heavy black metals.*

A: What is the order of *adjectives of quality*, referring to one noun?

B: Several variations are possible but a fairly usual order is adjectives of size, general description, age, shape, color, material, origin, and purpose. Examples: a long sharp knife, a round white cup, an elegant French clock.

A: Can you give an example of compound nouns formation?

B: Remember that gerunds are used to form *compound nouns* (gerund goes as the adjective of purpose). Examples: riding boots, walking stick.

A: Thank you. And what is the order of *adjectives of personality / emotion*?

B: These adjectives come after adjectives of physical description, including "dark", "fair", and "pale". Examples: a small suspicious official, a pale transparent mixture.

A: Adjectives "fine", "nice", "beautiful", "lovely" are used very often. Is there any particular order?

B: They are followed with adjectives of size, shape and temperature to express approval of the size. If we say "a beautiful big room", "a lovely warm house", "a fine clean lab", we imply that we like big room, warm house and clean lab.

A: But in scientific text we can often see *several nouns* following one another. What is a proper way of translation?

B: Translate several nouns following one another as adjectives characterizing the last noun. And start translating from the end. Example: university building, carbon dioxide, iron ore.

Ex. 11. Pay attention to different meanings of the word "far" in different word combinations. Translate the following sentences.

Far, adj – далекий

Far, adv – далеко

Far, adv – прилагательное в сравнительной степени – гораздо, значительно

By far – безусловно

So (as) far as … is concerned – что касается…

So far as – насколько, поскольку

So far – пока, до тех (сих) пор

Far from – далеко от, совсем не

1. At first sight the phenomena of electrolysis are from simple to explain and further experiments are necessary. 2. The small non-metallic atoms exert a powerful attraction on the hydrogen because its electron is so far removed that it is almost a hydrogen ion. 3. Far greater use of plastics is expected in industrial construction. 4. Every enzyme so far isolated has proved to be either a simple or complex protein. 5. The process of fractionation may be carried so far that a pure crystalline active substance is obtained. 6. Apparatus not immediately required should be kept as far as possible in a neat orderly manner. 7. Coal does far more for each of us than supply the necessary heat to move our trains. 8. So far s we know the oil that we obtain from the earth will not last more than a few centuries at the present rate of consumption. 9. By far the most useful solvents are the hydrides. 10. So far they did not succeed in their efforts to raise the engines.

Ex. 12. Speak on the topic “Soil Contamination”.

6.4. INDUSTRIAL POLLUTION

Ex. 1. Read and memorize the following words.

Poisonous – ядовитый; to damage – повреждать; exposure – подвергание какому-либо воздействию, выставление, оставление (на солнце, под дождем); to implement – выполнять, осуществлять; hazardous – опасный, рискованный; solution – метод решения проблемы; to distinguish – различать, характеризовать; to reduce – уменьшать, сокращать; consumption – затраты, издержки; release – освобождение, избавление; intentional – намеренный, умышленный; to prohibit – запрещать; feasible – вероятный, возможный; adversely – неблагоприятно, вредно; pristine – чистый, нетронутый, неиспорченный; pre-emptive – упреждающий; bioavailability – биодоступность; due to – благодаря; dissolute – растворенный; spatially –

пространственно; temporally – временно; to contain – ограничивать, сдерживать; to retract – вбирать, отводить; build-up – накопление; household – бытовой; to incur – навлекать на себя.

Ex. 2. Read and translate the following international words. Use a dictionary if necessary.

Biodiversity; toxification; toxicants; pollutant; anthropogenic; aquatic; biodegradation; intolerant; recolonize; locate; emission; agrochemicals; volatile; pest; pesticide; data; accumulate; extrapolate; correlate; nature; act; economically; cyanide; ammonia; human; pose; degradability.

Ex. 3. Read and translate text A.

Industrial Pollution

Industrial pollution has adversely affected biodiversity for the last two centuries and continues to increase globally. The effect most closely correlated with loss of ecosystem services is toxification of environment, whereby the organisms living in the ecosystem are damaged because of the poisonous nature of many pollutants. As many toxicants (poisonous materials) can act even with very minimal exposure, it is almost impossible and economically infeasible to remove dissolute pollution from the environment with modern technical methods.

Only spatially and temporally concentrated pollution can be retracted effectively by anthropogenic efforts, and such methods are already in use. Any dissolute pollution (pollution present in low concentrations in aquatic systems) cannot be removed efficiently by human efforts since such large areas are affected and must therefore be removed through natural biodegradation.

The only way to restore biodiversity to areas affected by dissolute pollution is to remove the sources of pollution, make sure that toxic buildups can be naturally removed through chemical, physical and biological processes and ensure that pollution-intolerant organisms have access to recolonize the area. The process, especially of the last two steps, is very time-consuming.

To evaluate solutions to pollution, it may be helpful to distinguish between different kinds of industrial pollution. The first and common distinction is between sources of pollution: point sources, which are spatially and temporally defined such as a factory, and non-point sources, which are impossible to locate or confine such as household

emissions. Only point sources can be effectively reduced by treatment of waste due to the possibility of regulation.

Organic and inorganic wastes are releases of large amounts of the most ecotoxic materials such as heavy metals, ammonia, cyanide, volatile organic compounds, and halogenated organic compounds. Release of these chemicals into the environment is not intentional; that is, the release of these chemicals is not required in order for any process to work.

As agrochemicals are intentionally released into the environment, prohibiting their usage would probably not be politically or economically feasible. This kind of regulation would significantly raise food prices and incur food shortages and famines because pests would destroy a significant amount of the crop yield. A feasible solution should include both reduction of use and shifts to less chronically toxic products.

Data on ecotoxicity is accumulated by reviewing polluted sites and comparing them to pristine sites or to historical data. Where pollution has already been released into the environment, circumstances previous to the pollution are difficult to extrapolate. For example, Pesticides need to pass a series of tests demonstrating that they are not "unreasonably" harmful to the surrounding ecosystems (concerning both their toxicity and their degradability). While expansive toxicity databases exist for most laboratory materials, they are accumulated for regularly applied chemicals (household, medicinal, and etc).

Ex. 4. Answer the following questions.

1. What is the adverse effect of industrial pollution? 2. Why can't many toxicants be removed from the environment? 3. What pollution can be effectively retracted from the environment? 4. What is dissolute pollution? 5. How is biodiversity restored in the areas affected by dissolute pollution? 6. What is recolonization? 7. What kinds of industrial pollution are distinguished? 8. What wastes are the most toxic materials? 9. What is the feasible solution to protect the environment from agrochemical pollution? 10. Why is it hardly possible to find pristine sites?

Ex. 5. Find synonyms in the following list of words.

Adversely; database; correlate; remove; distinguish; effect; solution; feasible; method; approach; accumulate; reduction; apply; consider; release; pristine; pollution; contamination; eliminate; influence; information; possible; technique; lessening; take into account; liberation; manner; unspoilt; harmful; compare; discern; use.

Ex. 6. Translate the following sentences. Point out the infinitive constructions. State the function of the infinitive.

1. It is often assumed that governmental restrictions or strong consumer pressure are necessary to cause significant reduction in the production of polluting goods. 2. The EPA reviews research to be submitted before a product can be sold on the market. 3. Industrial pollution has been reported to increase globally. 4. Poisonous materials can act even with very minimal exposure. 5. Dissolute pollution is almost impossible and economically infeasible to remove from the environment with modern technical methods. 6. To evaluate solutions to pollution, it may be helpful to distinguish between different kinds of industrial pollution. 7. Some effective methods are already in use to contain hazardous pollution and restore polluted sites. 8. The only way to restore biodiversity to areas affected by dissolute pollution is to remove the sources of pollution. 9. EPA takes a pre-emptive approach to minimize damage to ecosystems from pesticides.

Ex. 7. Translate the sentences into English.

1. Многие ядовитые вещества могут воздействовать даже в малых количествах. 2. Существует обширная база данных токсичных веществ, включающая лабораторные материалы, сельскохозяйственные химикаты, соединения тяжелых металлов. 3. Агентство по охране окружающей среды использует метод упреждения, чтобы минимизировать вред, который наносят экосистеме пестициды. 4. Единственный способ восстановить биоразнообразие, это устранить источники загрязнения. 5. Промышленное загрязнение неблагоприятно воздействует на биоразнообразие в течение последних 200 лет. 6. Данное исследование классифицирует биодоступность продуктов для организмов в окружающей среде и их относительную токсичность.

Ex. 8. Read and translate text B. Answer the following questions.

1. What methods can help to decrease the availability of chemicals?
2. What are the influential inorganic pollutants?
3. Why is it important to rebuild the ecosystem services?

Degrading Toxicants

In the case of pollution leading to buildup of toxic material, reduction of availability to the environment must be ensured to rebuild ecosystem services in a polluted area. Although physical or chemical

methods such as change in acidity or absorption into the soil can help decrease the availability of chemicals, additional monitoring and securing is necessary to make sure that the pollutant is not brought back into the environment.

Ideally, the system should be able to degrade the pollutant by microbes or fungi, as this will irreversibly destroy the toxicant. Many inorganic materials take a long time to biodegrade, which means that their buildup rate is almost proportional to the total rate of pollution at any given time. These are also often some of the most potent and generally poisonous materials and thus strongly toxic even in low concentrations. Influential inorganic pollutants include non-metals like ammonia and cyanide and heavy metals such as Cu, Hg, Cd among others, which are all toxic in various degrees.

Many inorganic discharges are point sources, so proper treatment of material is generally possible through biological degradation with microbes and fungi or electro-kinetic treatment (the use of electricity to reduce heavy metal ions and turn them into elemental precipitates). Also, most heavy metals are much less toxic in alkaline environments, a fact that can be used in treatment plans. Some combination of these three techniques should be established to lower emissions for point source metal pollution.

Ex. 9. Point out which of the words in italics perform the function of the subject of the sentence.

1. Many inorganic *materials* take a long *time* to biodegrade. 2. Some *combination* of these three *techniques* should be established to lower emissions. 3. Influential inorganic *pollutants* include non-metals like *ammonia* and cyanide and heavy metals. 4. It is often assumed that governmental *restrictions* or strong consumer pressure are necessary to cause significant *reduction* in the production of polluting *goods*. 5. Organic and inorganic *wastes* are releases of large amounts of the most ecotoxic *materials*. 6. The *effect* most closely correlated with *loss* of ecosystem services is toxification of *environment*.

Ex. 10. Speak on the topic “Industrial Pollution”.

APPENDIX

1. The Belarusian State Technological University

The Belarusian State Technological University, founded in 1930, trains specialists for different careers in economics, forestry, woodworking, landscape architecture, glass and glass ceramics production, construction and fine functional ceramics, chemical sources of current and functional electroplating, polymer and mould products design, engineering and medical bindings, basic organic and petrochemical synthesis, paintwork materials, industrial ecology, bio-ecology, certification, automation of technological processes, biotechnology of energy carriers, enzymes and fermentation technologies, fine organic synthesis, medicines, perfumery and cosmetics, information systems and technologies, printing industry, data processing and publishing, management, marketing, tourism and nature management, etc.

The BSTU structure. The University houses 10 faculties, the Institute for retraining and professional development, 53 departments, 20 affiliated departments, 5 affiliated colleges (Polotsk State Forestry College, Vitebsk State Technological College, Gomel State Polytechnic College, Bobruisk State Forestry College, and Belarusian State College of construction materials industry), and affiliated forestry experimental station in Negoreloe.

The head of the University is the Rector and 5 Deputy Rectors. There are Economic Engineering Faculty (ИЭФ), Forestry Faculty (ЛХФ), Faculty of Print Technology and Media Communications (ПиМ), Organic Substances Technology Faculty (ТОВ), Faculty of Forest Engineering, Materials Science and Design (ЛИД), Chemical Technology and Engineering Faculty (ХТиТ), Faculty of Information Technology (ФИТ), Faculty of Extra Mural Studies, Faculty of Pre-University Training, Faculty of Social Professions. There is a special Dean's Office for International Students. Nearly 680 university academic staff and researchers support 9,000 enrolled students. About 73 per cent of the university academic staff holds scientific ranks and degrees. Nowadays the BSTU can boast over 9,000 students, 6,000 are full-time students and the other 3,000 are extramural, MSc and PhD students.

The BSTU Academic and Educational Work. The University is the leading educational institution in the fields of forestry, chemical and printing industries. The teaching process at the University is organized in the following way. The academic year is divided into two terms. During the terms students attend lectures and carry out laboratory and practical work. At the end of each term student pass credit tests and sit exams. The course of studies lasts 4–5 years. At the end of the course of studies, students sit the State Examination and defend Diploma paper (project).

The BSTU Research Activities and International Cooperation. The BSTU is engaged in collaborative projects and partnerships all over the world focusing on the following cooperation strategies: interuniversity cooperation agreements; visit-lecturing; traineeship and internship exchanges of academic staff, PhD and Master's degree students; joint research projects; joint contributions to reputable science and research journals; student exchange; study programs for international students taught in English and Russian; international conferences and other professional and scientific events; participation in international and EU programs.

The University holds over 150 bilateral cooperation agreements with educational and research institutions from 32 countries worldwide. The strongest partnerships are maintained with the following universities: Vilnius Gediminas Technical University (Lithuania), D. Mendeleyev University of Chemical Technology of Russia (Russia), Saint-Petersburg State Chemical and Pharmaceutical Academy (Russia), Saint-Petersburg State Forest Technical University named after S. M. Kirov (Russia), Warsaw University of Life Sciences (Poland), etc.

The University houses a number of international research and innovation centers, i.e. UNESCO-Associated Centre for Chemical Sciences and Education, International Biopharmaceutical Centre, International IT Centre, International Centre for Advanced Materials and Technology.

The University is a full member of several international organizations and networks, i.e. International Centre for Forestry and Forest Industry, European bilateral cooperation agreements Forest Institute, European Real Estate Society, International Association of Research Organizations for the Information, Media and Graphic Arts Industries, Baltic University Program, and etc.

The BSTU scholars are active participants of various scientific and technical programs. For instance, they contribute to different national and regional research and technical projects; collaborate with over 400 international and national partners within commercial research contracts.

2. My Faculty

I am a student of the Chemical Technology and Engineering Faculty, founded in 1968. It is one of the largest faculties of the Belarusian State Technological University.

There are six affiliates of the Faculty departments at such enterprises as JSC "Keramin", JSC "Gomelglass", JSC "NPO Center", JSC "GrodnoAzot", SE "Institute NIISM", and JSC "Minsk Cement Plant".

Training is focused on such industries as chemical, petrochemical, construction materials industry, and mechanical engineering. At present Faculty trains engineering personnel for 7 specialties, namely: Manufacture of products based on the three-dimensional technology (the engineer); Design and Production of Goods from Composite Materials and Technological Facilities (mechanical engineer); Machines and Apparatus for Chemical Production and Building Materials Enterprises (mechanical engineer); Automation of Technological Processes and Production (automation engineer); Chemical Technology of Inorganic Substances, Materials and Goods (engineer-chemist-technologist); Technology of Electrochemical Production (engineer-chemist-technologist); Environmental Protection and Rational Utilization of Natural Resources (engineer-ecologist); and Industrial Water Treatment and Purification.

Today, the graduate of the Faculty is a universal specialist with a high level of knowledge in the fields of technology, mechanics, and computer simulation and design. Our graduates are in demand in almost all industries of the Republic of Belarus and are employed at the leading enterprises of the Republic.

Also our graduates can continue education to get Master degree in Engineering or Chemistry at the following Departments of the Faculty: Material and Construction Mechanics; Machines and Apparatus for Chemical and Silicate Production; Processes and Apparatus for Chemical Production; Automation of Production Processes and Electrical Engineering; Inorganic Materials Technology and General Chemical Technology; Glass and Ceramics Technology; Chemical Technology of Binding Materials; Chemistry, Technology of Electrochemical Production and Electronic Engineering Materials; and Industrial Ecology.

3. Introduction to Chemistry

Chemistry is an experimental and theoretical study of 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 behavior with other materials.

Matter exists in three states: the solid, the liquid and the gaseous state. A substance usually can be transformed from one state to another under the changes of its temperature.

Chemistry is so much a part of our lives that it is very easily taken for granted. Metals, glass, plastics, dyes, drugs, insecticides, paints, paper, soap, detergents, explosives and perfumes are all made of chemicals.

4. Chemical Elements and Their Pronunciation

Symbol	Atomic number	English name	Pronunciation
Ac	89	actinium	æk'tiniəm
Ag	47	silver	silvə
Al	13	aluminium	ælə'miniəm
Am	95	americium	əme'risiəm
Ar	18	argon	'a:gən
As	33	arsenic	'a:sənik

Symbol	Atomic number	English name	Pronunciation
At	85	astatium	astatium
Au	79	gold	aurum
B	5	boron	‘bo:ron
Ba	56	barium	‘beəriəm
Be	4	beryllium	bə‘riliəm
Bh	107	bohrium	‘bo:riəm
Bi	83	bismuth	‘bizməə
Bk	97	berkelium	bə:’keiliəm
Br	35	bromine	‘brəumi:n
C	6	carbon	‘ka:bən
Ca	20	calcium	‘kælsiəm
Cd	48	cadmium	‘kædmiəm
Ce	58	cerium	‘siəriəm
Cf	98	californium	kæli’fo:niəm
Cl	17	chlorine	‘klo:ri:n
Cm	96	curium	‘kjuəriəm
Cn	112	copernicium	kopən’i:šiəm
Co	27	cobalt	‘kəu,bo:lt
Cr	24	chromium, chrome	‘krəumiəm
Cs	55	caesium	‘si:ziəm
Cu	29	copper, cuprum	‘kopə
Db	105	dubnium	‘dubniəm
Ds	110	darmstadtium	da:m’stætiəm
Dy	66	dysprosium	dis’prəuziəm
Es	99	einsteinium	ain’stainiəm
Er	68	erbium	‘ə:biəm
Eu	63	europium	juə’rəupiəm
F	9	fluorine	‘fluəri:n
Fe	26	iron, ferrum	‘aiən, ‘ferəm
Fl	114	flerovium	fle’rəuviəm
Fm	100	fermium	‘fə:miəm
Fr	87	francium	‘frænsiəm
Ga	31	gallium	‘gæliəm
Gd	64	gadolinium	gædə’liniəm
Ge	23	germanium	džə:’meiniəm
H	1	hydrogen	‘haidrədžən

Symbol	Atomic number	English name	Pronunciation
He	2	helium	‘hi:liəm
Hf	72	hafnium	‘ha:fniəm
Hg	80	mercury	‘mə:kjuri
Ho	67	holmium	‘həulmiəm
Hs	108	hassium	‘hæsiəm
I	53	iodine	‘aiədi:n
In	49	indium	‘indiəm
Ir	77	iridium	ai’ridiəm
K	19	potassium	pə’tæsiəm
Kr	36	krypton	‘kriptən
La	57	lanthanum	‘lænθənəm
Li	3	lithium	‘liθiəm
Lu	71	lutecium	lu’ti:šiəm
Lv	116	livermorium	livə’mo:riəm
Lw	103	lawrentium	lo:’rentiəm
Md	101	mendelevium	mendə’li:viəm
Mg	12	magnesium	mæg’ni:ziəm
Mn	25	manganese	‘mængəni:z
Mo	42	molybdenum	mə’libdinəm
Mt	109	meitnerium	mait’ne:riəm
N	7	nitrogen	naitrədžən
Na	11	sodium	ŕsəudiəm
Nb	41	niobium	nai’əubiəm
Nd	60	neodymium	niə’dimiəm
Ne	10	neon	‘ni:on
Ni	28	nickel	‘nikl
No	102	nobelium	nəu’bi:liəm
Np	93	neptunium	‚nep’tju:niəm
O	8	oxygen	‘oksidž(ə)n
P	15	phosphorus	‘fosfərəs
Pa	91	protactinium	proutæk’tiniəm
Pb	82	lead, plumbum	‘led, ‘plambəm
Pd	46	palladium	pə’leidiəm
Pm	61	prometheum	prə’mi:θiəm
Po	84	polonium	pə’ləuniəm
Pr	59	praseodymium	præziə’dimiəm
Pt	78	platinum	‘plætinəm

Symbol	Atomic number	English name	Pronunciation
Pu	94	plutonium	plu:'təouniəm
Ra	88	radium	'reidiəm
Rf	104	rutherfordium	raəə'fo:diəm
Rg	111	roentgenium	rən'dži:niəm
Rh	45	rhodium	'rəudiəm
Rn	86	radon	'reidən
Ru	44	ruthenium	ru:'əiniəm
S	16	sulphur	'salfə
Sb	51	antimony	'æntiməni
Sc	21	scandium	'skændiəm
Se	34	selenium	si'liniəm
Si	14	silicon	'silikən
Sn	50	tin, stannum	'tin, 'stænəm
Sr	38	strontium	'strontiəm
Ta	73	tantalum	'tæntələm
Tc	43	technecium	tek'nišiəm
Te	52	tellurium	te'ljuəriəm
Ti	22	titanium	tai'teiniəm
U	92	uranium	ju'reiniəm
V	23	vanadium	və'neidiəm
W	74	tungsten	'taŋstən
Xe	54	xenon	'ksi:nən
Y	39	yttrium	'itriəm
Zn	30	zinc	'zink
Zr	40	zirconium	zə'kəuniəm

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ОГЛАВЛЕНИЕ

Учебное издание

АНГЛИЙСКИЙ ЯЗЫК

Учебно-методическое пособие

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Подписано в печать 19.05.2021. Формат $60\times84^{1}/_{16}$.
Бумага офсетная. Гарнитура Таймс. Печать ризографическая.
Усл. печ. л. 9,0. Уч.-изд. л. 9,3.
Тираж 100 экз. Заказ .

Издатель и полиграфическое исполнение:
УО «Белорусский государственный технологический университет».
Свидетельство о государственной регистрации издателя,
изготовителя, распространителя печатных изданий
№ 1/227 от 20.03.2014.
Ул. Свердлова, 13а, 220006, г. Минск.