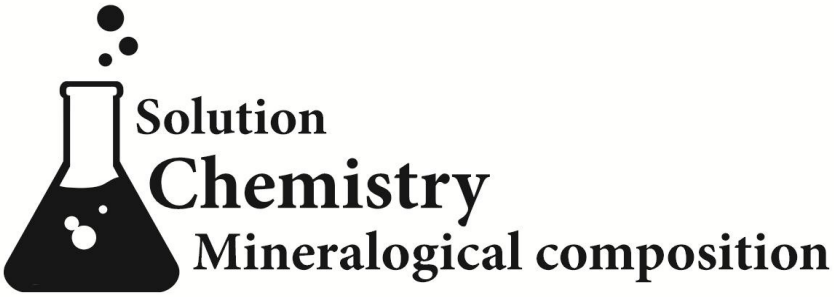
И. Ю. Лавриненко, В. В. Козлова

Английский язык для химиков-технологов

Учебное пособие



Воронеж 2022

Министерство науки и высшего образования
Российской Федерации

Федеральное государственное бюджетное образовательное
учреждение высшего образования

«Воронежский государственный технический университет»

И. Ю. Лавриненко, В. В. Козлова

АНГЛИЙСКИЙ ЯЗЫК ДЛЯ ХИМИКОВ-ТЕХНОЛОГОВ

Учебное пособие

Воронеж 2022

УДК 802.0:66 (07)
ББК 81. 432.1:35я7
Л135

Рецензенты:
кафедра английского языка Воронежского государственного педагогического университета
(зав. кафедрой, канд. пед. наук, доцент М. А. Шевцова);
С. Ю. Бурякова, канд. филол. наук, доцент кафедры французской филологии Воронежского государственного университета

Лавриненко, И. Ю.

Л135 **Английский язык для химиков-технологов**: учебное пособие / И. Ю. Лавриненко, В. В. Козлова; ФГБОУ ВО «Воронежский государственный технический университет». – Воронеж: Изд-во ВГТУ, 2022. – 115 с.

ISBN 978-5-7731-1004-0

Пособие состоит из 12 уроков, в каждом из которых студентам предлагается перевести аутентичный текст и выполнить упражнения к тексту, целью которых является знакомство студентов со специализированной профессиональной англоязычной терминологией по направлению «Химическая технология». Тексты пособия охватывают следующие темы: химия как наука, понятия химический элемент, химическая реакция, химическое вещество. Раскрываются технологии производства таких продуктов химической отрасли как краски, лаки, полимеры, описывается сущность хроматографии, экологических аспектов химической отрасли и др. В рамках вышеуказанных тем пособия предлагаются упражнения для построения самостоятельных монологических высказываний, для понимания внешней англоязычной речи на слух. Каждый урок сопровождается аутентичным видеоматериалом и комплексом упражнений к нему, помогающим глубже изучить тематику урока и способствующим развитию и совершенствованию навыков аудирования в профессиональной сфере общения.

Издание предназначено для обучения английскому языку студентов 1 курса направления подготовки 18.03.01 «Химическая технология».

Библиогр.: 28 назв.

УДК 802.0:66 (07)
ББК 81.432.1:35я7

Печатается по решению редакционно-издательского совета Воронежского государственного технического университета

ISBN 978-5-7731-1004-0

CONTENTS

ВВЕДЕНИЕ

Уровень развития естественнонаучных дисциплин по итогам 2020 года достигает самых верхних позиций на научном пьедестале. Согласно мнению ведущих информационных агентств, на их долю приходится большая часть инновационных разработок, повлиявших на уровень жизни миллиардов людей во всем мире. На сегодня инновации в области медицины, искусственного интеллекта, авиа и космической промышленности помогают решить ряд задач не только в узкоспециализированных сферах, но оказывают существенное влияние на интенсивность мирового экономического развития. Уровень научных теоретических и практических достижений определяет вектор, по которому будут осуществляться нововведения мирового уровня, а также обозначает спектр учебных дисциплин, относящихся к числу ведущих и перспективных.

Химические науки, наряду с математическими и физическими науками, представляют перспективное направление развития. Приоритетными областями развития химических наук являются: контроль над химическими реакциями, управление живыми системами, защита окружающей среды, разработка инновационных материалов и др.

На сегодняшний день роль гуманитарных наук в профессиональном ученом сообществе возрастает. Причина этому - острая потребность общества в разработках, осуществляемых на базе естественных дисциплин. Знание иностранного языка открывает широкие перспективы для общения с профессиональными сообществами других стран мира, создания совместных проектов, обмена знаниями и опытом. Умения общаться на иностранном языке на бытовом уровне не всегда достаточно для успешной профессиональной деятельности. Важно обладать необходимым уровнем профессиональной языковой компетенции для обсуждения узкоспециальных вопросов с иностранными коллегами.

Ведущие позиции среди иностранных языков занимает английский язык как язык международного общения.

В данном пособии предлагается материал для изучения профессионального английского языка в области химической технологии. Авторами представлен ряд уроков, изучение которых направлено на формирование навыков и развитие умений осуществлять монологической высказывание на профессиональные темы в сфере химической промышленности.

Тематика предлагаемых к изучению тем пособия касается базовых понятий химической технологии: рассматривается природа химических элементов и веществ, химических реакций, технология производства лаков и красок, процессы полимеризации, хроматографии, описывается специфика работы химика-технолога, в том числе, аспекты безопасности рабочих процессов на производстве, а также воздействия химической технологии на экологию.

Комплекс предложенных тем составляет 12 уроков, объединенных в 4 блока, отражающие их тематику и содержание. В начале урока предлагаются вопросы, подготавливающие обучающихся к последующему обсуждению профессиональных аспектов. Далее обучающимся предлагается прочитать и перевести профессиональный текст, приводится список базовых терминов и их перевод на русский язык, что поможет оптимизировать процесс работы с новой лексикой урока, акцентирует внимание обучающихся на специфике её произношения, значения, контекстного употребления.

Послетекстовые упражнения направлены на запоминание обучающимися терминологии, пополнение и активизацию их пассивного словаря. Предложенные упражнения помогают научиться употреблять изученную терминологию в ином профессиональном контексте, провести аналогию между терминологическими системами, касающиеся области химии, в английском и русском языках, подробно проанализировать содержание текста, отражающего проблематику химической технологии и составить собственное монологическое высказывание по обсуждаемой тематике.

Важным шагом в работе над текстом является умение обобщать и систематизировать содержащуюся в тексте информацию и представлять её в форме резюме. Умение составлять резюме (аннотацию) необходимо специалистам любой профессиональной сферы, что подчеркивает не только его свободное владение материалом текста, но способность синтезировать полученные знания, обобщать, выделять главную и второстепенную информацию. Делать выводы. На формирование этого навыка в каждом уроке учащимся предлагаются задания на заполнение недостающей информации и последующее самостоятельное составление аннотации к тексту.

В завершении уроков предлагается видеоматериал, в котором демонстрируется применение изученной профессиональной терминологии в речи, что позволяет обобщить полученные знания и более обстоятельно погрузиться в тему. Видеоматериал содержит аутентичную речь разного формата: монологи, диалоги, полилоги, представляет собой форму видеолекции, видеорепортажа, постановочного видео обучающего содержания, что позволяет небанально, в разнообразной и интересной форме рассмотреть изученные темы и получить опыт восприятия речи аутентичных англоязычных СМИ.

Для закрепления изученного материала в конце каждого из четырех блоков пособия обучающимся предлагается раздел Revision. В нем содержатся упражнения на повторение лексики уроков секции: сопоставительные упражнения и творческое задание – заполнение кроссворда, вопросно-ответные упражнения на закрепление базового содержания тем уроков и тестовое подстановочное задание, рассчитанное на закрепление контекстного употребление базовой терминологии блока. После изучения всех 12 уроков пособия обучающимся также предложен раздел Revision, в котором содержатся задания на повторение базовой лексики, понимание профессионального текста

на английском языке, а также тест на повторение лексики и тематического содержания всего представленного материала пособия.

В конце всех уроков пособия размещен раздел Supplementary Reading and Comprehension. В нем предложены аутентичные профессиональные тексты по темам, косвенным образом связанным с тематикой уроков, но раскрывающим проблематику в более узкоспециализированной форме. К каждому тексту прилагается задание для контроля понимания его содержания: упражнения множественного выбора, подстановочные упражнения, упражнении на выявление логики изложенного материала текстов, уточнение элементов его содержания и т.д.

Пособие содержит 5 приложений, представленный материал которых касается важных аспектов обучения английскому языку по направлению «Химическая технология». В приложениях содержится профессиональный терминологический тезаурус в составе около 250 лексических единиц, необходимых для корректного произношения и перевода базовых терминов, понимания профессиональных текстов по специальности, таблица неправильных глаголов, знание форм которых важно для построения грамматически корректных высказываний, список тем для подготовки студентами проектов на английском языке в рамках их специальности, приводится список фраз на английском языке, необходимых для использования в чрезвычайной ситуации, а также синтаксические конструкции для компетентного составления резюме к профессиональному тексту на английском языке.

Используемые в пособии иллюстрации взяты с сайтов: Yandex.ru, URL: https://yandex.ru/images/search?pos … (время обращения – 12.08.2021).

Section 1

BASICS OF CHEMISTRY

Unit 1

What is Chemistry

Task 1. Answer the following questions:

1. What meanings of the word "chemistry" do you know?
2. What is the role of Chemistry as a science?
3. What other branches of sciences is Chemistry connected with?

Task 2. Read aloud the words below and give their Russian equivalents:

Naturally, artificially, identify, behavior, materials, formation, destruction, artificial technology

Task 3. Read the text below about chemistry as a science. The words below will help you understand the text. Read them aloud before starting working with the text.

1) property [ˈprɒpətɪ] – свойство, качество
2) undergo [ʌndəˈgəʊ] – подвергаться, испытывать
3) particle [ˈpɑːtɪk(ə)l] – частица
4) quantity [ˈkwɒntɪtɪ] – количество
5) subatomic domain [də(ʊ)ˈmeɪn] – внутриатомная область
6) challenge [ˈtʃælɪn(d)ʒ] – зд. задача
7) coherent explanation [kə(ʊ)ˈhɪər(ə)nt] – четкое объяснение
8) enduring properties [ɪnˈdjʊərɪŋ] – зд. свойственные, типичные качества
9) indestructible [ɪndɪˈstrʌktɪb(ə)l] – неразрушимый
10) intermingled atom [ɪntəˈmɪŋg(ə)ld] – смешанный
11) interaction [ɪntərˈækʃ(ə)n] – взаимодействие
12) violent reaction [ˈvaɪəl(ə)nt rɪˈækʃ(ə)n] – бурная реакция
13) date [deɪt] – датироваться, относиться к определенному времени
14) liquid crystal [ˈlɪkwɪd ˈkrɪst(ə)l] – жидкий кристалл

Chemistry as a Science

Chemistry, the science that deals with the properties, composition, and structure of substances (defined as elements and compounds), the transformations they undergo, and the energy that is released or absorbed during these processes. Every substance, whether naturally occurring or artificially produced, consists of one or

more of the hundred-odd species of atoms that have been identified as elements. Although these atoms, in turn, are composed of more elementary particles, they are the basic building blocks of chemical substances; there is no quantity of oxygen, mercury, or gold, for example, smaller than an atom of that substance. Chemistry, therefore, is concerned not with the subatomic domain but with the properties of atoms and the laws governing their combinations and how the knowledge of these properties can be used to achieve specific purposes.

The great challenge in chemistry is the development of a coherent explanation of the complex behaviour of materials, why they appear as they do, what gives them their enduring properties, and how interactions among different substances can bring about the formation of new substances and the destruction of old ones.

From the earliest attempts to understand the material world in rational terms, chemists have struggled to develop theories of matter that satisfactorily explain both permanence and change. The ordered assembly of indestructible atoms into small and large molecules, or extended networks of intermingled atoms, is generally accepted as the basis of permanence, while the reorganization of atoms or molecules into different arrangements lies behind theories of change. Thus, chemistry involves the study of the atomic composition and structural architecture of substances, as well as the varied interactions among substances that can lead to sudden, often violent reactions.

Chemistry also is concerned with the utilization of natural substances and the creation of artificial ones. Cooking, fermentation, glass making, and metallurgy are all chemical processes that date from the beginnings of civilization. Today, vinyl, Teflon, liquid crystals, semiconductors, and superconductors represent the fruits of chemical technology [1].

Task 4. Translate the following words into Russian:

Identify, behavior, materials, formation, destruction, theories, reactions, creation, technology, molecule.

Task 5. Match English and Russian equivalents:

1) property	a) частица
2) release	b) свойство
3) absorb	c) знание
4) substance	d) высвобождать
5) hundred-odd	e) пятьсот с лишним
6) particle	f) поглощать
7) knowledge	g) использование, утилизация
8) matter	h) вещество
9) utilization	i) материя

Task 6. Find 7 pairs of synonyms among the words below:

Property, small, release, quantity, permanence, large, absorb, change, artificial, superconductor, creation, semiconductor, utilization, natural.

1	2	3	4	5	6	7

Task 7. Match the halves of the sentences:

1. Chemistry	a) can bring about the formation of new substances
2. Chemists	b) are composed of more elementary particles
3. Every substance	c) deals with the properties, composition, and structure of substances
4. Atoms	d) have struggled to develop theories of matter
5. Interactions among different substances	e) consists of one or more of the hundred-odd species of atoms

Task 8. Answer the questions to the text:

1. What is chemistry?
2. What does every element consist of?
3. Does chemistry study substances in subatomic domain?
4. Does chemistry deal with only natural substances?
5. What materials resulted from developments in chemical technology?

Task 9. Complete the sentences with the information from the text:

Chemistry is a science that_____.

Every substance consists of _____ that are elements.

These atoms in turn are composed of _____

The great challenge of chemistry is _____

Chemistry also involves _____ and structural architecture of substances.

It is also concerned with utilization of_____and creation of _____.

Task 10. Use the prompts above and speak about chemistry as a science.

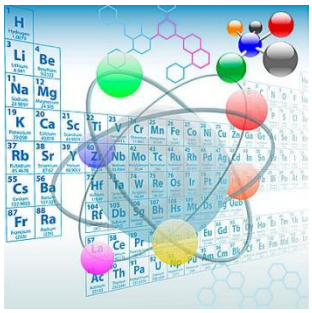
Task 11. Extra questions and tasks:***

What chemical elements are mentioned in the text?

Find 4 pairs of antonyms in the text.

Unit 2

Chemical Element



Task 1. Answer the following questions:

a). How many elements are there in the world?

b). What are the most wide-spread chemical elements on Earth?

c). What chemical elements are important for the life of man?

Task 2. Read the text below about chemistry as a science. The words below will help you understand the text. Read them aloud before starting working with the text.

1) fundamental [fʌndəˈment(ə)l] – фундаментальный
2) matter [ˈmætə] – вещество
3) mixtures [ˈmɪkstʃəz] – смеси
4) trace amounts [treɪs] – следовые количества
5) synthetically [sɪnˈθetɪkəli] – синтетически
6) hydrogen [ˈhaɪdrədʒ(ə)n] – водород
7) nitrogen [ˈnaɪtrədʒ(ə)n] – азот
8) oxygen [ˈɒksɪdʒ(ə)n] – кислород
9) fluorine [ˈflɔːriːn] – фтор
10) chlorine [ˈklɔːriːn] – хлор
11) noble gases [ˈnəʊb(ə)l] – благородные газы
12) bromine [ˈbrəʊmiːn] – бром
13) mercury [ˈmɜːkjərɪ] – ртуть
14) variety [vəˈraɪətɪ] – многообразие
15) identities [aɪˈdentɪtɪz] – тождества
16) gaseous elements [ˈgæsɪəs] – газообразные элементы
17) occure [əˈkɜː] – возникать
18) mixtures [ˈmɪkstʃəz] – смеси
19) sodium chloride [ˈklɔːraɪd] – хлористый натрий, поваренная соль
20) evaporation [ɪˌvæpəˈreɪʃ(ə)n] – испарение

What is Chemical Element

Chemical element, also called element, is any substance that cannot be decomposed into simpler substances by ordinary chemical processes. Elements are the fundamental materials of which all matter is composed.

At present there are 118 known chemical elements. About 20 percent of them do not exist in nature (or are present only in trace amounts) and are known only because they have

been synthetically prepared in the laboratory. Of the known elements, 11 (hydrogen, nitrogen, oxygen, fluorine, chlorine, and the six noble gases) are gases under ordinary conditions, two (bromine and mercury) are liquids (two more, cesium and gallium, melt at about or just above room temperature), and the rest are solids.

Elements can combine with one another to form a wide variety of more complex substances called compounds. The number of possible compounds is almost infinite; perhaps a million are known, and more are being discovered every day. When two or more elements combine to form a compound, they lose their separate identities, and the product has characteristics quite different from those of the constituent elements. The gaseous elements hydrogen and oxygen, for example, with quite different properties, can combine to form the compound water, which has altogether different properties from either oxygen or hydrogen.

Water clearly is not an element because it consists of, and actually can be decomposed chemically into the two substances hydrogen and oxygen; these two substances, however, are elements because they cannot be decomposed into simpler substances by any known chemical process. Most samples of naturally occurring matter are physical mixtures of compounds. Seawater, for example, is a mixture of water and a large number of other compounds, the most common of which is sodium chloride, or table salt. Mixtures differ from compounds in that they can be separated into their component parts by physical processes; for example, the simple process of evaporation separates water from the other compounds in seawater [2].

Task 3. Match English and Russian equivalents:

1) decompose	a) газообразные элементы
2) trace amounts	b) физическая смесь
3) fluorine	c) разлагаться
4) liquid	d) жидкость
5) gaseous elements	e) испарение
6) infinite	f) следовые количества
7) physical mixture	g) морская вода
8) seawater	h) фтор
9) evaporation	i) бесконечный

Task 4. Form Adjectives from the following Nouns, using suffixed –cal, -al, -ible, -ent:

Physics, Chemistry, difference, fundament, possibility.

Task 5. Fill in the gaps with one of the words below in a correct form. There are three extra words that you don`t need to use.

Compound, laboratory, substance, chemical process, data, hydrogen, chlorine, decompose, consists, evaporation, properties.

1. Water … of the atoms of … and oxygen.
2. Mixtures of two or more …make up ….

3. … experiments take place in …..
4. In nature some substances … their nucleus into smaller ones.
5. When you heat water he process of … is very intensive.

Task 6. Say if the sentences are true or false:

1. Element consists of several substances.
2. All chemical elements can be found in nature.
3. The elements are divided into liquids, gases and solids.
4. New compound elements appear every day.
5. Two compounds combine two characteristics of the elements they are composed of.
6. Oxygen and hydrogen can be decomposed into simpler elements.
7. Most number of natural elements is compounds.

Task 7. Answer the following questions:

1. What is chemical element?
2. How many chemical elements are there in nature?
3. What are the main forms of elements?
4. How many possible compounds are there in nature?
5. What happens to elements when they form a compound?
6. What can you say about oxygen and hydrogen?
7. What is the difference between mixture and compound?

Task 9. Fill in the short narration of the text with the proper words and phrases.

Matter is composed of 1) _____ substances. Any substance can`t be 2)_____ into simpler 3) _____. Of the known 118 elements 11 are 4)_____ (for example 5)___._ and 6)_____) and 2 are _7)_____(for example 8)____ and9) _____). The rest are 10_____.

Combinations of elements are called 11)_____. When elements are combined to form a compound, the product has quite 12)_____ characteristics from the constituent elements.

Water isn`t an 13)_____, because it consists of 14)____ and 15) ____, which can`t be 16)_____ into simpler substances.

Most matter in the world is a 17)_____ of compounds. Seawater is a mixture of 18) _____ and 19) _____. Mixtures can be separated into their 20)_____ _____ by 21) _____ processes.

Unit 3

Chemical Substance

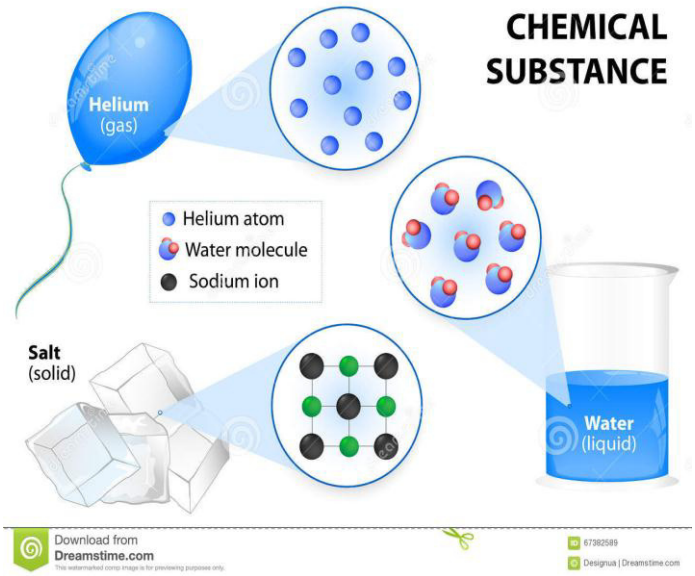
Task 1. Answer the following questions:

1). What substances do you know?

2). Is substance the same as element?

3). Is substance a part of nature?

4). Look at the diagram on the right. What substances are given there?



Task 2.

a) Translate the following words with the international stems:

constant temperature different phases molecular ion atom proton period metal conductive magnet, fractions, substance.

b) Make the adjectives from the nouns from exercise Task 2 a) using the suffix –*ic*. Translate the adjectives into Russian.

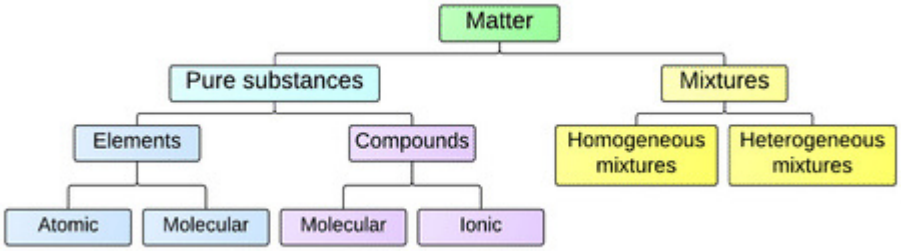
e.g.: ion – ion*ic* ион – ионический

Task 3. Read and translate the text below. Use the following words:

1) chemical bonds – химические связи
2) solids – твердые вещества
3) liquids - жидкости
4) to shift - сдвигаться
5) matter - вещество
6) pure substance – чистое вещество
7) nucleus - ядро
8) ascend – располагаться по убывающей
9) metalloid - металлоиды
10) conductive - производный
11) malleable - плавкий
12) stable - стабильный

The Nature of Chemical Substance

In chemistry, a chemical substance is a form of matter that has constant chemical composition and characteristic properties. It cannot be separated into components without breaking chemical bonds. Chemical substances can be solids, liquids, gases, or plasma. Changes in temperature or pressure can cause substances to shift between the different phases of matter.



Elements. A chemical element is a pure substance that consists of one type of atom. Each atom has an atomic number, which represents the number of protons that are in the nucleus of a single atom of that element. The periodic table of elements is ordered by ascending atomic number. The chemical elements are divided into the metals, the metalloids, and the non-metals. Metals, typically found on the left side of the periodic table, are:

often conductive to non-conductive
malleable
shiny
sometimes magnetic.

Aluminum, iron, copper, gold, mercury and lead are metals.

In contrast, non-metals, found on the right side of the periodic table (to the right of the staircase), are:

typically not conductive
not malleable
dull (not shiny)
not magnetic.

Examples of elemental non-metals include carbon and oxygen.

Metalloids have some characteristics of metals and some characteristics of non-metals. Silicon and arsenic are metalloids.

As of November, 2011, 118 elements have been identified (the most recently identified was *ununseptium*, in 2010). Of these 118 known elements, only the first 98 are known to occur naturally on Earth. The elements that do not occur naturally on Earth are the synthetic products of man-made nuclear reactions. 80 of the 98 naturally-occurring elements are stable; the rest are radioactive, which means they decay into lighter elements over timescales ranging from fractions of a second to billions of years [3].

Task 3. Give Russian equivalents to the following words and phrases:

a) ascending atomic number	
b) nuclear reactions	
c) constant chemical composition	
d) periodic table of elements	
e) dull metals	
f) homogeneous mixtures	
g) identify the element	
h) man-made reactions	
i) lighter elements	

Task 4. Give English equivalents to the following words and phrases:

a) неизменная форма вещества	
b) чистое вещество	
c) металлы-проводники	
d) недавно обнаруженный металл	
e) искусственные атомные реакции	
f) доли секунды	
g) плавкое вещество	
h) неметаллы	

Task 5. Say if the sentences are true or false. Prove your choice:

1. Constant temperatures make substance change.
2. One chemical element has a number of atoms.
3. Mercury and copper aren`t metals.
4. All 118 elements of the periodic table occur naturally.

Task 6. Answer the following questions:

1. What is chemical sentence?
2. What are the main forms of chemical substances?
3. What is there in an atom of an element?
4. What are chemical elements divided into?
5. What are metalloids?
6. What are the elements that don`t occur naturally?
7. What elements are called radioactive?

Task 7. Fill in the short narration of the text with the proper words and phrases.

Substance has a constant chemical _____ and _____ _____. Temperature changes can cause a substance to change into different _____ of matter: _____,_____ or gases.

Elements consist of _____. Each atom has protons in its _____. Elements can be divided into three classes: _____, _____, and _____.

Examples of metals are: _____,_____ and_____. They are usually _____ or non-conductive.

Non-metals are _____and _____, they are not_____,not _____ and not_____.

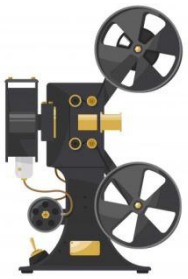
At November , 2011 _____ elements were _____.98 of them _____ naturally, the others are _____ products of _____nuclear reaction.

Task 8.

Search information about application of metals, non-metals and metalloids. What is the difference? What is the specifics? Make a presentation to the class.

Video Entry

Follow the link below, watch the video:
https://www.youtube.com/watch?v=-HjMoTthEZ0 **and do the exercise below:**



1. Make sure you know the following words and word combinations:

Bonds, magnetic properties, compound, hydrogen, oxygen, carbon dioxide, sulphur, iron, filings, drag, separate, unlike, chemical means, electric current, bubble up, electrolyze, ferrous chloride.

2. Answer the following questions:

1. What compounds are mentioned in the video?
2. What are compounds made of?
3. What is the difference between compounds and mixtures?
4. How can elements in compound be separated?
5. What happens when we electrolyze water?
6. What happens when the number of atoms in a compound changes?
7. What examples of chemical compounds do you know?

Unit 4

Chemical Reaction

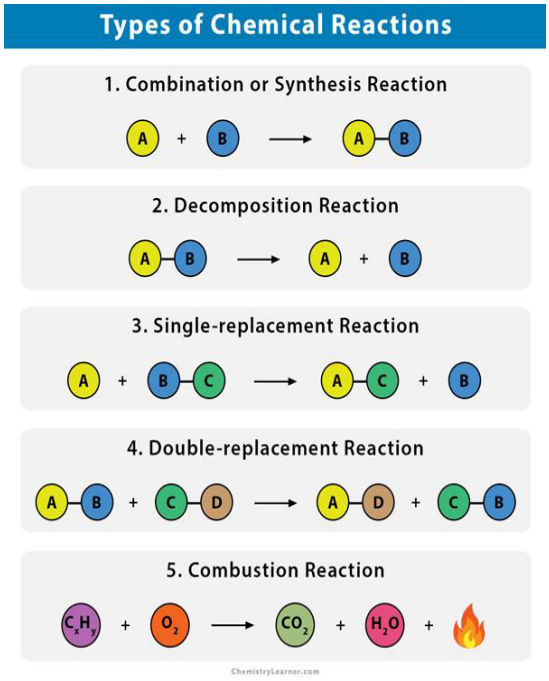
Task 1. Answer the following questions:

1. What is chemical reaction?
2. What chemical reactions are the most common.
3. Are chemical reactions used in industry/household?

Task 2. Translate the words with the international stems. They will help you understand the text below:

Process, convert, substances, form, products, indicators, characteristics, gas, formation, temperature, symbol, element, number, mole, basic

Task 3. Use the words below to translate the following text:



1) reactants [rɪˈæktənts] - реагент
2) signs [saɪnz] – признаки
3) breaking [ˈbreɪkɪŋ] – разрыв
4) bonds [bɒndz] – связи
5) essential [ɪˈsenʃ(ə)l] – важный
6) precipitate [prɪˈsɪpɪtət] – осадок
7) odor [ˈəʊdə] – запах
8) equation [ɪˈkweɪʒ(ə)n] – уравнение
9) compound [ˈkɒmpaʊnd] – соединение, смесь
10) coefficient [ˌkəʊɪˈfɪʃ(ə)nt] – коэффициент
11) subscript [ˈsʌbskrɪpt] – подстрочный индекс
12) relationship [rɪˈleɪʃ(ə)nʃɪp] – взимоотношение
13) decomposition [di:kɒmpəˈzɪʃn] – разложение, распад
14) single-replacement [rɪˈpleɪsm(ə)nt] – единое замещение
15) double-replacement [ˈdʌb(ə)l] – двойное замещение
16) combustion [kəmˈbʌstʃ(ə)n] – горение

The Basic Facts about Chemical Reaction

A chemical reaction is a process in which one or more substances are converted to one or more different substances. The starting substances are called the reactants, and the new substances that form are called the products.

There are ways to identify a chemical reaction. The signs that indicate a reaction are called indicators of a chemical reaction. The breaking and formation of bonds are considered as the essential characteristic for the occurrence of a chemical reaction. Therefore, the characteristics of a chemical reaction include:

- change in color
- formation of a precipitate
- formation of a gas
- odor change
- temperature change

How to Write a Chemical Reaction?

A chemical reaction is written in an equation by using the chemical symbol of the element or compound participating in the reaction process. The reactants are written on the left, and the products are written on the right. An arrow separates the two. The coefficient in front of a compound represents the number of moles that are being consumed or formed. The subscript represents the number of atoms of a particular element present in the compound. Finally, balancing the equation ensures that the relationship between the reactants and the product is correct.

Different Types of Chemical Reactions and How they are Classified

Many chemical reactions can be classified as one of five basic types. A thorough understanding of these types of reactions is useful for predicting the products of an unknown reaction. The five basic types of chemical reactions are combination, decomposition, single-replacement, double-replacement, and combustion [4].

Task 1. Match Russian and English equivalents:

1) convert	a) выпадать в осадок
2) reactant	b) уравнение
3) chemical reaction	c) преобразовывать
4) formation of bonds	d) разрыв связей
5) precipitate	e) запах
6) odor	f) химическая реакция
7) equation	g) формирование связей
8) breaking of bonds	h) реактант

Task 2. Fill in the gaps with the words below. There are three words that you don`t need to use: *substances, essential characteristic, color, odor, gas, change, symbols, compound*.

1. Noble yellow colour is … of gold.
2. Oxygen is a … that is formed from green plants.
3. Water contains many dissolved ….
4. In chemical equation elements are represented by special …. .
5. High and low temperature usually … the speed of reaction.

Task 3. Say if the sentences are true or false:

1. The starting substance of chemical reaction is called product.
2. Signs help to identify a chemical reaction.
3. In the result of the reaction colour, temperature of precipitation can change.
4. The error in the equation separates reactants and products.
5. The subscript represents the number of compounds participating in reaction.
6. There are five basic types of reactions.
7. The number in front of the compound represents the number of atoms of this element.

Task 4. Answer the following questions:

1. How many substances take part in one chemical reaction?
2. What help to identify a chemical reaction?
3. How are elements of chemical reaction called?
4. What elements or characteristics may form or change in the result of chemical reaction?
5. How are elements represented in equation?
6. What does the coefficient in front of a compound represent?
7. What does subscript represent?
8. What are the basic types of chemical reaction?

Task 5. Fill in the summary of the text "What is a Chemical Reaction?" with the proper information:

A chemical reaction is a _____when one or more _____form one or more different _____. In the result of chemical reaction starting substances - ____- form final substances -_____. Indicators are the signs that _____ reaction. During reaction ____ or _____ of bonds take place. The characteristics of chemical reaction are _____,_____,_____and others.

A chemical reaction is written in an _____. The _____in front of a _____ represents the number of moles. The _____represents the number of _____.There are _____basic_____of chemical reactions: _____,_____,_____, double-replacement and _____.

Task 6. Extra questions and tasks:***

a) use suffixes to form derivatives from the stems below. The derivative should determine "subject", "person" or "adjective":
scien___, econom___, gene____, mathema___, technolo___, chem___, biolo___.

Subject	Person	Adjective
Scien*ce*	**scien*tist***	**scien___**

b) Sort out the words from the columns in a) above to fill in the table below. Mind the stressful syllable.

○○⬭○	○ ⬭○○	○ ○ ⬭ ○ ○	⬭ ○ ○
1	**1**	**1**	**1**
	2	**2**	**2**
	3	**3**	**3**
	4	**4**	
	5		
	6		
	7		
	8		
⬭ ○	○ ⬭ ○	○ ○ ○ ⬭ ○	⬭ ○
1	**1**	**1**	**1**
	2		

[5, p. 178]

Video Entry

Follow the link below, watch the video: https://www.youtube.com/watch?v=ApJvQQLL2iY and do the exercise below:

1. Make sure you know the following words and word combinations:

Reaction, substance, chemical equation, symbol, reactants, take part, products, error, condition, heat, make it simpler, to be represented as, correct.

2. Answer the following questions:

1. What happens in a chemical reaction?
2. What does chemical equation show?
3. What are parts of chemical equation?
4. What does error represent?
5. Is the chemical equation in the video correct?

Revision. Units 1-4

Task 1. Match Russian and English equivalents:

1	chemistry reaction	a)	образование осадка
2	hydrogen	b)	подвергаться преобразованиям
3	liquid	c)	полное понимание
4	substance	d)	водород
5	undergo transformations	e)	химическая реакция
6	basic building blocks	f)	составной элемент
7	subatomic domain	g)	поведение материалов
8	chemical bonds	h)	распадаться
9	enduring properties	i)	жидкость
10	develop theories	j)	внутренняя область
11	decompose	k)	единое замещение
12	trace amounts	l)	следовые количества
13	formation of a precipitate	m)	химические связи
14	single-replacement	n)	основные строительные блоки
15	constituent element	o)	постоянные свойства
16	thorough understanding	p)	ядро
17	nucleus	q)	обладающий проводной способностью
18	behaviour of materials	r)	вещество
19	conductive	s)	разрабатывать теории

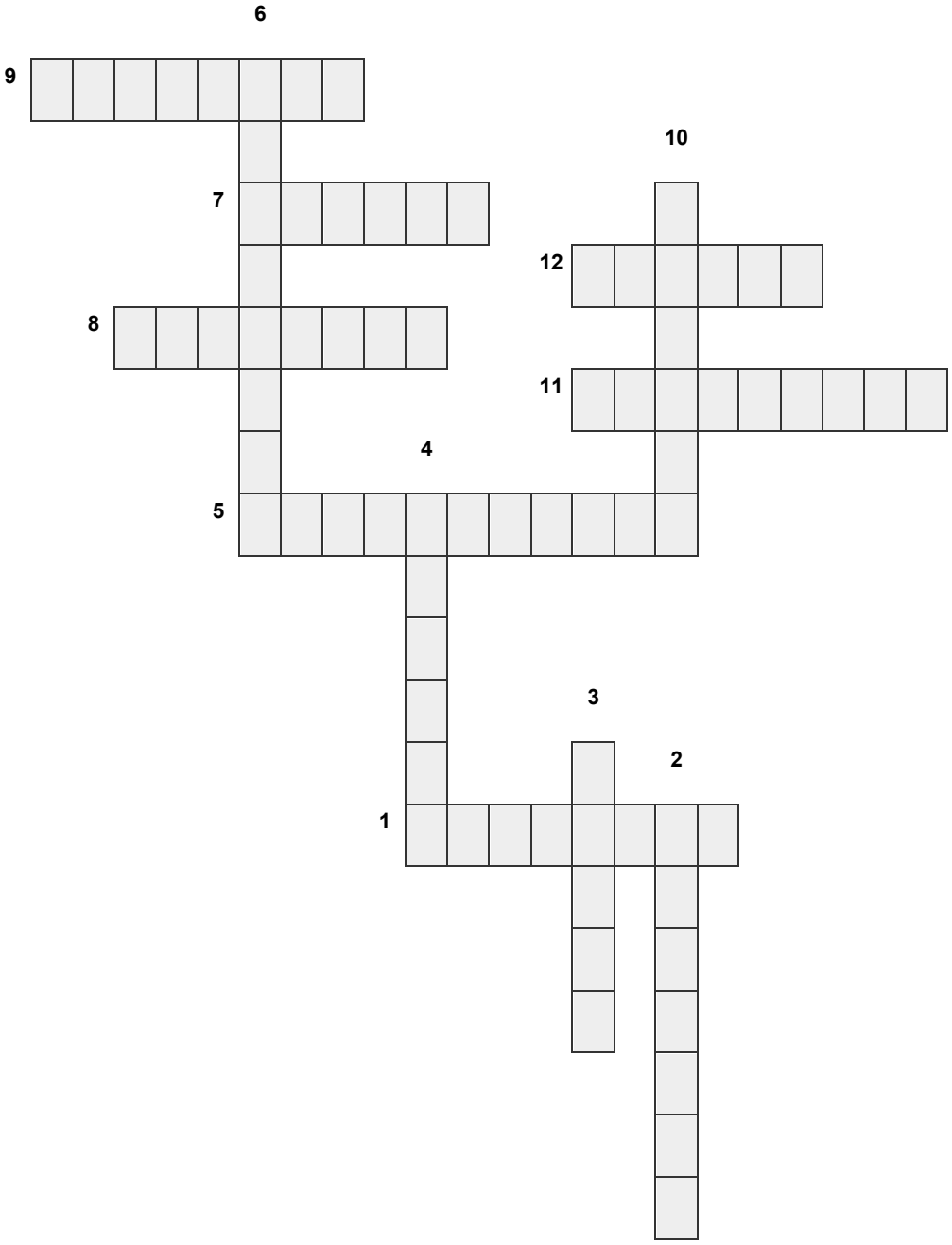
Task 2. Do the crossword (crossword puzzle in American English). **Give English equivalents to the following Russian words:**

Words outlined horizontally:

1) азот
5) испарение
7) жидкий
8) водород
9) частица
11) вещество
12) стабильный, устойчивый

Words outlined vertically:

2) элемент
3) связи
4) кислород
6) хлор
10) углерод



Task 3. Answer the following questions:

1. What is chemistry concerned with?
2. What are the materials or products that show the achievements of chemistry?
3. What is element? How many elements are known today?
4. How are elements in the periodic table divided? Give examples.
5. What is chemical substance? What are possible states of chemical substance?

Units 1-4. Test

Choose the correct variant to fill in the gaps in the sentences below:

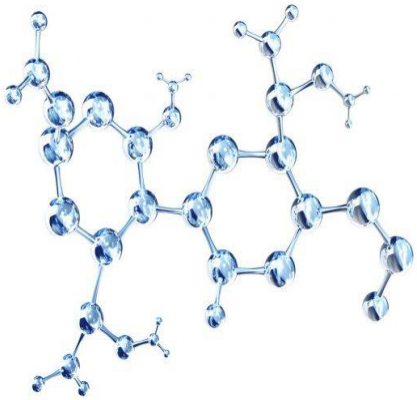
1. There is no a substance smaller than _____ .
a) an element b) a particle c) an atom
2. The interaction between substances lead to violent _____.
a) reactions b) mixtures c) sedimentations
3. Chemistry uses _____ elements and create _____ ones.
a) atomic, subatomic b) natural, artificial c) temporary, permanent
4. Chemical element _____ be divided into smaller substances.
a) can b) can`t c) will be
5. Cesium and gallium are _____.
a) liquids b) solids c) gases
6. The properties of s combined elements are _____ the properties of its compounds.
a) different from b) not different from c) the same as
7. Water is _____.
a) an element b) a mixture c) a particle
8. Seawater is a mixture of_____.
a) soda and lime b) water and carbonate c) water, sodium chloride and other compounds
9. The starting substances in chemical reaction are called ____.
a) products b) reactants c) inhibitors
10. One of the features of chemical reaction is formation and breaking of _____.
a) precipitation b) bonds c) heat
11. Chemical reactions types are: _____.
a) combination, decomposition, replacement and combustion
b) replacement and combustion
c) composition and decomposition.
12. The chemical elements are divided into: _____.
a) liquids and solids b) metals, non-metals and metalloids
c) gaseous or plasma
13. Element consists of _____ of atom.
a) one type b) two types c) three types
14. Non-Metals are _____.
a) conductive b) non-conductive c) magnetic
15. There are more _____ element on Earth than _____ ones.
a) artificial, natural b) natural, artificial c) synthetic, natural

Section 2

CHEMICAL PRODUCTS

Unit 5

Polymers



Task 1. Answer the following questions:

1). What do you know about polymers?

2). Can you give example of polymer?

3). Is a polymer simple or complex substance?

Task 2. Translate the following words with the international stems:

synthetic, chemical, molecule, mass, material, organism, protein, basis, mineral, plastics, physical, thermodynamics, energy.

Task 3. Read and translate the text below. Use the following words:

1) monomers [ˈmɑːnəmərz] - мономер
2) word [wɜːd] - слово
3) repeating units [rɪˈpiːtɪŋ] - звенья полимера
4) relative molecular mass [ˈrelətɪv] - относительная молекулярная масса
5) nucleic acids [nucleic ˈæsɪdz] - нуклеиновые кислоты
6) feldspar [ˈfeldspɑː] – полевой шпат
7) rubbers [ˈrʌbəz] – резина, каучук
8) physical basis [ˈfɪzɪk(ə)l] – физическая основа
9) continuous macroscopic material [ˌmækrə(ʊ)ˈskɒpɪk] – однородный микроскопический материал
10) bulk properties [bʌlk] – свойства по всему объему образца
11) walks of life - сферы жизни
12) density [ˈdensɪtɪ] - плотность
13) insulation properties [ɪnsjʊˈleɪʃ(ə)n] – изоляционные свойства
14) facile [ˈfæsæɪl] – поверхностный
15) fertilizers [ˈfɜːtəlaɪzəz] - удобрение
16) synthetic fibres [sɪnˈθetɪk ˈfaɪbəz] – синтетические волокна
17) hygiene [ˈhaɪdʒiːn] - гигиена
18) crucial role [ˈkruːʃ(ə)l] – решающая роль
19) lignin - лингин
20) weight distribution [weɪt dɪstrɪˈbjuːʃ(ə)n] – распределение нагрузки

What are Polymers

Polymer is any of a class of natural or synthetic substances composed of very large molecules, called macromolecules. They are multiples of simpler chemical units called monomers.

The term "polymer" derives from the Greek word πολύς (*polus*, meaning "many, much") and μέρος (*meros*, meaning "part"), and refers to large molecules whose structure is composed of multiple repeating units, from which originates a characteristic of high relative molecular mass and attendant properties. The units composing polymers derive from molecules of low relative molecular mass.

Polymers make up many of the materials in living organisms, including, for example, proteins, cellulose, and nucleic acids. Moreover, they constitute the basis of such minerals as diamond, quartz, and feldspar and such man-made materials as concrete, glass, paper, plastics, and rubbers.

Polymer properties depend of their structure and they are divided into classes according to their physical basis. Many physical and chemical properties describe how a polymer behaves as a continuous macroscopic material. They are classified as bulk properties, or intensive properties according to thermodynamics.

Nowadays, synthetic polymers are used in almost all walks of life. Modern society would look very different without them. The spreading of polymer use is connected to their unique properties: low density, low cost, good thermal/electrical insulation properties, high resistance to corrosion, low-energy demanding polymer manufacture and facile processing into final products.

Their application allows to save energy (lighter cars and planes, thermally insulated buildings), protect food and drinking water (packaging), save land and reduce use of fertilizers (synthetic fibers), preserve other materials (coatings), protect and save lives (hygiene, medical applications).

Organic polymers play a crucial role in living things, providing basic structural materials and participating in vital life processes. For example, the solid parts of all plants are made up of polymers. These include cellulose, lignin, and various resins. Cellulose is a polysaccharide, a polymer that is composed of sugar molecules. Lignin consists of a complicated three-dimensional network of polymers. Wood resins are polymers of a simple hydrocarbon, isoprene. Another familiar isoprene polymer is rubber.

Polymer characterization spans many techniques for determining the chemical composition, molecular weight distribution, and physical properties [6; 7].

Task 4. Match English and Russian equivalents:

1) attendant properties	a) термодинамические параметры
2) man-made materials	b) бетон
3) concrete	c) упаковка
4) unique properties	d) соответствующие свойства
5) thermal properties	e) твердые части
6) packaging	f) уникальные свойства
7) solid parts	g) похожие полимеры
8) familiar polymer	h) искусственные материалы

Task 5. Give English equivalents to the following word combinations:

1) более простые химические соединения	
2) множественные повторяющиеся соединения	
3) основа минералов	
4) искусственные материалы	
5) свойства по всему объему образца	
6) уникальные свойства	
7) хорошие изоляционные свойства	
8) важная роль	
9) твердые части	
10) молекулы сахара	

Task 6. Say if the sentences are true or false:

1. Polymers derive from the units of high molecular mass.
2. Polymers are parts of some minerals and diamonds.
3. Cellulose is a monosaccharide.
4. Lingin consist of two-dimention network of polymers.
5. Rubber is example of isoprene.

Task 7. Answer the following questions:

1. What are monomers?
2. What is the origin of the word “polymer”?
3. How are polymers connected with living organisms?
4. What information do physical and chemical properties of polymers give?
5. What are the advantages of polymer use?

Task 8. Write a short version of the text.

Video Entry

Follow the link below, watch the video: https://www.youtube.com/watch?v=sp4AWe4UIgA and do the exercise below:

1. Make sure you know the following words and word combinations:

Wool, long chain, leather, starch, DNA (deoxyribonucleic acid), impact, man-made, polystyrene [pɒlɪˈstaɪriːn], carbon, backbone.

2. Answer the following questions:

1. In what groups are materials made of polymers defined?
2. What polymers are used to make: a) fibers; b) buildings; c) kitchenware; d) cosmetics: e) medicine?
3. What activities are directly involved in polymer industry?
4. What activities are indirectly connected with polymer industry?
5. How do organic and non-organic polymers differ?

Unit 6

Paints

Task 1. Answer the following questions:

1. What do you know about application of paints in industry?
2. What are paints made of?
3. What are the types of paints?
4. What kind of paints have you used? What for?

Task 2. Translate the following words with the international stems:

Pigmented, mastic, substrate, oxide, resin, component, granular, production, combination, texture, synthetic, characteristics, temperature, manufacturer, aerosol, practical, emulsion.

Task 3. Read and translate the text below. Use the following words:

1) Hegman gauge - Измеритель Хегмана
2) ochre [ˈəʊkə] – охра, золото
3) ambient [ˈæmbɪənt] – внешний, окружающий
4) substrate [ˈsʌbstreɪt] – субстрат, подложка
5) solid film [ˈsɒlɪd] – плотная пленка

6) hematite [ˈhiːmətaɪt] – гематит, красный железняк
7) charcoal [ˈtʃɑːkəʊl] – древесный уголь
8) manganese oxide [ˈmæŋgəniːz ˈɒksaɪd] - полуторная окись марганца;
9) diluent [ˈdɪljʊənt] – разбавитель, растворитель
10) polymer backbone [ˈpɒlɪmə ˈbækbəʊn] – полимерная основа
11) film [fɪlm] - пленка
12) binder [ˈbaɪndə] – связующее вещество
13) thinner [ˈθɪnə] – разбавитель, разжижитель
14) dye [daɪ] – краска, краситель
15) watercolor [ˈwɒtərˌkələ] – акварель, акварельные краски
16) solvent [ˈsɒlv(ə)nt] - растворитель
17) gaseous [ˈgæsɪəs] - разнообразный
18) vanish [ˈvænɪʃ] – растворитель
19) vehicle [ˈviːɪk(ə)l] – зд. растворитель, связующее вещество
20) impart [ɪmˈpɑːt] – передавать, сообщать

What are Paints

One of the products of chemical industry used for manufacture today are paints and lacquers.

Paint is any pigmented liquid, liquefiable, or solid mastic composition that, after application to a substrate in a thin layer, converts to a solid film.

Paint was one of the earliest inventions of humanity. Some cave paintings drawn with red or yellow ochre, hematite, manganese oxide, and charcoal may have been made by early Homo sapiens as long as 40,000 years ago.

The vehicle of a paint is composed of the binder; or, if it is necessary to thin the binder with a diluent like solvent or water, it is the combination of binder and diluent. In this case, once the paint has dried or cured very nearly all of the diluent has evaporated and only the binder is left on the coated surface. Thus, an important quantity in coatings formulation is the "vehicle solids", sometimes called the "resin solids" of the formula. This is the proportion of the wet coating weight that is binder, i.e. the polymer backbone of the film that will remain after drying or curing is complete.

The binder is the film-forming component of paint. It is the only component that is always present among all the various types of formulations. Many binders are too thick to be applied and must be thinned. The type of thinner, if present, varies with the binder.

Pigments are granular solids incorporated in the paint to contribute color. Dyes are colorants that dissolve in the paint. Fillers are granular solids incorporated to impart toughness, texture, give the paint special properties, or to reduce the cost of the paint. During production, the size of such particles can be measured with a Hegman gauge. Rather than using only solid particles, some paints contain dyes instead of or in combination with pigments.

Paint is most commonly used to protect, color, or provide texture to objects. Paint can be made or purchased in many colors—and in many different types, such as watercolor or synthetic. Paint is typically stored, sold, and applied as a liquid, but most types dry into a solid. Most paints are either oil-based or water-based and each has distinct characteristics.

Clean up solvents are also different for water-based paint than they are for oil-based paint. Water-based paints and oil-based paints will cure differently based on the outside ambient temperature of the object being painted (such as a house.) Usually the object being painted must be over 10 °C (50 °F), although some manufacturers of external paints/primers claim they can be applied when temperatures are as low as 2 °C (35 °F).

Paint can be applied as a solid, a gaseous suspension (aerosol) or a liquid. Techniques vary depending on the practical or artistic results desired. Paints are used for a number of coatings: primers, emulsion paints, vanishes and shellacs, wood stains, etc. [8].

Task 4. Match English and Russian equivalents:

1) pigmented liquid	a) передать цвет
2) cave paintings	b) разжижать
3) to thin	c) твердые растворимые вещества
4) vehicle solids	d) растворять
5) resin solids	e) пигментированная жидкость
6) to contribute color	f) твердые частицы
7) dissolve	g) твердые смолы
8) solid particles	h) наскальные рисунки

Task 5. Match the words and word combinations in two columns to make possible combinations:

1) the earliest inventions	a) after drying or curing
2) remain	b) paints
3) granular	c) sapiens
4) impart	d) color
5) oil-based or water-based	e) of humanity
6) outside	f) toughness
7) Homo	g) ambient temperature
8) contribute	h) solids

Task 6. Fill in the gaps with the word combinations below:

substrate, liquid, oil-based paint, binder, liquefiable, varies, mastic composition

1. The … carbon dioxide gases is the mixture of gases with the boiling temperature from – 50 to o degrees Celsius.
2. To protect metal coatings, reservoirs, brick and concrete surfaces … is used.
3. … is a chemical substance that undergoes transformation under the influence of ferment.
4. The film in paint-and-lacquer coatings is formed by … .
5. The thickness of binders … depend on the thinner.
6. Water is a unique substance that can exist as …, gas or vapour.
7. The films of …. left after hardening is not so hard as the film left after other paints.

Task 7. Say if the sentences are true or false:

1. Paints when dry turn to liquefied film.
2. The earliest paints were made from natural ingredients.
3. The important characteristics of coating is the proportion of wet coating weight.
4. Pigments contribute to paint thickness.
5. The characteristics of water- and oil-based paints are the same.
6. There are different types of solvents for different paints.
7. The ambient temperature for all surfaces to be painted is below 10 degrease Celsius.

Task 8. Answer the following questions:

1. What does paint consist of?
2. Where were the first paints used?
3. When did the paint appear?
4. What can act as diluent in paints?
5. What is indispensible ingredient of any paint?
6. What is the role of fillers of paints?
7. What kind of paints are there?
8. What influences paint curing?
9. Why are there different paint techniques?
10. What types of coating do you know?

Task 9. Fill in the outline of the text with the words from the text in Task 3:

Paint is solid _____ composition. It is one of the earliest _____of humanity. The vehicle of paint is _____ or _____: solvent or water. When paint dries, diligent is _____ and binder is left. ____ or _____ is an important indicator of paint, it is the proportion of a weight of a wet coating.

_____ are colorants in paint, but ____ are solids that influence the texture of paint.

Paints are watercolor or _____. Depending on the base, pains can be _____ or _____. These paints cure differently based on the ambient _____.

Paints are applied as solids,_____ or liquids using different techniques.

Video Entry

Follow the link below, watch the video: https://www.youtube.com/watch?v=gyKTUmnHH-M and do the following exercises:

1. Make sure you know the following words and word combinations:

Highlighter pen, electrical conveyer, barrel, nib, cup, ink, mechanic arm, metallic charge.

2. Put the steps in highlighter pen production in a correct order according to the video entry:

a). Nibs are put into pens.
b). Ink reservoirs are made.
c). Melted plastic is put into the container.
d). Clear pen barrels are produced.
e). A dye is added into water.
f). Cups are put into nibs.
g). Ink reservoirs are put into barrels.
h). The thickness of water is measured.
i). Reservoirs are injected with ink.

3. Answer the following questions:

1. How many highlighter pens are produced in one production line?
2. What force is applied to make barrels?
3. What are ink reservoirs made of?

Unit 7

Lacquers

Task 1. Answer the following questions:

1. Where are lacquers applied?
2. How effective is the lacquer use?
3. What is the difference between paints and lacquers?

Task 2. Translate the following words with the international stems:

Group, lac, secretion, pigment, to produce, matte, latex, synthetic, polymers, organic, aesthetic, ingredients, category, form, type, risk, toxic, result, shellac, automobile.

Task 3. Read and translate the text below. Use the following words:

1) finishes [ˈfɪnɪʃ] – отделка
2) lac insect [lak ˈɪnsekt] – насекомое семейства Kerriidae, лаковых насекомых
3) acrylic resin [əˈkrɪlɪk ˈrezɪn] - акриловая смола
4) organic solvents [ɔːˈgænɪk ˈsɒlvənts] - органические растворители
5) durable [ˈdjʊərəb(ə)l] - долговечный
6) aesthetic [|iːsˈθetɪk] – эстетический
7) food-safe - безопасные продукты питания
8) vary [ˈveərɪ] – варьироваться
9) process [ˈprəʊses] - обрабатывать
10) impurity [ɪmˈpjʊərɪtɪ] – примесь, нечистота
11) stir [stɜː] – помешивать, размешивать
12) environmental consideration [ɪnvaɪrənˈment(ə)l kənsɪdəˈreɪʃ(ə)n] — учёт воздействия на окружающую среду
13) environmentally friendly – экологичный
14) fumes [fjuːmz] – выхлопы
15) hazardous [ˈhæzədəs] – опасный
16) airborne particulates [ˈeəbɔːn pɑːˈtɪkjʊləts] - взвешенные в воздухе частицы
17) lungs [lʌŋz] - легкие
18) under-hood [ˈʌndə hʊd] – внутренний
19) industrial applications [ɪnˈdʌstrɪəl ˌæplɪˈkeɪʃənz] – применение в промышленности
20) sheen level [ʃiːn ˈlev(ə)l] - уровень блеска

Lacquers: their Essential Characteristics

The term lacquer is used for a number of hard and potentially shiny finishes applied to materials such as wood or metal. These fall into a number of very different groups.

The term *lacquer* originates from the Sanskrit word *lākshā* (लाक्ष) representing the number 100,000, which was used for both the lac insect (because of their enormous number) and the scarlet resinous secretion, rich in shellac.

Lac Insect

Lacquers are thermoplastic coatings that form films by solvent evaporation. In these coatings, a blend of solvents is typically used to achieve the proper solvency, evaporation rate, and cost.

In modern techniques, lacquer means a range of clear or pigmented coatings that dry by solvent evaporation to produce a hard, durable finish. The finish can be of any sheen level from ultra matte to high gloss, and it can be further polished as required. Lacquer finishes are usually harder and more brittle than oil-based or latex paints, and are typically used on hard and smooth surfaces.

In terms of modern finishing products, finishes based on shellac dissolved in alcohol are often called *shellac* or *lac* to distinguish them from synthetic lacquer, often called simply *lacquer*, which consists of synthetic polymers (such as nitrocellulose, cellulose acetate butyrate ("CAB"), or acrylic resin) dissolved in *lacquer thinner*, a mixture of various organic solvents. Although synthetic lacquer is more durable than shellac, traditional shellac finishes are nevertheless often preferred for their aesthetic characteristics, as with French polish, as well as their "all-natural" and generally food-safe ingredients.

Types of lacquer vary from place to place but they can be divided into unprocessed and processed categories.

The basic unprocessed lacquer is called *raw lacquer* (*ki-urushi* in Japanese, *shengqi* in Chinese). This is directly from the tree itself with some impurities filtered out. Raw lacquer has a water content of around 25% and appears in a light brown colour. This comes in a standard grade made from Chinese lacquer, which is generally used for ground layers by mixing with a powder, and a high quality grade made from Japanese lacquer.

The processed form is a form in which the lacquer is stirred continuously until much of the water content has evaporated. These lacquers are generally used for the middle layers. Japanese lacquers of this type are generally used for the top layers.

Due to health risks and environmental considerations involved in the use of solvent-based lacquers, much work has gone into the development of water-based lacquers. Such lacquers are considerably less toxic and more environmentally friendly, and in many cases, produce acceptable results. While water-based lacquer's

fumes are considerably less hazardous, and it does not have the combustibility issues of solvent-based lacquers, the product still dries fairly quickly. Even though its odor is weaker, water-based lacquers can still produce airborne particulates that can get into the lungs, so proper protective wear still needs to be worn. More and more water-based colored lacquers are replacing solvent-based clear and colored lacquers in under-hood and interior applications in the automobile and other similar industrial applications. Water-based lacquers are used extensively in wood furniture finishing as well [9; 10].

Task 4. Match English and Russian equivalents:

1) synthetic lacquer	a) уровень блеска
2) sheen level	b) светло коричневый
3) high gloss	c) приемлемый результат
4) light brown	d) менее опасные
5) acceptable results	e) синтетический лак
6) less hazardous	f) защитный слой
7) protective wear	g) древесное покрытие
8) wood finishing	h) сильный блеск

Task 5. Match the following word combinations to make possible statements. More than one combination is possible:

1). Solvent-based lacquers	a) are less toxic
2). Water-based lacquers	b) are usually used for top layers
3). Japanese lacquers	c) is rich in shellac
4). Synthetic lacquer	d) involve health risks
5). Sheen level	e) is more durable than shellac
6). Oil-based or latex paints	f) help to achieve the proper solvency
7). Scarlet resinous secretion	g) varies from matte to high gloss
8). A blend of solvents	h) are less hard than lacquer finishes

Task 6. Fill in the gaps with the word combinations below:

Brittle finish, middle layers, ground layers, top layers, dries fairly quickly, weak odor, brittle.

1. Natural paints are ecologically sustainable but give less strong and … .
2. Glass is hard but also … .
3. Lacquers with less water contents are applied for …. . Analogues Japanese lacquers are used for ….
4. Paints with drying oils ….

5. To make … of timber harder concrete additives are used.

6. After applying any paint or lacquer on any surface the … will be smelt for several days.

Task 7. Say if the sentences are true or false:

1. Solvents influence the cost and evaporation of lacquer.
2. Oil-based paints are more brittle than lacquer finishes.
3. Shellac is synthetic lacquer.
4. Raw lacquers are one fourth of water.
5. Processed lacquers contain less water.
6. Solvent based lacquers are healthier.
7. Water-based lacquers are more widely used today.

Task 8. Answer the following questions:

1. What materials is lacquer applied for?
2. Where is shellac produced from?
3. How id film in lacquers formed?
4. What surface effect do lacquers produce?
5. What is more preferable: synthetic lacquer or shellac? Why?
6. What types of lacquer are there?
7. What types of lacquers are used for ground and middle layers? Why?
8. What are the tendencies in lacquer production due to environmental considerations?
9. Why does protective wear needs to be worn when working with lacquers?
10. Where is water-based lacquer used?

Task 9. Fill in the outline of the text with the words from the text in Task 3:

Lacquers are used to produce _____ finishes and to apply it on _____ or _____. Lacquers form films by _____ evaporation. They produce hard, durable _____: ultra _____ to _____ gloss.

Lacquer finishes are more _____ than paints and are used on _____ and _____ surfaces. There are _____ lacquers and shellac. _____ lacquer is more durable than _____. Shellac is more natural and contains _____ ingredients.

The main type of _____ lacquer is called *raw lacquer*. It is 25% of _____and is ____ ____ in colour. In _____ type of lacquer more water content is evaporated.

Due to health risks and environmental considerations today ___-____ lacquers are popular. They are less _____ and doesn't have _____ issues of other types. Its _____ is weaker , but _____ _____ still needs to be worn. They are used in under-hood and _____applications and ____ furniture _____.

Video Entry

Follow the link below, watch the video: https://www.youtube.com/watch?v=I5FyGxtjOYw **and do the following exercises:**

1. Make sure you know the following words and word combinations:

Applying coating, cultural heritage, craft, Chinese art, hue, lacquer mining, lashing, recover, perpetuate, lacquer cutting.

2. Choose the verbs from the list below which describe the process of lacquer production. There are five verbs that you don`t need to use. Put the verbs in an order of the lacquer process production according to the video entry:

Filtering, stirring, plating, mixing, applying lacquer, polishing, precipitating, heating, wipe again, drying, adding, colouring, evaporating.

3. Answer the following questions:

1. When did the art of lacquer coating started?
2. How is lacquer mined?
3. What device is used for polishing? Why?
4. How many steps are there in lacquer coating?
5. Do the Chinese use natural or synthetic coating? Why?
6. What are the restrictions in lacquer mining process? Why?
7. How long will the lacquer coating last?

Revision. Units 5-7

Task 1. Match Russian and English equivalents:

1 chemical units	a) полевой шпат
2 feldspar	b) химический состав
3 physical properties	c) химические элементы
4 high resistance	d) твердое покрытие
5 chemical composition	e) разбавитель, растворитель
6 vehicle of a paint	f) высокое сопротивление
7 solid film	g) состав покрытий
8 diluent	h) подходящая растворимость
9 coatings formulation	i) физические свойства
10 watercolor paint	j) безопасные для пищевых продуктов ингредиенты
11 proper solvency	k) пары лака
12 durable finish	l) акварельная краска
13 food-safe ingredients	m) растворитель, связующее вещество
14 ground layers	n) долговечное покрытие
15 lacquer's fumes	o) нижний слой

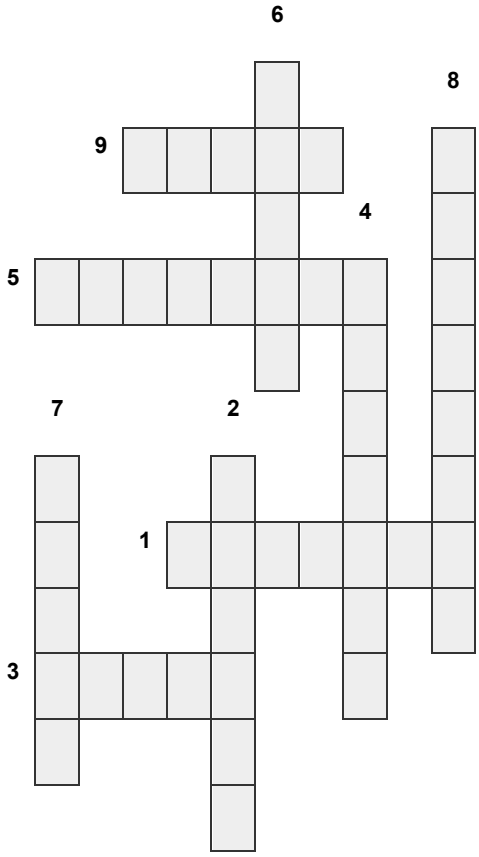
Task 2. Do the crossword (crossword puzzle in American English). **Give English equivalents to the following definitions:**

Words oriented horizontally:

1. A substance that gives colour to the mix
3. Opposite to liquid
5. A substance which molecules consist of many repeating units
9. Black waterproof material made from gum elastic, used to produce boots.

Words oriented vertically:

2. A substance that connects the elements in a mix
4. A substance that eliminates the other substance
7. Transparent substance used for windows
6. Material which looks like thread
8. Hard building material made from concrete, sand and water.



Task 3. Answer the following questions:

1. What are the examples of materials that contain polymers?
2. What are advantages of polymer use?
3. In what forms do natural polymers present in environment?
4. What are basic ingredients of paint? Why are they important?
5. What are the main types of paints? In what way are they different?
6. Where is lacquer used?
7. What are advantages and disadvantages of synthetic lacquers and shellac?
8. What is the popularity of lacquers according to environmental considerations?

Units 5-7. Test

Choose the correct variant to fill in the gaps in the sentences below:

1. Polymers are units composed of _____.
a) nanomers b) monomers c) multimers
2. Polymers are parts of such _____ materials as glass, paper and plastics.
a) natural b) organic c) man-made
3. There are different classes of polymers depending on their _____ basis.
a) physical b) chemical c) mechanical

4. The solid parts of all plants are made of _____.
a) non-organic polymers b) organic polymers c) lignin
5. _____ consists of sugar molecules.
a) Lignin b) Cellulose c) Wood-resin
6. _____ consist of hydro-carbon and isoprene.
a) Cellulose and cotton b) resin and rubber c) concrete and wood
7. After drying paints are converted into _____.
a) thin layer b) hard plastics c) solid film
8. Paints exist for _____ years.
a) more than 50 000 b) less than 50 000 c) more than 100 000
9. The quality of paints is determined by _____.
a) “vehicle solids” b) “vehicle liquids” c) “diluents”
10. To give paint special properties _____ are added.
a) solvents b) thinners c) fillers
11. Paints can be _____ and synthetic.
a) watercolour b) polychromic c) monochrome
12. Solvents for oil-based and water-based paints are _____.
a) the same b) different c) not necessary to use
13. The outside temperature of the painted surface must be _____.
a) below 2°C b) above 2°C c) over 10°C
14. _____ lacquer is made of lac insect.
a) ancient b) synthetic c) natural
15. Lacquers dry by _____ of solvent.
a) mixing b) heating c) evaporation
16. Lacquer finishers are usually _____ than latex paints
a) harder b) lighter c) softer
17. Shellac finishers are preferred because their _____ characteristics.
a) durable b) solvent c) aesthetic
18. _____ lacquers can have some impurities.
a) processed b) unprocessed c) all types of
19. Processed lacquers are used for _____layers.
a) top b) top and middle c) ground
20. _____ lacquers are less toxic than _____lacquers.
a) solvent-based, water-based b) colorless, pigmented
c) water-based, solvent-based

Section 3

CHEMICAL PROCESSES

Unit 8

Chemical Technology

Task 1. Answer the following questions:

1. What processes are characterized as chemical technology?
2. What products are made using chemical technology?
3. What can promote to chemical technology development in future?

Task 2. Translate the following words with the international stems:

Profession, engineering, physical, physics, materials, technique, person, process, manufacture, technology, complex, inorganic, organic, ceramics, discipline, modern, biology.

Task 3. Read and translate the text below. Use the following words:

1) intimately [ˈɪntɪmətli] **-** близко
2) application [æplɪˈkeɪʃ(ə)n] – применение
3) convert [kənˈvɜːt] – превращать
4) concern [kənˈsɜːn] – иметь дело с
5) chemical engineer [ˈkemɪk(ə)l endʒɪˈnɪə] – инженер-химик
6) maintenance [ˈmeɪnt(ə)nəns] – техническое обслуживание
7) large-scale [ˈlɑːdʒskeɪl] – в крупном масштабе
8) branch [brɑːn(t)ʃ] – отрасль
9) process engineer [ˈprəʊses endʒɪˈnɪə] – инженер-технолог
10) implement [ˈɪmplɪment] – выполнять, осуществлять
11) fuels [ˈfjuːəlz] – виды топлива
12) fertilizer [ˈfɜːtɪlaɪzə] - удобрение
13) insecticide [insecticide] - инсектицид, средство для истребления насекомых
14) explosive [|ɪkˈspləʊsɪvz] – взрывчатое вещество
15) detergent [dɪˈtɜːdʒ(ə)nt] – моющее средство
16) cleaning fluid [ˈfluːɪd] – чистящая жидкость
17) fragrance [ˈfreɪgrənsɪz] - аромат
18) additive [ˈædɪtɪv] - добавка

19) processing [ˈprəʊsesɪŋ] - обработка
20) coating [ˈkəʊtɪŋ] - покрытие
21) ink [ɪŋk] - краска
22) sealant [ˈsiːlənt] – герметик, уплотнитель
23) adhesive [ədˈhiːsɪv] - клей
24) intertwine [ɪntəˈtwaɪn] - переплетать

Chemical Technology as a Brunch of Engineering

Engineering and technology are separate but intimately related professions. As concerned to Chemical Technology/Engineering the definition is "Chemical engineering is the branch of engineering that deals with the application of physical science (e.g. chemistry and physics), with mathematics, to the process of converting raw materials or chemicals into more useful or valuable forms. In addition to producing useful materials, chemical engineering is also concerned with pioneering valuable new materials and techniques, an important form of research and development". A related term with a wider definition is chemical technology. A person employed in this field is called a chemical engineer.

Chemical engineering largely involves the design and maintenance of chemical processes for large-scale manufacture. Chemical engineers in this branch are usually employed under the title of process engineer.

Chemical engineering is applied in the manufacture of a wide variety of products implemented by chemical industry. Chemical industry is complex of processes, operations, and organizations engaged in the manufacture of chemicals and their derivatives. The chemical industry may be described simply as the industry that uses chemistry and manufactures chemicals. It manufactures inorganic and organic industrial chemicals, ceramics, fuels and petrochemicals, agrochemicals (fertilizers, insecticides, herbicides), plastics and elastomers, poleochemicals, explosives, detergents and detergent products (soap, shampoo, cleaning fluids), fragrances and flavors, additives, dietary supplements and pharmaceuticals. Closely allied or overlapping disciplines include wood processing, food processing, environmental technology, and the engineering of petroleum, glass, paints and other coatings, inks, sealants and adhesives.

The modern discipline of chemical engineering encompasses much more than just process engineering. It is often intertwined with biology and biomedical engineering [11].

Task 4. Match English and Russian equivalents:

1	physical science	1)	герметики
2	valuable forms	2)	ценные техники
3	valuable techniques	3)	обработка древесины
4	detergent products	4)	физические отрасли науки
5	wood processing	5)	покрывающие материалы
6	coatings	6)	ценные формы
7	sealants	7)	моющие средства
8	engineering of petroleum	8)	производство нефти

Task 6. Give English equivalents (synonyms) from the text to the following words:

1	building	
2	job	
3	initiating	
4	more general	
5	production	
6	natural	
7	includes	
8	connected with	

Task 7. Say if the sentences are true or false:

1. One of the aims of chemical engineering is to transform materials into more useful forms.
2. Chemical engineering is a part of chemical technology.
3. Chemical engineering deals only with producing inorganic industrial chemicals.
4. Chemical engineering works in close connection with biology and physics.
5. Fertilizers, insecticides, herbicides are all detergent products.

Task 8. Answer the following questions:

1. What is the difference between chemical technology and chemical engineering? What are these sciences?
2. What does chemical industry produce?
3. What are the examples of agrochemicals?
4. What disciplines are closely connected with chemical industry?
5. What other branches of science is chemical industry related to?

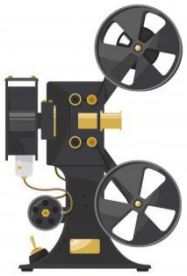
Task 9. Fill in the summary of the text with the proper words from the text in Task 3:

Chemical Technology of chemical _____ deals with the _____ of physical science and _____ or conveying _____ materials into more _____ or valuable form. The person who works in the field of chemical technology is called _____ _____. Chemical engineering is also connected with design and _____ of chemical processes for manufacture.

Chemical engineering manufactures a wide _____ of products implemented by _____ _____. It manufactures _____ and _____industrial chemicals, _____ (fertilizers and insecticides), explosives, detergent products (_____,_____,_____), etc. _____ and _____ processing are closely connected with chemical technology.

Modern chemical engineering is connected with _____ and _____engineering.

Video Entry



Follow the link below, watch the video: https://www.youtube.com/watch?v=2kttVyakHN4 and do the following exercises:

1. Make sure you know the following words and word combinations:

Gum base, flavouring, add, pour, syrup, soft, sweetener, dough, pre-extruder, squeeze, strip, heat up, cut, cooling, chamber wrap, slow motion, replay, scale.

2. Find the verbs in the list above that may refer to the process of gum production.

3. Say what do these numbers in the video refer to:

1869, 1928, 20 minutes, 900 pieces.

4. Put the stages in the gum production in the correct order according to the video entry:

a) add colour and flavor
b) pour gum base into mixer
c) the gum pieces are wrapped
d) pour the syrup and sweetener
e) the gum is cut into bite size pieces
f) the mass is squeezed through the extruder
g) blend the ingredients
h) the bubble gum is put into the container and sealed
i) blend the ingredients

Unit 9

Chromatography

Task 1. Answer the following questions:

1). Have you ever heard about chromatography?

2). When does a man need compose or decompose elements? How are composed/decomposed elements applied?

3). What are the ways to combine or separate chemical elements?

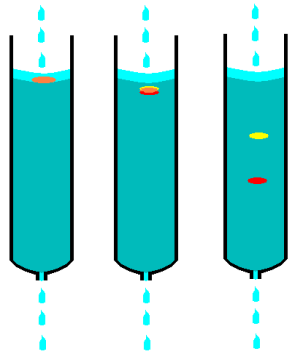
Task 2. Translate the following words with the international stems:

Analytical, individual, analyze, type, ion, basic, phase, gas, zone, biological, chemical, molecular, virus, method

Task 3. Read and translate the text below. Use the following words:

1) separate [ˈseprət] – отделять
2) liquid [ˈlɪkwɪd] – жидкий, жидкость
3) ion-exchange [ɪksˈʧeɪndʒ] – ионный обмен
4) affinity [əˈfɪnɪtɪ] – родство
5) mobile phase [ˈməʊbaɪl] – подвижная фаза
6) contiguous [kənˈtɪgjʊə] stationery [ˈsteɪʃ(ə)n(ə)rɪ] phase – продолжительная стационарная фаза
7) degree of adhesion [ədˈhiːʒ(ə)n] – степень сцепления
8) silica [ˈsɪlɪkə] – кремнезем
9) driving [ˈdraɪvɪŋ] force [fɔːs] – движущая сила
10) exert [ɪgˈzɜːt] – напрягать
11) solute [ˈsɒljuːt] – растворенное вещество
12) ionic charge [aɪˈɒnɪk] – ионный заряд
13) viscosity [vɪˈskɒsɪtɪ] – вязкость, тягучесть
14) nonflowing [non ˈfləʊɪŋ] solvent [ˈsɒlv(ə)nt] – нетекучий растворитель
15) hydrocarbons [ˌhaɪdrəˈkɑːbənz] – углеводороды
16) foreknowledge [fɔːˈnɒlɪdʒ] – предвидение, предположение
17) versatile [ˈvɜːsətaɪl] – универсальный, многогранный
18) forensic [forensic] science [science] – криминалистика
19) abused [əˈbjuːzd] – чрезмерно использовать
20) unequal [ʌn ˈiːkw(ə)l] – неравномерный
21) resolving power – разрешающая сила

The Wonder of Chromatography



'Chromatography' is an analytical technique commonly used for separating a mixture of chemical substances into its individual components, so that the individual components can be thoroughly analyzed. There are many types of chromatography e.g., liquid chromatography, gas chromatography, ion-exchange chromatography, affinity chromatography, but all of these employ the same basic principles. Chromatography is a separation technique that every organic chemist and biochemist is familiar with [12].

Chromatography consists of two phases: one mobile phase and one contiguous stationery phase. The stationery phase is liquid or solid and the mobile phase is gas or liquid. The compound mixture moves along with the mobile phase through stationery phase and separates depending on the different degree of adhesion (to the silica) of each component in the sample or the compound mixture [13].

Chromatography is one of several separation techniques defined as differential migration from a narrow initial zone. Electrophoresis is another member of this group. In this case, the driving force is an electric field, which exerts different forces on solutes of different ionic charge. The resistive force is the viscosity of the nonflowing solvent. The combination of these forces yields ion mobilities peculiar to each solute.

Chromatography has numerous applications in biological and chemical fields. It is widely used in biochemical research for the separation and identification of chemical compounds of biological origin. In the petroleum industry the technique is employed to analyze complex mixtures of hydrocarbons.

As a separation method, chromatography has a number of advantages over older techniques—crystallization, solvent extraction, and distillation, for example. It is capable of separating all the components of a multicomponent chemical mixture without requiring an extensive foreknowledge of the identity, number, or relative amounts of the substances present. It is versatile in that it can deal with molecular species ranging in size from viruses composed of millions of atoms to the smallest of all molecules—hydrogen—which contains only two; furthermore, it can be used with large or small amounts of material. Some forms of chromatography can detect substances present at the attogram (10^{-18} gram) level, thus making the method a superb trace analytical technique extensively used in the detection of chlorinated pesticides in biological materials and the environment, in forensic science, and in the detection of both therapeutic and abused drugs. Its resolving power is unequaled among separation methods [14].

Task 4. Match English and Russian equivalents:

1) thoroughly analyzed	a) аффинная хроматография
2) affinity chromatography	b) растворитель
3) separation technique	c) тщательно анализированный
4) contiguous stationery phase	d) нетекучий растворитель
5) different degree of adhesion	e) кремнезем
6) silica	f) техника разделения

7) the resistive force	g) сила сопротивления
8) nonflowing solvent	h) различные техники сцепления
9) solute	i) продолжительная неподвижная фаза

Task 5. Give English equivalents:

1) аналитическая техника	
2) отдельные компоненты	
3) жидкостная хромотография	
4) подвижная фаза	
5) жидкость	
6) степень скрепления	
7) электронное поле	
8) ионный заряд	

Task 6. Fill in the gaps with one of the following words/word combinations:

chemical field, compound mixture, petroleum industry, advantages, biological origin

1. Basic products in the _____ are oil and gasoline.
2. One of the _____ of the chromatography is ability to separate even small quantities of a substance.
3. Substances of _____ can be natural or synthetic.
4. In the process of chromatography _____ is divided into individual components.
5. Organic chemistry, non-organic chemistry and oil chemistry are part of _____.

Task 7. Say if the sentences are true or false. Prove your choice.

1. Chromatography is not widely popular in chemical world.
2. Chromatography consists of 3 phases.
3. Mixtures go through stationary phase first, than it follows mobile phase.
4. Chromatography and electrophoresis are the same processes.
5. Chromatography detects various sizes of matter.

Task 8. Answer the following questions:

1. Why is chromatography used?
2. What forms of matter are involved in mobile and stationary phases?
3. What is the principle of electrophoresis work?
4. Where is chromatography applied?
5. What are the names of older techniques used before chromatography?
6. What are advantages of the method of chromatography?
7. Are there methods of separation of an equal efficiency today?

Task 9. Fill in the short narration of the text with the proper words and phrases.

Chromatography is a _____ technique. It separates _____ in to _____components. There are _____ chromatography, _____ chromatography, _____ chromatography and other types.

It consists of two phases:_____ phase and ___phase. During these phases the compound mixture is separated depending on degree of_____ of each component. Electrophoreses is also a _____ technique, but it uses _____field that exerts _____ on solutes.

Chromatography is used in _____ and_____fields. It has a number of _____over older techniques: you don`t need to know _____, _____ or amount of a substance, it is _____ (deals with different sized of molecules), it can detect substance at the _____level. These advantages make it unequaled among _____ methods.

Task 10. What is practical application of chromatography? Think of some examples of its use in industry and make presentation to the class.

Video Entry

Follow the link below, watch the video: https://www.youtube.com/watch?v=uOhefwQBAbI
and do the exercise below:

1. Make sure you know the following words and word combinations:

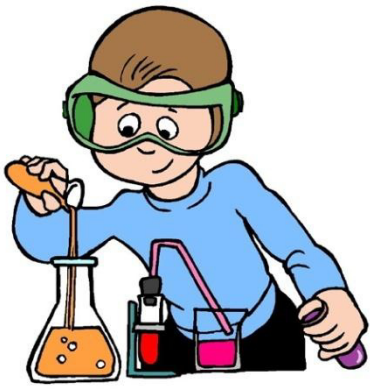
Coloured marker, filter paper, start line, pencil, concentrated spots, sample, distinguish, soluble solvent, water-based ink, dye, immerse, beaker, Rf values.

2. Answer the following questions:

1. What are some of the advantages of chromatography use?
2. Why was water used as a solvent in the video?
3. Why do we cover the beaker?
4. What for do we measure solvent front?
5. What colour sport is made of with the use of only one dye?
6. What dye is the most soluble? Why?
7. What dye is the least soluble? Why?
8. What do the second and the third experiments show?
9. Why do we place spots above the water level?

Unit 10

The Work of Chemical Engineer



Task 1. Answer the following questions:

1). What do you think the work in chemical industry connected with?

2). What makes the work of chemical engineer attractive?

3).What are the risks involved in this profession?

Task 2. Translate the following words with the international stems:

Specialists, design, economic, reactions, temperature, laboratory, filtration, distillation, configurations, transport, conservation, models, automotive, gel, genome, physics.

Task 3. Read and translate the text below. Use the following words:

1 production chain [prəˈdʌkʃ(ə)n ʧeɪn] – серийное производство
2 complicate [ˈkɒmplɪkeɪt] – усложнять
3 "showcase" reaction [rɪˈækʃ(ə)n] – «реакция демонстрации»
4 high-pressure [ˌhaɪ ˈpreʃə] – высокое давление
5 low yield [jiːld] – низкая продуктивность
6 arduous work [ˈɑːdjʊəs] – трудная работа
7 evaporator [ɪˈvæpəˌretə] – испаритель
8 economic advantage [ədˈvɑːntɪdʒ] – экономическое преимущество
9 unit operations [ˌɒpəˈreɪʃənz] – операции, объединенные в одном производственном шаге
10 momentum-transfer operations [məˈmentəm trænsˈfɜː(r)] – операции передачи импульса движения
11 chemical synthesis [ˈsɪnθɪsɪs] – химический синтез
12 chemical separation [sepəˈreɪʃ(ə)n] – химический распад
13 conservation [kɒnsəˈveɪʃ(ə)n] – сохранение
14 plant [plɑːnt] – строительная площадка
15 encompass [ɪnˈkʌmpəs] – заключать в себе
16 commodity [kəˈmɒdɪtɪ] – продукт, товар широкого потребления
17 specialty chemicals [ˈspeʃ(ə)ltɪ ˈkemɪkəlz] — химические продукты тонкого органического синтеза
18 high-performance material [haɪ pəˈfɔːm(ə)ns] — материал с повышенными технологическими показателями
19 application [æplɪˈkeɪʃ(ə)n] — применение
20 fiber [ˈfaɪbər] — волокно

21 fabrics [ˈfæbrɪks] – ткани

22 dye-sensitized solar cell [daɪ ˈsensɪtaɪzd] – солнечные батарейки и сенсибилизированным красителем

23 adhesives [ədˈhiːsɪvz] – клейкие вещества

24 mapping [ˈmæpɪŋ] – отображение, построение модели

25 mass produce [mæs prəˈdjuːs] – запускать массовое производство

Chemical Engineer: their Field of Work

The field of chemical technology applies a wide range of specialists, they can generally be called Chemical Technologists or Chemical Engineers.

Chemical engineers design processes to ensure the most economical operation. This means that the entire production chain must be planned and controlled for costs. A chemical engineer can both simplify and complicate "showcase" reactions for an economic advantage. Using a higher pressure or temperature makes several reactions easier; ammonia, for example, is simply produced from its component elements in a high-pressure reactor. On the other hand, reactions with a low yield can be recycled continuously, which would be complex, arduous work if done by hand in the laboratory. It is not unusual to build 6-step, or even 12-step evaporators to reuse the vaporization energy for an economic advantage. In contrast, laboratory chemists evaporate samples in a single step. The individual processes used by chemical engineers (e.g. distillation or filtration) are called unit operations and consist of chemical reactions, mass-, heat- and momentum- transfer operations. Unit operations are grouped together in various configurations for the purpose of chemical synthesis and/or chemical separation. Some processes are a combination of intertwined transport and separation unit operations, (e.g. reactive distillation).

Three primary physical laws underlying chemical engineering design are conservation of mass, conservation of momentum and conservation of energy. The movement of mass and energy around a chemical process are evaluated using mass balances and energy balances, laws that apply to discrete parts of equipment, unit operations, or an entire plant. In doing so, chemical engineers must also use principles of thermodynamics, reaction kinetics and transport phenomena. The task of performing these balances is now aided by process simulators, which are complex software models that can solve mass and energy balances and usually have built-in modules to simulate a variety of common unit operations.

The modern discipline of chemical engineering encompasses much more than just process engineering. Chemical engineers are now engaged in the development and production of a diverse range of products, as well as in commodity and specialty chemicals. These products include high performance materials needed for aerospace, automotive, biomedical, electronic, environmental, space and military applications. Examples include ultra-strong fibers, fabrics, dye-sensitized solar cells, adhesives and composites for vehicles, bio-compatible materials for implants and prosthetics, gels

for medical applications, pharmaceuticals, and films with special dielectric, optical or spectroscopic properties for opto-electronic devices.

Many chemical engineers work on biological projects such as understanding biopolymers (proteins) and mapping the human genome. The line between chemists and chemical engineers is growing ever thinner as more and more chemical engineers begin to start their own innovation using their knowledge of chemistry, physics and mathematics to create, implement and mass produce their ideas [15].

Task 4. Match English and Russian equivalents:

1 design processes	a) экономическое преимущество
2 economic advantage	b) аммиак
3 complicate	c) испарять образцы
4 ammonia	d) разрабатывать процессы
5 recycled continuously	e) относящийся к окружающей среде
6 evaporate samples	f) композиты для транспортных средств
7 environmental	g) подвергаться непрерывной переработке
8 composites for vehicles	h) усложнять

Task 5. Give English equivalents to the following Russian word combinations:

1 экономная работа	
2 реакция демонстрации	
3 реактор высокого давления	
4 повторно использовать реакцию испарения	
5 химический распад	
6 отдельные части оборудования	
7 сложные программные модели	
8 разнообразный перечень продуктов	

Task 6. Fill in the gaps with the correct preposition:

1. Today secondary industry employs a wide range … specialists.
2. Nitrogen is extracted from methane … produce ammonia. This process takes place … a high pressure reactor.
3. All processes of chemical production must be controlled … environmental safety.
4. The processes in chemical industry can be automated of done … hand.
5. Application of new machinery help to perform operations … a single step.
6. Distillation and filtration are used … chemical engineers … produce petrol and kerosene from crude oil.
7. Minerals are chemical combinations … native elements.
8. Chemical engineering is based on the principles … thermodynamics.

9. Many chemical laboratories today work … elimination all sorts of viruses from the technological production.

10. The materials such …. ultra strong fiber, solar cells, adhesives and gels are high-performance ones.

Task 7. Make derivatives from the following stems. Translate them into Russian:

Example: *conserve (консервировать) – conservat**ion** (консервация)*

General - , economy - , produce - , simple - , react - , continue - , evaporate - , vapour - , operate - , equip - , compose - , apply - , biology - , innovate - .

Task 8. Fill in the gaps with the proper word or word combination from the list below:

Encompasses, mass produce, done by hand, human genome, adhesives, space and military applications, commodities

1). … consists of 3 billion pairs of nucleotide elements.

2). In the beginning of the 20-th century …. of industrial goods started. Before it was only relevant for food and clothes.

3). The work of chemical engineer … the development of chemical materials and their use in production.

4). A wide range of oil … is used in chemical industry, machinery and light industry.

5). High-performance materials have wide automotive, ….

6). When you mix … with water they form plastic mass that subsequently is made into artificial stone.

7). When chemical experiments are done in the laboratory …. you must wear special protective equipment.

Task 9. Say if the sentences are true or false:

1. One of the tasks of chemical engineer is to simplify the process of production.
2. Some reactions are dome in laboratories by hand.
3. The reaction of evaporation is always performed in many steps.
4. Unit operations consists of several reactions.
5. Chemical engineering design is based on three laws.
6. Chemical technologists produce only within process engineering.
7. There is no much difference between chemists and chemical engineering.

Task 10. Answer the following questions:

1. What specialists are employed in the field of chemical technology?

2. What factors should chemical engineers consider when designing production process?

3. What are unit operations and what do they consists of?

4. What principles do chemical engineers use in their work?

5. What are process simulators?

6. For what products are high-performance materials needed?

7. Can you give examples of high-performance materials?

8. How are chemical engineers and chemists related?

Task 11. Fill in the outline of the text with the words from the text in Task 3:

The specialist working in the sphere of chemical technology is called _____ _____ or _____ _____. Chemical engineer controls entire production costs for _____. He or she can make several reactions _____, using higher _____ or _____.

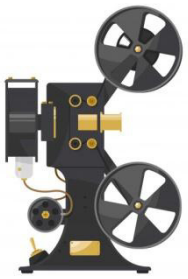
The processes of filtration or distillation are called _____ _____. They can be groups together for the purpose of chemical _____ or chemical_____.

There are three laws underlying chemical engineer design: _____ of_____, _____of_____and _____of_____. The movement of mass and energy are evaluated by the laws of mass and energy _____.

Chemical engineers are involved in the _____ of a _____range of products. These products include _____ materials, ____ for medical applications, films with special_____, _____ or_____ properties, etc. The examples of such materials are: _____, _____, _____.

Today the line between chemist and chemical engineer has become ___, because many chemical engineers start their own _____ using their knowledge of _____.

Video Entry



Follow the link below, watch the video: https://www.youtube.com/watch?v=k-7B_YfHWXQ and do the following exercises:

1. Make sure you know the following words and word combinations:

Scale up, work in team, small and large skills, come up with the idea, laundry, drier, smell, rotation in agitator, breaking up, it`s awesome, plant safety, environmentally sustainable.

2. Choose the most appropriate answer:

1. What does Anita work with?

a) green gases b) solids c) liquids

2. What does consumer of P&G products want?

a) low product cost b) the products dry well c) the products to smell well

3.What are Anita and Laura talking about?

a) the name of their products b) how to make production more effective c) light on plants

4. What topic do Anita and her team discuss?

a) the noise study b) the fire safety study c) the smell study

5) What is the most important thing in the profession of a chemical engineer?

a) experience b) team c) creativity

3. Answer the following questions:

1. What does the work of chemical engineer combine?
2. What fields do chemical engineers work in?
3. What does the experiment with rotation of the liquid show?
4. How does Laura describes the benefits of working as chemical engineer?
5. What does Anita do in her free time?
6. What education must chemical engineers receive?
7. What is the most rewarding in Anita`s job, in her opinion? What do you think about her job?

Revision. Units 8-10

Task 1. Match Russian and English equivalents:

1 maintenance	a) клейкие вещества
2 large-scale manufacture	b) методы разделения
3 derivatives	c) крупномасштабное производство
4 insecticides	d) высокоэффективные материалы
5 detergent products	e) обслуживание
6 adhesives	f) сложная смесь
7 stationery phase	g) производные
8 compound mixture	h) средство для истребления насекомых
9 biological origin	i) сохранение энергии
10 separation methods	j) моющие средства
11 "showcase" reactions	k) реакции с низкой продуктивностью
12 low yield reactions	l) сверхпрочные волокна
13 conservation of energy	m) «реакция демонстрации»
14 high performance materials	n) неподвижная фаза
15 ultra-strong fibers	o) биологическое происхождение

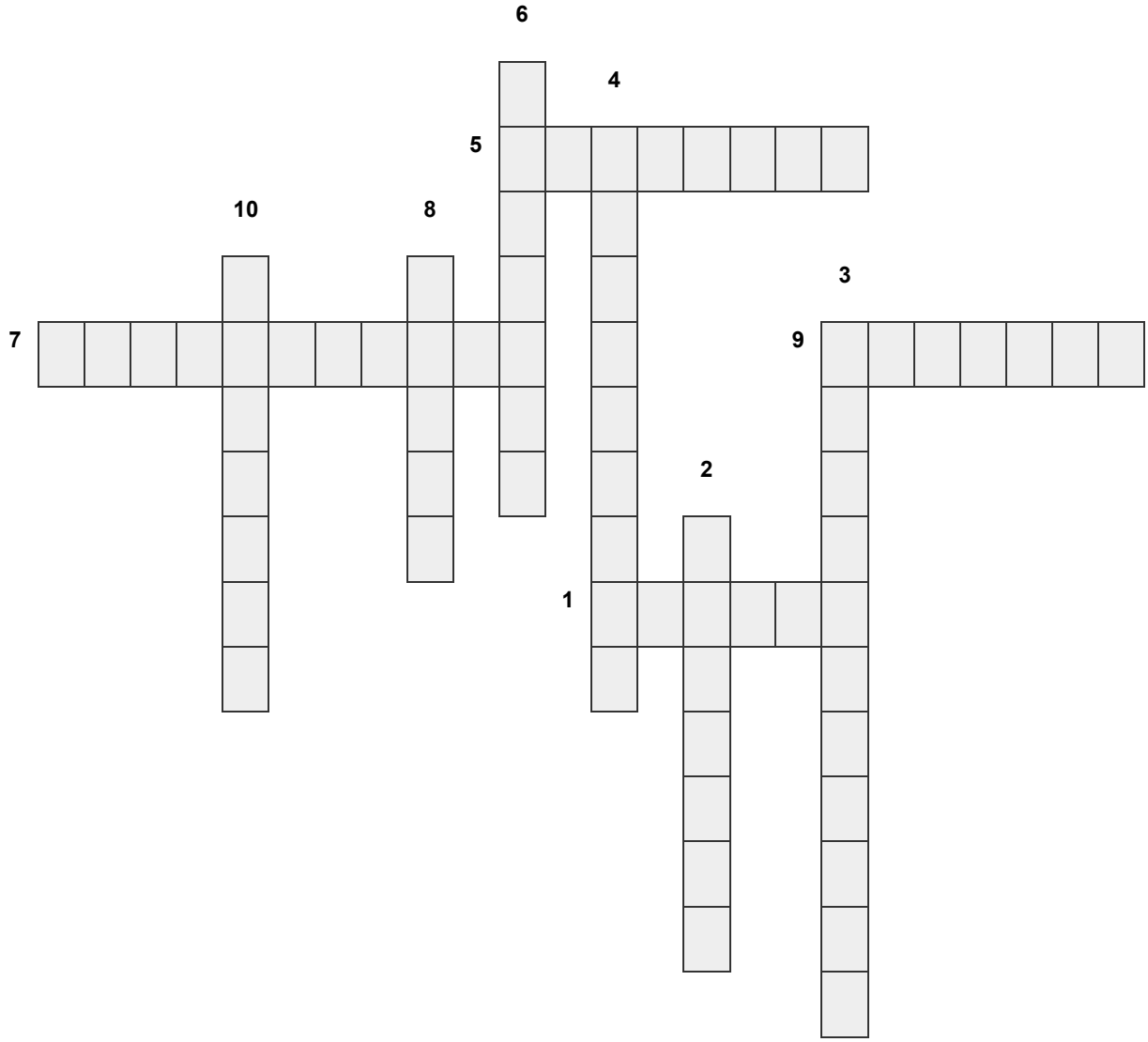
Task 2. Do the crossword (crossword puzzle in American English).
Give English equivalents to the following definitions:

Words oriented horizontally:

1. It is electronic characteristics of matter, it can be positive or negative and forms electrical field.
5. It is the analysis and experiments to get some scientific results.
7. It is a process when liquids turns to vapour
9. When you add one substance to the others and make it one substance.

Words oriented vertically:

2. The synonym to equilibrium
3. The science that deals with numbers. It is studied at school
6. Natural substance (adjectives)
4. The synonym to matter, it consists of particles such as electrons, protons and neutrons.
8. The area or spectrum. It is formed around electrically charged particles
11. The substance that makes the other substance thinner, without changing its contents



Task 3. Answer the following questions:

What are the products of chemical industry?

What two aspects does the work of chemical engineer involve?

What is chromatography and what types of chromatography do you know?

What are the advantages of chromatography compared to older separation techniques?

What do you think is the most interesting in the work of the chemical engineer?

Units 8-10. Test

Choose the correct variant to fill in the gaps in the sentences below:

1. Chemical engineers process raw materials into _____ forms.
a) useful b) expensive c) large-scale
2. Chemical engineer who deals with design of chemical processes is called _____ engineer.
a) processing b) process c) designing
3. Soap and cleaning fluids are _____ product.
a) fertilizing b) adhesive c) detergent
4. Chromatography is a process of _____ of a complex substance.
a) separation b) mixing c) designing
5. Stationary phase of chromatography is _____.
a) gas or liquid b) liquid or solid c) solid or gas
6. In petroleum industry chromatography is used for separating _____.
a) hydrocarbons b) monomers c) gases
7. One of the advantages of the chronometry is that it can deal with _____ amounts of substances.
a) very small b) very large c) very large or small
8. A chemical engineer _____ "showcase reactions".
a) simplifies b) complicates c) simplifies and complicates
9. The work of chemical engineer is based on the laws of _____ of mass, energy and momentum.
a) conversation b) conservation c) combination
10. Ultra-strong fibers, fabrics, dye-sensitized solar cells are _____ materials.
a) low-performance b) middle-performance c) high-performance
11. Low-yield reactions are _____.
a) one-step reactions b) complex reaction c) unit-operations
12. The connection between chemical engineering and chemists is _____.
a) very small b) very thin c) very strong

Section 4

Chemical Safety

Unit 11

Safety in a Chemical Laboratory

Task 1. Answer the following questions:

1). What are possible risks in chemical laboratory?

2).What are the usual reasons for emergencies in labs?

3). Below are the names of safety equipment. Find the words that name the gadgets in the picture to the fight. What gadgets are usually used in chemical laboratories?

goggles, harness, gloves, hard hat, face shield, respirator, filter, reflective string, apron, hat rig

Task 2. Translate the following words with the international stems:

Testing, cabinet, detail, latex, recommend, bandage, antibiotic, culture, risk, minimize.

Task 3. Read and translate the text below. Use the following words:

1) fire hazards [ˈfaɪə ˈhæzədz] – пожарная опасность
2) serious injury [ˈsɪərɪəs ˈɪn(d)ʒ(ə)rɪ] – серьезная травма
3) safety goggles [ˈseɪftɪ gɒglz] – защитные очки
4) disposable gloves [dɪˈspəʊzəb(ə)l glʌvz] – одноразовые перчатки
5) lab coats [læb kəʊts] – лабораторный халат
6) first aid kit [fɜːst eɪd kɪt] – аптечка, набор для оказания первой помощи
7) fire blankets [ˈfaɪə ˈblæŋkɪts] – пожарное покрывало
8) emergency shower [ɪˈmɜːdʒ(ə)nsɪ ʃaʊə] – душевая для аварийных ситуаций
9) chemical fume hood [ˈkemɪk(ə)l fjuːm hʊd] – химический вытяжной шкаф
10) lab gear [læb gɪə] – лабораторное оборудование
11) exposure [ɪkˈspəʊʒə] – зд. воздействие

12) irritants [ˈɪrɪtənts] – химикаты, вызывающие раздражение
13) nitrile gloves [ˈnaɪtraɪl glʌvz] – нитриловые перчатки
14) flame [fleɪm] – пламя
15) scissors [ˈsɪzəz] – ножницы
16) tweezers [ˈtwiːzəz] – пинцет, щипчики
17) ointment [ˈɔɪntm(ə)nt] – мазь
18) fire extinguisher [ˈfaɪə ɪkˈstɪŋgwɪʃə] – огнетушитель
19) foam [fəʊm] –пена
20) spills [spɪlz] – утечка
21) caution tape [ˈkɔːʃ(ə)n teip] – предостерегающая лента
22) waste tags [weɪst tægz] – метка для отходов
23) flame retardant [fleɪm rɪˈtɑːdɪnt] – защищающий от огня
24) smoother [ˈsmuːðə] – смягчающее вещество
25) safety storage cabinets - шкафы для безопасного хранения

Safety Rules and Equipment

Laboratories are the rooms where business, government, and schools conduct tests and research. With fire hazards, dangerous chemicals, and high-risk procedures, a lab can become a dangerous workplace. But by following laboratory safety rules and having the correct safety equipment available will reduce serious injury when working with chemicals.

Among important equipment needed when working in laboratory are: safety goggles, disposable gloves, lab coats, first aid kit, fire extinguisher, chemical spill kit, fire blankets, emergency showers, chemical fume hood and safety storage cabinets. Let`s look onto these pieces of equipment in details.

The useful equipment in labs is safety goggles. It is the simplest and inexpensive lab gear, but they will serve as a perfect protection of your eyes from exposure of the dangerous materials.

To have a stock of disposable gloves is also very important. They will provide protection from chemicals and other irritants. You should always remember, that latex glove are effective only against water-based solutions and for added protection, Nitrile gloves are recommended.

To protect you from uncontrolled flame of aggressive chemicals if it occurs while working, lab coats are useful. They provide a full body protection from hazardous materials. They are manufactured to be flame and chemical resistant and must be worn by all team members.

In the case of emergency all laboratories must have first aid kit. This indispensible equipment contains bandages, scissors, tweezers, hand sanitizers, antibiotic ointments and other emergency appliances. Several first aid kits must be available around the lab so that to land a hand to all who needs it.

Laboratories are required to have multiple fire extinguishers. There are several types of extinguishers a lab should be equipped with: water-based, AFFF (Aqueous Film-Forming) Foam and Wet Chemical Extinguishers.

It is quite common that chemical laboratories work with acids, corrosive liquids or unknown substances and sometimes spills of these liquids occur. In this case the staff must use chemical spill kits. They help you to handle and clean up corrosive chemicals and hazardous liquids. There are many ranges of chemical spill kits available in variety of containers of different materials and sizes. You can put these kits together using disposable nitrile gloves, caution tape, plastic bags, hazardous waste tags, a container with sodium carbonate, etc.

One more type of equipment to protect from fire is s fire blanket. They are often made of wool and treated with flame retardant. They are used to smoother the fire or to wrap around a person who is close to the source of fire and may catch it. Eye Wash Station and Emergency Showers are also useful to provide quick access to decontamination to minimize accidental exposure to chemicals.

Flammable liquids, corrosives and other hazardous materials must be stored inside safety storage cabinets. These cabinets are designed to reduce the risk of damaging fire in the workspace.

Having all the correct safety equipment isn't enough to prevent all laboratory injuries. A set of general laboratory safety rules should be established and followed by all lab works. Creating a safety culture and providing safety training decreases the risk of accidents from occurring in the workplace [16].

Task 4. Match English and Russian equivalents:

1) high-risk procedures	a) воспламеняемые жидкости
2) safety storage cabinets	b) приспособления для поведения в опасных ситуациях
3) stock	c) полезное оборудование
4) emergency appliances	d) опасные жидкости
5) corrosive chemicals	e) высокоопасные процессы
6) hazardous liquids	f) коррозийные химикаты
7) useful equipment	g) шкафы для безопасного хранения
8) flammable liquids	h) запас

Task 5. Give English equivalents to the following Russian word combinations:

1 опасные химикаты	
2 оборудование по обеспечению безопасности	
3 одноразовые перчатки	
4 лабораторное приспособление	
5 защита от раздражающих веществ	

6 растворы на водной основе	
7 огнестойкий	
8 аптечка первой помощи	
9 средства для оказания первой медицинской помощи	
10 разные типы огнетушителей	
11 коррозивные жидкости	
12 огнезащитное средство (ингибитор)	

Task 7. Match the type of equipment with its application:

1 first aid kit	a) to work with alkaline acids
2 disposable gloves	b) to protect people who are close to the source of fire by covering them
3 nitrile gloves	c) for the emergency help
4 lab coat	d) to control or put out the fire caused by oil, paints or fuels
5 fire extinguishers	e) to protect from flame
6 chemical spill kit	f) to work with water-based solutions
7 fire blanket	g) to keep flammable substances from ignition
8 safety storage cabinet	h) to absorb corrosive chemicals

Task 7. a) Below are the signs used in a chemical manufacturing. Translate them into Russian using the prompts below:

mandatory – обязательный
face shield - сварочный щиток
laboratory coat – лабораторный халат
breathing apparatus – респиратор
inhalation – вдох

b) Divide the signs into these categories: a) extremely important to do (obligatory); b) advisory; c) warning; d) regulations for doing something;
e) regulations got skipping something; and fill in the table below:

a)	b)	c)	d)	e)

c) Use the mandatory signs above and design the safety signs board for the laboratory in your University. Use the expressions below depending on the degree of importance and obligation of the rules: *must be, please, need to be, keep, watch, avoid.*

Task 8. Say if the sentences are true or false:

1. To protect your eyes from water-based solutions nitrile gloves are recommended.
2. To have one first aid kit in chemical plant is enough.

3. Fire blanket is made from fire proof materials.
4. There is special equipment to wash your body from accidental spread of toxic substances.
5. Fire blanket is used for the person who risks to catch fire.

Task 9. Answer the following questions:

1. What can reduce risks in chemical laboratories?
2. What types of equipment can you name?
3. What is the function of safety goggles?
4. What types of safety gear are used to protect yourself from fire?
5. What is usually included in the first aid kit?
6. What helps to protect health and equipment from corrosive chemicals?
7. How can you protect your laboratory from fire caused by flammable liquids kept there?
8. What else must laboratory personnel follow apart from emergency equipment to make laboratory a safe place for work?

Task 10. Continue the following sentences using the information from the text:

1. A lab can be dangerous place to work at because of _____.
2. Important equipment for the work in laboratory is _____.
3. The simples and chip lab gear is _____.
4. Disposable gloves are important because_____.
5. To provide full body protection from fire _____is used.
6. First aid kit contains_____.
7. There are many types of fire extinguishers:_____.
8. Spill kits can help to _____. They consist of _____.
9. Fire blankets are made from_____. They are used to _____.
10. Safety storage cabinets are designed to _____.

Task 11. Project. Choose one of the type of protective gear used in chemical laboratory and make a report about their construction, types and the way to use.

Video Entry

Follow the link below, watch the video:
https://www.youtube.com/watch?v=gi3DeFY0cfw
and do the following exercises:

1. Make sure you know the following words and word combinations:

Loose fitting, long hair tied back, burned hand, waft, broken glass disposal, remove, rinse, splash, point, catch fire, roll, beaker, stock bottle.

2. Answer the following questions:

1. When and why do novices come to the laboratory?
2. What protective lab gear is mentioned in the video? Make a list.

3. Below is the list of safety rules for chemical laboratory. Tick the ones mentioned in the video:

1. Always wear loose clothes.
2. Always wear face shield in the laboratory.
3. No smoking in the laboratory.
4. No washing in the laboratory.
5. Always wear safety clothes.
6. No eating in the laboratory.
7. Always read labels on the chemicals carefully.
8. In case of fire use fire extinguisher.
9. In case of fire lie down and roll.
10. What you laboratory station when you leave the lab.

4. Match the sentences below as True or False according to the information in the video:

1. Throw broken glass beakers in the waste basin.
2. Notify your safety instructor about any accidents.
3. Always smell chemicals yourself.
4. Always return unused chemicals in stock bottle.
5. When in chemical lab always wear shoes covering the top of your feet.

Unit 12

Chemistry and Ecology

Task 1. Answer the following questions:

1. What are the potential dangers in the chemical laboratory or chemical plant?
2. How is it possible to make the work with chemicals safe?
3. What protective equipment for the work of chemical engineer do you know? Have you used any of it?

Task 2. Translate the following words with the international stems:

Technology, products, materials, associate, component, design, discipline, innovation, nature, atom, catalysis, strategy, principles, final, syntheses, generate, toxicity, alternatives, focus, methods.

Task 3. Read and translate the text below. Use the following

1) considerable [kənˈsɪd(ə)rəb(ə)l] - значительный
2) undergo [ʌndəˈgəʊ] – испытывать, переносить, претерпевать
3) harmful impact [ˈhɑːmfʊl ˈɪmpækt] – вредное воздействие
4) undoubtedly [ʌnˈdaʊtɪdlɪ] - несомненно
5) contamination [kənˌtæmɪˈneɪʃ(ə)n] - загрязнение
6) observation [ɒbzəˈveɪʃ(ə)n] – наблюдение, изучение
7) regulations [ˌregjʊˈleɪʃənz] – нормы, правила
8) eliminate [ɪˈlɪmɪneɪt] – устранять, исключать
9) reduce [rɪˈdjuːs] - снижать
10) adoption [əˈdɒpʃ(ə)n] - принятие
11) consumption [kənˈsʌm(p)ʃ(ə)n] - потребление
12) nonrenewable resources [nanrɪˈnuːəbəl rɪˈzɔːsɪz] – невозобновляемые ресурсы
13) technological approaches [teknəˈlɒdʒɪk(ə)l əˈprəʊtʃɪz] – технологические подходы
14) research efforts [rɪˈsɜːtʃ ˈefəts] – объем исследований
15) prevent [prɪˈvent] - предотвращать
16) leave [liːv] - оставлять
17) treat [triːt] – зд. обрабатывать что-то
18) avoid [əˈvɔɪd] - избегать
19) auxiliary chemicals [ɔːgˈzɪlɪərɪ ˈkemɪkəlz] – дополнительные, вспомогательные химикаты
20) ethidium bromide [ˈbrəʊmaɪd] - бромистый этидий
21) xylene [zaɪliːn] - ксилол
22) mercury [ˈmɜːkjərɪ] - ртуть
23) formaldehyde [fɔːˈmældɪhæɪd] - формальдегид

24) worst offenders [wɜːst əˈfendəz] – «злостные нарушители»
25) remediation [rɪˌmiːdɪˈeɪʃ(ə)n] – исправление, восстановление
26) waste streams [weɪst striːmz] **-** поток отходов (кол-во различных отходов, образующихся на какой-либо территории в течение определенного времени)
27) end-of-the-pipe treatment [ˈtriːtm(ə)nt] - обезвреживание отходов в конце производственного процесса
28) environmental spills [ɪnvaɪrənˈment(ə)l spɪlz] – утечка вредных веществ в окружающую среду
29) reduce [rɪˈdjuːs] – преуменьшать, уменьшать

Green Chemistry

In view of considerable developments in technology, the growing need for products and materials, environment undergoes great harmful impact. Green issues are the topics of close social attention. Chemistry is undoubtedly very necessary branch of science, that is, unfortunately, associated with contamination of nature.

Modern state of chemistry as a science and technological component requires observation of all regulations that are needed to protect the environment. As a result of this the idea of "green chemistry" emerged.

Green chemistry is the design of chemical products and processes that reduce or eliminate the generation of hazardous substances. The efforts to speed the adoption of this revolutionary and diverse discipline have led to significant environmental benefits, innovation and a strengthened economy.

While environmental chemistry focuses on the effects of polluting chemicals on nature, green chemistry focuses on the environmental impact of chemistry, including reducing consumption of nonrenewable resources and technological approaches for preventing pollution.

Green chemistry emerged from a variety of existing ideas and research efforts (such as atom economy and catalysis) in the period leading up to the 1990s. The development of green chemistry in Europe and the United States was linked to a shift in environmental problem-solving strategies: a movement from command and control regulation toward the active prevention of pollution through the innovative design of production technologies themselves.

These are the principles of the concept of green chemistry:

1. Prevent waste: Design chemical syntheses to prevent waste. Leave no waste to treat or clean up.

2. Maximize atom economy: Design syntheses so that the final product contains the maximum proportion of the starting materials. Waste few or no atoms.

3. Design less hazardous chemical syntheses: Design syntheses to use and generate substances with little or no toxicity to either humans or the environment.

4. Design safer chemicals and products: Design chemical products that are fully effective yet have little or no toxicity.

5. Use safer solvents and reaction conditions: Avoid using solvents, separation agents, or other auxiliary chemicals. If you must use these chemicals, use safer ones.

6. Increase energy efficiency: Run chemical reactions at room temperature and pressure whenever possible.

Several laboratory chemicals are controversial from the perspective of green chemistry. The Massachusetts Institute of Technology helps to identify alternatives to the harmful substances. For example, ethidium bromide, xylene, mercury, and formaldehyde have been identified as "worst offenders" which have alternatives. Solvents in particular make a large contribution to the environmental impact of chemical manufacturing and there is a growing focus on introducing Greener solvents into the earliest stage of development of these processes: laboratory-scale reaction and purification methods.

Green chemistry is unlike cleaning up pollution (also called remediation), which involves treating waste streams (end-of-the-pipe treatment) or clean up of environmental spills and other releases. Remediation may include separating hazardous chemicals from other materials, then treating them so they are no longer hazardous or concentrating them for safe disposal. Most remediation activities do not involve green chemistry. If a technology reduces or eliminates the hazardous chemicals used to clean up environmental contaminants, this technology would qualify as a green chemistry technology [17; 18].

Task 4. Match English and Russian equivalents:

1) social attention	a) отрасль наук
2) branch of science	b) стратегии по решению проблем
3) hazardous substances	c) разделительные агенты
4) strengthened economy	d) общественное внимание
5) environmental impact	e) исходные материалы
6) preventing pollution	f) вредные вещества
7) problem-solving strategies	g) воздействие на окружающую среду
8) innovative design	h) безопасная утилизация
9) starting materials	i) инновационный дизайн
10) separation agents	j) крепкая экономика
11) safe disposal	k) предотвращение загрязнения

Task 5. Give English equivalents to the following Russian word combinations:

1) Масштабные разработки	
2) Вопросы экологии	
3) Загрязнение окружающей среды	

4) Экологически чистая («зеленая») химия	
5) Преимущества для окружающей среды	
6) Химический синтез	
7) Токсичность веществ	
8) Использование растворителей	

Task 6. Fill in the gaps with the words and word combinations below:

room temperature, auxiliary chemicals, pressure, safe, safe disposal laboratory-scale reaction, solvent.

1. Addition of the … – solvents or lubricants - stimulate effectiveness of chemical substance.
2. The storage of chemicals in laboratories must be environmentally …. .
3. The … in laboratory must be from +19 to + 24 above zero, the humidity – from 15 to 75%.
4. The process of olive oil extraction involves pressure up to 400 atm.
5. The …. in paints control their viscosity and thickness.
6. Before using chemical substance in large scale on plants, it is tested in …. .
7. …. of harmful substances like ethylene tetrachloride means prevention of contamination of soil, water and air.

Task 7. Say if the sentences are true or false:

1. The developments in chemistry leads to contamination of nature.
2. Green chemistry didn`t lead to any innovations.
3. In green chemistry starting product makes up the most proportion of he final product.
4. Green chemistry doesn`t use any solvents of auxiliary chemicals.
5. Chemical processes in green chemistry doesn`t use the electricity affectively.
6. Green chemistry uses alternatives to the harmful substances.
7. Clean up pollution (remediation) is the same as green chemistry.

Task 8. Answer the following questions:

1. Why did the green chemistry emerge?
2. What is the difference between environmental chemistry and green chemistry?
3. When did the idea of green chemistry appear?
4. What chemical substance is particular dangerous for environment?
5. How can you identify the chemical technology as green?

Task 9. Fill in the summary with the words and words combinations from the text:

Nowadays environment undergoes great _____ impact. Unfortunately, chemistry is associated with nature _____. Modern chemistry requires observations of all _____ to protect the environment.

Green chemistry regulates the generation of _____ substances. Green chemistry focuses on environmental _____ of chemistry, reducing consumption of _____ resources for _____pollution. The development of green chemistry is linked to ____ _____ strategies.

The principles of green chemistry are: _____ waste, maximize _____ economy, design ____ _____ chemicals, etc. Chemical institutes help to identify _____ to the harmful substances. Today there is a growing focus on introduction _____solvents into the _____ stage of development of chemical reactions and methods.

Green chemistry is unlike _____ ___ pollution. Green _____ technology _____ or _____ the use of hazardous chemicals to clean up environmental _____.

Task 10. In each of the sentences below the word in italics is in the wrong place, it was taken from the other sentence. Put the word in the sentence what is correct.

1. *Considerable developments* is a science that controls the elements of nature such as soil, atmosphere and hydrosphere.
2. *Soil contamination* are dust, fumes, gases or some living organisms that can cause intoxication.
3. Coal, oil or natural gas are examples of *solvents*.
4. Green ecology aims at less *non-renewable resources* of xylene and mercury.
5. Industrial activity, agricultural chemicals and poor utilization of waste cause *ecological chemistry*.
6. We need to use safe *consumption* and reaction conditions at workplace and follow all regulations to protect the lives of workers.
7. Kazakhstan, Canada and Australia are the world largest countries where *harmful substances* of uranium takes place.

Task 11. Self-study. Project.

a) Think of possible ways to reduce the impact of chemical substances to the environment when some product is produced. Make up and present the project.

b) Think of the ways to process the waste in your area. Make up and present the project.

Video Entry

Follow the link below, watch the video: https://www.youtube.com/watch?v=TZ7qx7KPTFY

and do the following exercises:

1. Make sure you know the following words and word combinations:

Renewable, non-renewable, emissions, pollution, combustion, waste water, acid rain, global warming, feedstock, crops, pests, consumer, release, decline, chemistry bleaches, hair care.

2. Fill in the table with the examples of the products for each type of chemical industry. 3-4 entries are required for each column:

Basic Chemistry	Specialty Chemistry	Life Science Chemistry	Consumer Care Products Industry

3. Answer the following questions:

1. What are the two ways how natural resources can be used by chemical industry?
2. What are the key uses of water by chemical industry?
3. How much of the world energy are used by chemical industry?
4. What substances are hazardous?
5. Ho are diverse chemical industries divided?

Revision. Units 11-12

Task 1. Match Russian and English equivalents:

1) fire-hazards	a) обеззараживающие мази
2) reduce	b) лабораторное оснащение
3) safety goggles	c) загрязнение природы
4) chemical fume hood	d) вещество, вызывающее раздражение
5) lab gear	e) воздействие на окружающую среду
6) irritant	f) опасные вещества
7) tweezers	g) химический вытяжной шкаф
8) antibiotic ointment	h) перерабатывать отходы
9) contamination of nature	i) уменьшать
10) hazardous substances	j) пинцет
11) environmental impact	k) очищение
12) preventing pollution	l) огнеопасность
13) treat waste	m) более безопасные растворители
14) safer solvents	n) предотвращение загрязнения
15) purification	o) защитные очки

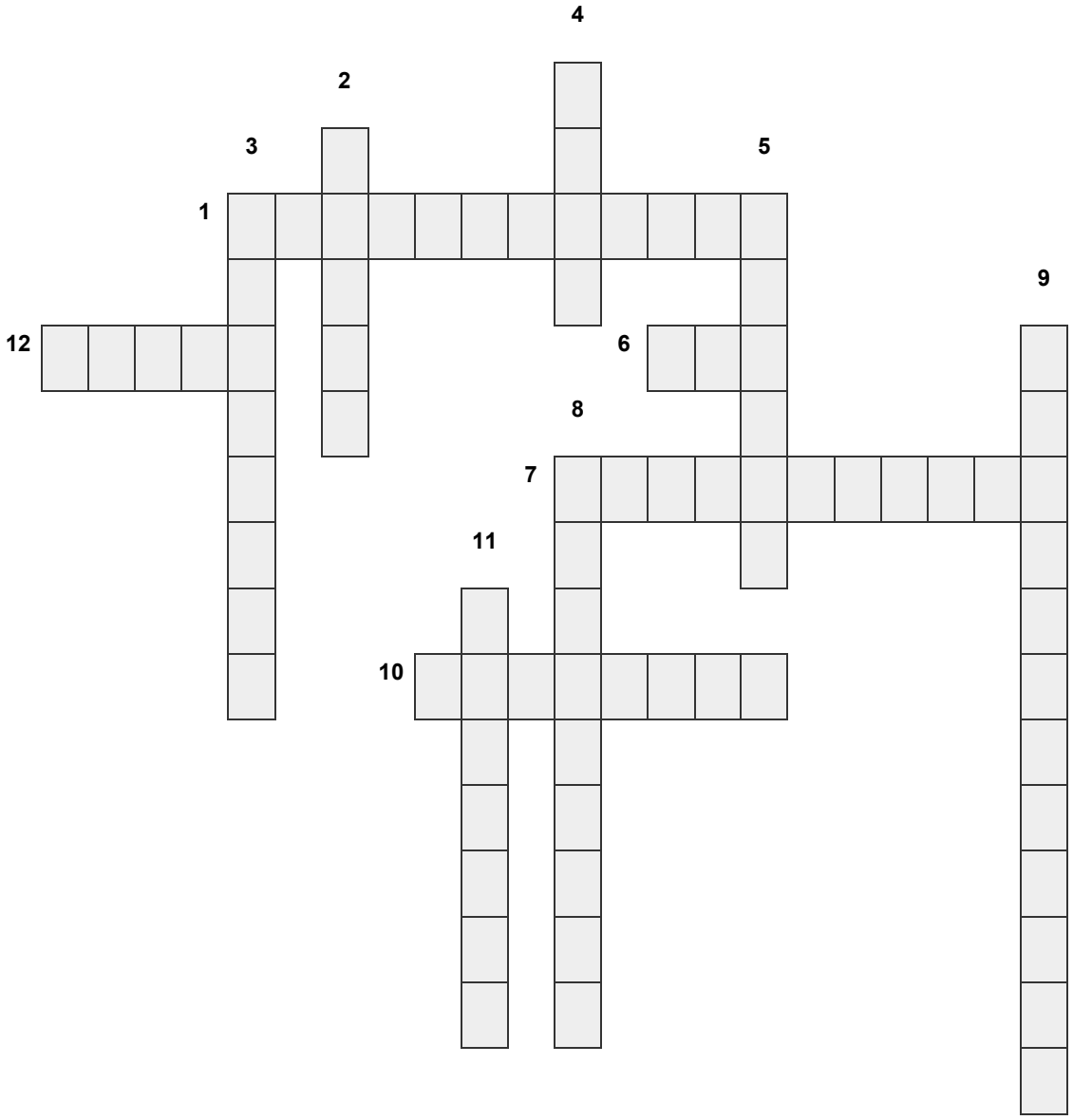
Task 2. Do the crossword (crossword puzzle in American English). **Give English equivalents to the following definitions:**

Words oriented horizontally:

6. The synonym to set, collection or case (Noun).
7. Everything that concerns nature and ecological conditions of some place (Noun).
10. Some poisonous material are characterized as …. (Noun).
11. The process when a substance is cleaned (Noun)
12. Something that is used and is thrown away (Noun).

Words oriented vertically:

2. The colour that is also used to characterize something ecologically clean (Adj.).
3. Applied force creates … (Noun).
4. The synonym to *equipment* (Noun).
5. Physical, material world, the Universe, the area where living organisms live.
8. Devices in laboratory (Noun).
11. Substance in which some other material is dissolved.
9. The device in red colour that is used to set out fire (Noun).



Task 3. Answer the following questions:

1. What are the potential hazards in chemical laboratory?
2. What is safety equipment that is every laboratory must have?
3. Have you ever had some emergency case when working with chemicals? How did you deal with it?
4. What does green chemistry do?
5. What are the main principles and concepts of green chemistry?
6. Name some hazardous materials that must be substituted for safer ones?

Units 11-12. Test

Choose the correct variant to fill in the gaps in the sentences below:

1. Safety goggles protect your _____.
a) eyes b) ears c) feet
2. _____ gloves are only effective for water-based mixtures.
a) Nitrile b) latex c) wool
3. _____ must be worn by all workers in the lab.
a) hard hats b) fire blankets c) lab coats
4. First-aid-kits are equipped by _____.
a) extinguishers b) scissors c) caution tapes
5. To clean up surfaces corrosive chemicals and hazardous liquids use _____.
a) chemical spill kits b) water c) oil
6. Fire blanket is made of _____.
a) wool treated with retardant b) cotton wool c) plastic
7. The periodical _____ helps to decrease the risks of fire in the labs.
a) cultural education b) safety training c) skills training
8. _____ is usually associates with harmful effect on environment.
a) Computing b) Biology c) Chemistry
9. Green chemistry studies how _____.
a) polluting chemicals are harmful for environment
b) chemistry influences the environment
c) environment influences chemical production
10. Safer solvents must _____.
a) have no toxicity b) be effective and not toxic c) be effective
11. Today greener solvents are included into _____ stages of products development.
a) final b) middle c) early
12. Remediation in green chemistry means _____.
a) cleaning up environment from waste
b) separating contaminants from other materials
c) safe disposal of ready-made products

Revision. Units 1-12

Task 1. Read the text below and say if the sentences are true or false. Prove your choice.

1. Heterogeneous mixture consists of one substance.
2. Heterogeneous and homogeneous substances don`t have many differences.
3. The world consists mainly of heterogeneous substances.
4. You can say if the substance is homogeneous or heterogeneous by looking at it.
5. Homogeneous substances are only natural.

Heterogeneous and Homogeneous Mixtures

A heterogeneous mixture is simply any mixture that is not uniform in composition - it's a non-uniform mixture of smaller constituent parts.

One of the most interesting facts about heterogeneous and homogeneous mixtures is that, in a sense, there's no real distinction. Look closely enough at any substance, even a pure element, and it becomes heterogeneous because it's made up of different subatomic particles. Conversely, at a large enough scale everything in the universe is homogeneous, because it becomes impossible to differentiate components.

The properties of homogeneous mixtures are best defined on a scale somewhere between the two. Scientists (and we) most often use the simple standard of the naked eye. If a substance can be seen to contain two or more distinct components, it is considered heterogeneous. If it appears to be just one uniform substance, it's homogeneous.

There is a wide variety of solid homogeneous mixtures, from naturally occurring materials like stone to synthetic plastics. Several homogeneous mixtures of gases, such as heliox and trimix, are used in scuba diving.

Task 2. Fill in the gaps with one of the words of phrases below:

Light, strong, tubing, carries electricity, transparent, rust,

1. Plastic is used for worm and cold water _____.
2. Metals have a disadvantage: they can _____.
3. Glass is _____and _____.
4. Cotton is _____ and soft.
5. Copper _____ _____ very well.

Final Test

Choose the correct variant:

1. A heterogeneous mixture is simply any mixture that is ____in composition
a) uniform b) not uniform c) subatomic
2. It ____impossible to differentiate components.
a) become b) don`t become c) becomes
3. Metals have a disadvantage: they can ____.
a) well b) rust c) burn
4. Cotton is ____ and soft.
a) tubing b) rust c) light
5. Glass is ____ and _____.
a) transparent, strong b) soft, light c) rigid and light
6. The units composing polymers derive from molecules of _____molecular mass.
a) high b) low relative c) good
7. 'Chromatography' is used for _____ a mixture of chemical substances
a) separating b) uniting c) exchanging
8. _____ represents the number of protons that are in the nucleus.
a) non-metals b) atomic number c) malleable number
9. There is _____able in ____room.
a) the , the b) a, a c) a, the
10. Heterogeneous and homogeneous substances ___ _____many differences.
a) don`t have b) doesn`t have c) didn`t had
11. During chemical reactions _____ elements are transformed into _____ ones.
a) subatomic, atomic b) natural, artificial c) permanent, constant
12. Seawater consists of _____.
a) carbonate and chlorine b) sodium, water, chloride and compounds
c) water and nitrogen
13. There are three classes of chemical elements: _____.
a) gases, solids and liquids b) atoms, neutrons and molecules
c) b) metals, non-metals and metalloids
14. One of the key property of metal is that it is _____.
a) non-conductive b) conductive c) magnetic
15. Polymers are_____substances.
a) non-organic and organic b) natural c) man-made
16. _____ determines the quality of paint.
a) Lingin b) "vehicle liquids" c) thinner
17. The appropriate temperature for applying the paint to the surface is _____.
a) above 10 °C b) 2 °C c) above 2 °C
18. Lacquers dry when solvent _____
a) disappears b) evaporates c) dissolves

19. _____ lacquers are more ecologically clean than _____ ones.
a) water-based, colourless b) water-based, solvent-based
c) water-based, pigmented.
20. _____ are products of chemical technology used in agriculture.
a) detergents b) fertilizers c) evaporators
21. _____reactions are called low-yield.
a) Short-term b) Complex c) Low level
22. _____ protect your face from harmful substances.
a) face lift b) face shield c) face glass
23. When you work with acids, you must use _____ gloves.
a) cotton b) latex c) nitrile
24. If you need to clean surface from chemical spill, use _____kit.
a) washing b) disposable c) chemical spill
25. Green chemistry deals with _____.
a) acids and alkali disposal b) separation of hazardous chemicals from environment c) reduction of elimination of hazardous chemicals use

SUPPLEMENTARY READING AND COMPREHENSION

Text 1

Task 1. Read and translate the text below.

Adhesion and Coatings

The bond strength between coating and substrate is dependent on the two properties of a material that include:

Adhesion – the bonding strength of an adhesive to the substrate surface

Cohesion– the strength of a bond between adhesive particles

Adhesion of a coating refers to the strong bond between the coating and substrate of a substance. Adhesion is one of the essential properties in paints and coatings industry that ensures the coating (or paint film) remains adhered to the surface for long especially under aggressive conditions. The nature of adhesion has a direct relation with the durability and quality of a coating.

The important requirement for most coatings and inks is that they form a strong bond and adhere strongly to the substrate for long after the curing and film formation is complete.

The key elements governing adhesion of coatings and inks to the substrate include:

Substrate-coating interface

Composition of coatings and inks

Film formation (must be such that the interface becomes as strong as possible)

With strong adhesion, the coating can prevent damage on the surface. One notable example is the use of coatings in corrosion protection. However, after prolonged exposure to external factors, such as water, humidity and UV exposure, the coating adhesion can be affected adversely. Also, an improper selection of coatings for a surface, incompatibility of coating with surface and inadequate surface preparation can lead to adhesion failures in coatings.

Several methods can be used to determine how well a coating is bonded to the substrate – allowing the coating to perform well. While implementing any test method, it is important to take into consideration if the bond failure is adhesive (failure at the coating/substrate interface) or cohesive (failure within the coating film or the substrate).

The primary methods used to test paint adhesion include:

Cross-Cut Test

Scrape Test

Pull-Off Test

Cross-Cut test methods cover procedures to assess the adhesion of coating films to metallic substrates by applying and removing pressure-sensitive tape over cuts made in the film. *Scrape Test* method determines the adhesion of organic

coatings, such as paint, varnish and lacquer when applied to smooth and flat (planar) panel surfaces. *Pull-Off Test* covers a procedure to evaluate the pull-off strength (commonly referred to as adhesion) of a coating on rigid substrates, such as metal, concrete or wood [19].

Task 2. Put the sentences below in the order the ideas they relay are given in the text. There are three sentences that you don`t need o use.

a). Coatings can protect surfaces from corrosion.
b). The production of adhesion.
c). Methods of cohesion testing.
d). Types of failures within coating films.
e). The difference between adhesion and cohesion.
f). Factors that influence the strength of cohesion.
g). How to make cohesion stronger.
h). Factors that influence adhesion.
i). Methods of adhesion testing.
j). Adhesion makes a coating stay longer on the surface.

Text 2

Task 1. Read and translate the text about the work of a chemical scientist below.

Day-to-day Engineering

Meet Claudio, a chemical engineer, a Post-doctoral research fellow working on the automation of chemistry at AstraZeneca. He deals with automated chemistry exploration, planning experiments, data analysis, data mining and much more.

Through his research, he has custom built an intelligent machine that is able to perform automated chemistry by combining robotics, artificial intelligence (AI) and self-optimisation methods, with the aim of speeding up drug discovery and reducing attrition rates.

In particular, my work is half experimental and half theoretical, requiring expertise in chemistry, chemical engineering, software and system engineering, and data sciences.

His typical day follows a pattern that has evolved as his research has done.

For instance, at the beginning of his research project he concentrated on building the instrumentation and automating the chemistry, which was an iterative process of design-build-test-analyse to optimise the experimental hardware and complete the software programming.

He is now in the middle of an experimental phase that has sub-cycles. For example, the first weeks are dedicated to planning the experiments, ordering the consumables and preparing the instrumentation. Then, he started the automated chemistry exploration which requires his constant supervision, even when it’s done

by a robot. As this is a custom-built machine, he needs to be on hand and ready to problem solve.

Once done, the job shift towards data analysis and data mining. Often this requires a lot of hours in front of a computer, programming new software to uncover trends from the data that will take his team to the next step.

At the end, the whole experience repeats again, and with each iteration, he sees and learns new things, which makes the job really exiting.

Though, his work is challenging. There are two things he enjoys the most. First, he loves communicating his research findings to other scientists and engineers, publishing papers and presenting to an audience. Automation in chemistry for drug discovery has huge potential that is only starting to be realised so it is great to be at the forefront of cutting-edge research. This creates interest and questions, which he channels to new ideas for improving his system and methods.

Second is more technical – he really enjoys introducing small changes into his experimental set-up or into the software, which can lead to big improvements in terms of time savings or for observing new things. For instance, he once made a small change in the hardware which reduced the time to run a full experimental sequence from days to hours. This is the beauty of automation and it is amazing when it works!

He is an engineer with a passion for science. He believes that discoveries are made when we have technological innovations progressing in tandem with innovative science.

His first piece of advice is to be open minded. This means you should train your brain to think outside the box. He believes this is a key factor that differentiates good and ground-breaking scientists [20].

Task 2. Choose the correct answer:

1) Claudio is _____.
a) an engineer
b) a scientist
c) a Doctor
d) an engineer and a scientist

2) His work is connected with_____.
a) testing and supervising a complex machine
b) planning practical chemical experiments
c) drawing a future machine
d) writing theory about machine

3) Claudio`s occupation is _____
a) theoretical
b) theoretical-and-practical
c) practical
d) calculative

4) “Custom built” means_____.
a) made for a customer
b) unique
c) built according to engineering traditions
d) built on an assembly line

5) His work involves_____.
a) hardware
b) software
c) collaboration of hardware and software
d) programming

6) His job is _____.
a) repetitive
b) challenging
c) boring
d) theoretical

7) Claudio enjoys _____.
1) checking calculation
b) maintaining automation
c) reading about engineering
d) sharing his research results with other specialists

8) What improvements does he enjoy the most?
a) saving cost of production
b) saving laboratory equipment
c) saving time
d) saving staff

9) He believes that a good specialist needs to _____.
a) think carefully
b) think differently
c) think twice
d) think practically

10) What makes his job exciting?
a) his knowledge
b) his team
c) learning new things
d) finding new substances

Text 3

Task 1. Read and translate the text below.

PPE: Personal Protective Equipment

Personal protective equipment is carefully selected to ensure that it is compatible with the chemicals and the process used. Protective Equipment (PPE) includes safety glasses, goggles, face shields, gloves, lab coats, aprons, ear plugs, and respirators.

- Safety glasses or chemical goggles must be donned before entering any wet bench lab (стендовая лаборатория), including cell culture labs. This applies to lab visitors, GT maintenance and custodial workers as well as staff and students.
- Safety glasses must meet the ANSI Z87.1 - 2010 standard for impact resistance and have side shields for splash protection.
- Chemical goggles may be required for certain processes where safety glasses are deemed inadequate.
- Safety glasses or goggles must be worn over prescription glasses.

Lab Coats Shall be donned before handling chemicals, biologicals, or unsealed radiological sources. They shall cover the wearer to the knees.

- Lab Coat fabric of poly-cotton blends are acceptable. Exceptions include:

Labs were open flames are used (such as alcohol burners)- lab coat must be made of 100% cotton or flame resistant material.

Labs where pyrophoric materials are handled- lab coat must be of flame resistant materials.

- Face shields worn over safety glasses may be required for certain processes as determined by the Principle Investigator (PI) and/or GT EHS.
- Face shields must always be worn over safety glasses or goggles, *not* instead of safety glasses or goggles
- Gloves, especially, should be chosen carefully: They must be resistant to the chemicals being used but also not put the wearer at risk because of loss of dexterity, risk of ergonomic injury (such as increased muscle strain from gloves that are too heavy or stiff for pipetting, handling small objects, etc.), or increased risk of being caught in rotating equipment from gloves that are too loose on the user's hands.
- While there is no single glove material that provides 100% protection from all chemicals, a good all purpose glove is the nitrile exam glove. Latex gloves, which have been the most commonly used glove in labs for many years, are not resistant to many of the most common solvents found in laboratories. Additionally, latex is a natural product and is also a powerful allergen which readily becomes airborne on glove powder each time a glove is removed. Most

hospitals have banned the use of powdered latex gloves. Many institutions have banned latex gloves entirely.

Respirators are a last resort when it comes to protecting people in the workplace.

A respirator is a device designed to protect the wearer from inhalation of harmful substances. When chosen correctly and used properly, respirators can protect the wearer from harmful gases, mists, vapors, fumes, and fine particulates. Respirators fall into the following two general classifications, according to mode of operation:

1. Atmosphere-supplying respirators
2. Self contained breathing apparatus (SCBA)
3. Air-purifying respirators [21].

Task 2. Read the prompts below and tick the ones mentioned in the text.

a. How PPE is chosen.
b. The allergic substances.
c. The types of PPE used.
d. When safety gloves are worn.
e. Electric burning risks
f. The construction of safety glasses.
g. Wash stations instructions
h. When chemical glasses, safety goggles of prescription glasses are worn.
i. The length of lab coat.
j. The material used for lab coats.
k. The types of work and the types of lab coats worn.
l. The possible restrictions of using gloves.
m. The materials for upron.
n. The disadvantages of using gloves.
o. The standard for face masks
p. Where nitrile gloves are used.
q. The disadvantages of using nitrile gloves.
r. The types of respirators.
s. The advantages of respirators.
t. The size of air plug
u. What is respirator.
v. Harmful gases.

Text 4
Dmitri Mendeleev

Task 1. Read and translate the text below and choose the best heading for it.

A. What do you know about D. Mendeleev.

B. A life of a famous scientist.

C. The invention of D. Mendeleev.

a)_____

Dmitri Mendeleev, (born January 27 (February 8, New Style), 1834, Tobolsk, Siberia, Russian Empire—died January 20 (February 2), 1907, St. Petersburg, Russia), Russian chemist who developed the periodic classification of the elements. Mendeleev found that, when all the known chemical elements were arranged in order of increasing atomic weight, the resulting table displayed a recurring pattern, or periodicity, of properties within groups of elements. In his version of the periodic table of 1871, he left gaps in places where he believed unknown elements would find their place. He even predicted the likely properties of three of the potential elements. The subsequent proof of many of his predictions within his lifetime brought fame to Mendeleev as the founder of the periodic law.

b)_____

Mendeleev was born in the small Siberian town of Tobolsk as the last of 14 surviving children. To support the family, his mother turned to operating a small glass factory owned by her family in a nearby town. The factory burned down in December 1848, and Dmitri's mother took him to St. Petersburg, where he enrolled in the Main Pedagogical Institute. Mendeleev graduated in 1855. Some months later he decided to continue his education. He received a master's degree in 1856 in St. Petersburg and began to conduct research in organic chemistry.

c)_____

Financed by a government fellowship, he went to study abroad for two years at the University of Heidelberg. In September 1860 he attended the International Chemistry Congress in Karlsruhe, convened to discuss such crucial issues as atomic weights, chemical symbols, and chemical formulas. There he met and established contacts with many of Europe's leading chemists.

d)_____

In 1861 Mendeleev returned to St. Petersburg, where he obtained a professorship at the Technological Institute in 1864. After the defense of his doctoral dissertation in 1865 he was appointed professor of chemical technology at the University of St. Petersburg

As he began to teach inorganic chemistry, Mendeleev could not find a textbook that met his needs.

e)_____

When Mendeleev began to compose the chapter on the halogen elements (chlorine and its analogs) at the end of the first volume, he compared the

properties of this group of elements to those of the group of alkali metals such as sodium. Within these two groups of dissimilar elements, he discovered similarities in the progression of atomic weights, and he wondered if other groups of elements exhibited similar properties. After studying the alkaline earths, Mendeleev established that the order of atomic weights could be used not only to arrange the elements within each group but also to arrange the groups themselves.

Thus, in his effort to make sense of the extensive knowledge that already existed of the chemical and physical properties of the chemical elements and their compounds, Mendeleev discovered the periodic law [22].

Task 2. Find the best heading for the paragraphs:

His studies abroad
The beginning of table creation
The wonder periodic table
Mendeleev`s early life
The basis of Periodic law creation
Scientific career in Russia

Task 3. Answer the following questions:

1) What was in the basis of Mendeleev `s periodic law?
2) Where did Mendeleev study?
3) What subject did he teach?
4) What was the principle of Mendeleev` s classification of elements?
5) What was the secrete of Mendeleev`s scientific talent?

Text 5

Task 1. Read and translate the text below:

Chemical Computing

Chemical computing is an unconventional approach to computation that uses a "soup" where data is represented by different concentrations of chemicals.

Chemical computers can exploit several different kinds of reaction to carry out the computation. For example, so-called conformation computers use polymer molecules that change shape in response to a particular input. Metabolic computing exploits the kinds of reactions typically found inside a living cell.

Dr Andrew Adamatzky of the University of West England works on another type. "I am dealing only with reaction-diffusion computing," he explains. This type of computation exploits waves travelling through a beaker of chemicals to carry out useful calculations. These waves are the information carriers in the computer. They are created by triggering chemical reactions in the soup at specific points.

As waves propagate from different areas they collide and interact - effectively processing the information they hold. At the site of their interaction a point with a new chemical concentration is created, which is in effect an answer. With a beaker full of thousands of waves travelling and interacting with each other, complex computational problems can be solved.

Robot gel

Although the process sounds complicated and esoteric it can be applied to almost all computational problems."Reaction-diffusion processors are universal computers, they can solve all types of problems," said Dr Adamatzky.

As a result, computer giant IBM is already interested in the technology. Although slower than silicon, its key advantage is that it is cheap to produce and incredibly robust.

Working with chemist Ben De Lacy Costello, Dr Adamatzky has already produced logic gates using the technique that can be used to make chemical "circuitry". "Ultimately, we will produce a general purpose chemical chip," he said. The chip would be capable of mathematical operations such as adding and multiplying numbers, he said. However, he believes he can take the research even further to create intelligent, amorphous robots. In these, he said, silicon circuitry would be of no use.

"Assume we have fabricated an artificial amoeba, gel-based robot, without any fixed shape, and capable for splitting into several smaller robots," he said. "Conventional silicon circuits will not work because they have rigid architecture." But as chemical computers are an amorphous blob they could be cut in half and both would continue functioning independently. "You can not cut your laptop in half and

expect both parts to function properly; you can do this with reaction-diffusion processors," he said [23].

Task 2. Choose the correct answer:

1. The data in chemical computing is presented by _____.
a) circuits
b) cells
c) substances
d) numbers

2. Reaction-diffusion computing uses _____.
a) chemical movement
b) waves
c) polymer molecules
d) reaction in the living cell

3. Computation on chemical computers can be solved by _____.
a) new concentration of chemicals
b) changing shapes of chemicals
c) particular input
d) fixed shapes

4. All sorts of problems can be solved by_____.
a) conformation computing
b) metabolic computing
c) reaction-diffusion computing
d) silicon technology

5. The technology with amorphous robots uses_____.
a) silicon circuitry
b) gel-based robot
c) fixed shape
d) conventional reactions

Training for Summary Skills

Task 1. Read the information about what Summary is and about the discourse markets in the Application 5. Correct the mistakes in the sentences below:

1. The text titled “Natural substances”.
2. It outlines topic essence of purification.
3. At first, speaks on the topic of what happens in the process of electrolysis.
4. Secondly, presented the ideas about retort, receiver and condensing liquid.
5. After, there are some information about the origin of condensation as chemical procedure.
6. Also it is say what liquids are suitable for dissolving sodium.
7. The text a part of scientific article.
8. It is of interesting for future specialist in chemical technology.

Task 2. Read the text *Distillation* and the sentences summarizing its contents. All the discourse markers are in the wrong places (mixed up). Put them back in the correct places.

1) ***After that***, “Distillation and its types”. 2) ***The most interesting to read*** the essence of distillation. 2) ***The title of the text is*** it speaks about what happens in the process of distillation. 3) ***The text may be taken*** it goes on speaking about retort, receiver and condensing liquid. 4) ***Firstly,*** there is some information about the origin of distillation. The information about the materials used for apparatuses for distillation was 5) ***the text concerns***, because it helps to imagine that the scales of distillation used in laboratory and on the plant are different. 6) ***At last***, from some professional site about chemical industry.

Distillation

Distillation, process involving the conversion of a liquid into vapour that is subsequently condensed back to liquid form. It is exemplified at its simplest when steam from a kettle becomes deposited as drops of distilled water on a cold surface. Distillation is used to separate liquids from nonvolatile solids, as in the separation of alcoholic liquors from fermented materials, or in the separation of two or more liquids having different boiling points, as in the separation of gasoline, kerosene, and lubricating oil from crude oil. Other industrial applications include the processing of such chemical products as formaldehyde and phenol and the desalination of seawater. The distillation process appears to have been utilized by the earliest experimentalists. Aristotle (384–322 BCE) mentioned that pure water is made by the evaporation of seawater. Pliny the Elder (23–79 CE) described a primitive method

of condensation in which the oil obtained by heating rosin is collected on wool placed in the upper part of an apparatus known as a still.

Most methods of distillation used by industry and in laboratory research are variations of simple distillation. This basic operation requires the use of a still or retort in which a liquid is heated, a condenser to cool the vapour, and a receiver to collect the distillate. In heating a mixture of substances, the most volatile or the lowest boiling distills first, and the others subsequently or not at all. This simple apparatus is entirely satisfactory for the purification of a liquid containing nonvolatile material and is reasonably adequate for separating liquids of widely divergent boiling points. For laboratory use, the apparatus is commonly made of glass and connected with corks, rubber bungs, or ground-glass joints. For industrial applications, larger equipment of metal or ceramic is employed [24].

Task 3. Read and translate the text about alkali and three variants of the summaries that follows. What variant of the summary is more suitable and why?

Alkali

Alkali is any of the soluble hydroxides of the alkali metals—*i.e.,* lithium, sodium, potassium, rubidium, and cesium. Alkalies are strong bases that turn litmus paper from red to blue; they react with acids to yield neutral salts; and they are caustic and in concentrated form are corrosive to organic tissues. The term alkali is also applied to the soluble hydroxides of such alkaline-earth metals as calcium, strontium, and barium and also to ammonium hydroxide. The term was originally applied to the ashes of burned sodium- or leach-bearing plants, from which the oxides of sodium and potassium could be leached.

People have been using alkali for centuries, obtaining it first from the leachings (water solutions) of certain desert earths.

The manufacture of industrial alkali usually refers to the production of soda ash (Na_2CO_3; sodium carbonate) and caustic soda (NaOH; sodium hydroxide). Other industrial alkalies include potassium hydroxide, potash, and lye.

The production of a vast range of consumer goods depends on the use of alkali at some stage. Soda ash and caustic soda are essential to the production of glass, soap, miscellaneous chemicals, rayon and cellophane, paper and pulp, cleansers and detergents, textiles, water softeners, certain metals (especially aluminum), bicarbonate of soda, and gasoline and other petroleum derivatives.

Common properties of alkaline aqueous solutions include:

- Moderately concentrated solutions can turn phenolphthalein from colorless to pink.
- Concentrated solutions are caustic (causing chemical burns).
- Alkaline solutions are slippery or soapy to the touch, due to the saponification of the fatty substances on the surface of the skin.

- Alkalis are normally water-soluble, although some like barium carbonate are only soluble when reacting with an acidic aqueous solution.

The terms "base" and "alkali" are often used interchangeably, particularly outside the context of chemistry and chemical engineering.

There are various more specific definitions for the concept of an alkali. Alkalis are usually defined as a subset of the bases. One of two subsets is commonly chosen [25; 26].

a) The text calls *Alkali*. There is about alkali, its manufacture and properties. It divided into parts. Firstly, about number of substances referring to the class of alkalies. Secondly, about manufacture of alkalies. Thirdly, about its properties. The article informative and precise. It is from the Internet maybe.

b) The article is titled *Alkali*. It outlines the idea of the origin, composition and use of alkalies. The article is divided into three parts.

First of all the composition of alkalies is given and their abilities to react with different substances is outlined. Secondly, the industrial processes with alkalies are innumerated and their use as potassium hydroxide, potash, and lye. Finally their properties are described: he information about structure of the crust is presented: abilities to be of different colour, cause burns, being slippery and water-soluble. The difference between alkali and base is given. The article may be of interest to chemical engineers employed in the sector of industrial production of chemicals.

c) The article name *Alkali*. It is about alkalies. Firstly, alkali is any of the soluble hydroxides of the alkali metals. Secondly, the manufacture of industrial alkali usually refers to the production of soda ash. Then, the production of a vast range of consumer goods depends on the use of alkali at some stage. After that, the terms "base" and "alkali" are often used interchangeably. There are various more specific definitions alkali. The article interesting and important for future chemists.

Task 4. Read and translate the text Wastewater Chemical Treatment and write a summary:

Wastewater Chemical Treatment

Wastewater originates from homes, businesses, industry, as well as storm drains and rainwater runoff. Generally, wastewater contains around 99.9% water by weight with the remaining 0.1% representing dissolved solids or other suspended materials. This material may include excrement, detergents from washing clothes and dishes, food scraps, grease, oils, plastics, salts, sand, grit, and heavy metals. Some wastewaters from industrial or agricultural processes may also contain chemicals that may be hazardous to the environment or to public health and which need to be neutralized or removed from the water before it can be safely reintroduced into the environment. The primary objective of wastewater treatment processes is to purify

the water and make certain that it is safe for subsequent use once it has been returned to the environment as part of the water cycle.

Wastewater treatment involves a number of stages involving processes that are mechanical (physical)-based, biological-based, chemical-based, as well as membrane (filtration) processes.

Chemicals are used during wastewater treatment in an array of processes to expedite disinfection. These chemical processes, which induce chemical reactions, are called chemical unit processes and are used alongside biological and physical cleaning processes to achieve various water standards.

Specialized chemicals such as chlorine, hydrogen peroxide, sodium chlorite, and sodium hypochlorite (bleach) act as agents that disinfect, sanitize, and assist in the purification of wastewater at treatment facilities.

There are several distinct chemical unit processes, including chemical coagulation, chemical precipitation, chemical oxidation, and advanced oxidation, ion exchange, and chemical neutralization and stabilization, which can be applied to wastewater during cleaning [27].

Application 1. Professional Thesaurus

Aa

abused [əˈbjuːzd] – чрезмерно использовать
acrylic resin [əˈkrılık ˈrezın] - акриловая смола
additive [ˈædıtıv] - добавка
adhesive [ədˈhiːsıv] - клей
adhesives [ədˈhiːsıvz] – клейкие вещества
adoption [əˈdɒpʃ(ə)n] - принятие
aesthetic [|iːsˈθetık] – эстетический
affinity [əˈfınıtı] – родство
airborne particulates [ˈeəbɔːn pɑːˈtıkjʊləts] - взвешенные в воздухе частицы
ambient [ˈæmbıənt] – внешний, окружающий
application [æplıˈkeıʃ(ə)n] — применение
arduous work [ˈɑːdjʊəs] – трудная работа
ascend – располагаться по убывающей
auxiliary chemicals [ɔːgˈzılıərı ˈkemıkəlz] – дополнительные, вспомогательные химикаты
avoid [əˈvɔıd] - избегать

Bb

binder [ˈbaındə] – связующее вещество
bonds [bɒndz] – связи
branch [brɑːn(t)ʃ] – отрасль
breaking [ˈbreıkıŋ] – разрыв
bromine [ˈbrəʊmiːn] – бром
bulk properties [bʌlk] – свойства по всему объему образца

Cc

caution tape [ˈkɔːʃ(ə)n tape] – предостерегающая лента
challenge [ˈtʃælın(d)ʒ] – зд. задача
charcoal [ˈtʃɑːkəʊl] – древесный уголь
chemical bonds – химические связи
chemical engineer [ˈkemık(ə)l endʒıˈnıə] – инженер-химик
chemical fume hood [ˈkemık(ə)l fjuːm hʊd] – химический вытяжной шкаф
chemical separation [sepəˈreıʃ(ə)n] – химический распад
chemical synthesis [ˈsınθısıs] – химический синтез
chlorine [ˈklɔːriːn] – хлор

cleaning fluid [ˈfluːɪd] – чистящая жидкость
coating [ˈkəʊtɪŋ] - покрытие
coefficient [ˌkəʊɪˈfɪʃ(ə)nt] – коэффициент
coherent explanation [kə(ʊ)ˈhɪər(ə)nt] – четкое объяснение
combustion [kəmˈbʌstʃ(ə)n] – горение
commodity [kəˈmɒdɪtɪ] – продукт, товар широкого потребления
complicate [ˈkɒmplɪkeɪt] – усложнять
compound [ˈkɒmpaʊnd] – соединение, смесь
concern [kənˈsɜːn] – иметь дело с
conductive - производный
conservation [kɒnsəˈveɪʃ(ə)n] – сохранение
considerable [kənˈsɪd(ə)rəb(ə)l] - значительный
consumption [kənˈsʌm(p)ʃ(ə)n] - потребление
contamination [kənˌtæmɪˈneɪʃ(ə)n] - загрязнение
contiguous [kənˈtɪgjʊəs] stationery [ˈsteɪʃ(ə)n(ə)rɪ] phase – продолжительная стационарна фаза
continuous macroscopic material [ˌmækrə(ʊ)ˈskɒpɪk] – однородный микроскопический материал
convert [kənˈvɜːt] – превращать
crucial role [ˈkruːʃ(ə)l] – решающая роль

Dd

date [deɪt] – датироваться, относиться к определенному времени
decomposition [diːkɒmpəˈzɪʃn] – разложение, распад
degree of adhesion [ədˈhiːʒ(ə)n] – степень сцепления
density [ˈdensɪtɪ] - плотность
detergent [dɪˈtɜːdʒ(ə)nt] – моющее средство
diluent [ˈdɪljʊənt] – разбавитель, растворитель
disposable gloves [dɪˈspəʊzəb(ə)l glʌvz] – одноразовые перчатки
double-replacement [ˈdʌb(ə)l] – двойное замещение
driving [ˈdraɪvɪŋ] force [fɔːs] – движущая сила
durable [ˈdjʊərəb(ə)l] - долговечный
dye [daɪ] – краска, краситель
dye-sensitized solar cell [daɪ ˈsensɪtaɪzd] – солнечные батарейки и сенсибилизированным красителем

Ee

economic advantage [ədˈvɑːntɪdʒ] – экономическое преимущество
eliminate [ɪˈlɪmɪneɪt] – устранять, исключать
emergency shower [ɪˈmɜːdʒ(ə)nsɪ ʃaʊə] – душевая для аварийных ситуаций

encompass [ɪnˈkʌmpəs] – заключать в себе

end-of-the-pipe treatment [ˈtriːtm(ə)nt] - обезвреживание отходов в конце производственного процесса

enduring properties [ɪnˈdjʊərɪŋ] – зд. свойственные, типичные качества

environmental spills [ɪnvaɪrənˈment(ə)l spɪlz] – утечка вредных веществ в окружающую среду

environmental consideration [ɪnvaɪrənˈment(ə)l kənsɪdəˈreɪʃ(ə)n] — учёт воздействия на окружающую среду

environmentally friendly – экологичный

equation [ɪˈkweɪʒ(ə)n] – уравнение

essential [ɪˈsenʃ(ə)l] – важный

ethidium bromide [ˈbrəʊmaɪd] - бромистый этидий

evaporation [ɪˌvæpəˈreɪʃ(ə)n] – испарение

evaporator [ɪˈvæpəˌretə] – испаритель

exert [ɪgˈzɜːt] – напрягать

explosive [ɪkˈspləʊsɪvz] – взрывчатое вещество

exposure [ɪkˈspəʊʒə] – зд. воздействие

Ff

fabrics [ˈfæbrɪks] – ткани

facile [ˈfæsæɪl] – поверхностный

feldspar [ˈfeldspɑː] – полевой шпат

fertilizer [ˈfɜːtɪlaɪzə] - удобрение

fertilizers [ˈfɜːtəlaɪzəz] - удобрение

fiber [ˈfaɪbər] — волокно

film [fɪlm] - пленка

finishes [ˈfɪnɪʃ] – отделка

fire blankets [ˈfaɪə ˈblæŋkɪts] – пожарное покрывало

fire extinguisher [ˈfaɪə ɪkˈstɪŋgwɪʃə] – огнетушитель

fire hazards [ˈfaɪə ˈhæzədz] – пожарная опасность

first aid kit [fɜːst eɪd kɪt] – аптечка, набор для оказания первой помощи

flame [fleɪm] – пламя

flame retardant [fleɪm rɪˈtɑːdɪnt] – защищающий от огня

fluorine [ˈflɔːriːn] – фтор

foam [fəʊm] –пена

food-safe - безопасные продукты питания

foreknowledge [fɔːˈnɒlɪdʒ] – предвидение, предположение

forensic [forensic] science [science] – криминалистика

formaldehyde [fɔːˈmældɪhæɪd] - формальдегид

fragrance [ˈfreɪgrənsɪz] - аромат

fuels [ˈfjuːəlz] – виды топлива

fumes [fjuːmz] – выхлопы

fundamental [fʌndəˈment(ə)l] – фундаментальный

Gg

gaseous [ˈgæsɪəs] - разнообразный
gaseous elements [ˈgæsɪəs] – газообразные элементы

Hh

harmful impact [ˈhɑːmfʊl ˈɪmpækt] – вредное воздействие
hazardous [ˈhæzədəs] – опасный
Hegman gauge - Измеритель Хегмана
hematite [ˈhiːmətaɪt] – гематит, красный железняк
high-performance material [haɪ pəˈfɔːm(ə)ns] — материал с повышенными технологическими показателями
high-pressure [ˌhaɪ ˈpreʃə] – высокое давление
hydrocarbons [ˌhaɪdrəˈkɑːbənz] – углеводороды
hydrogen [ˈhaɪdrədʒ(ə)n] – водород
hygiene [ˈhaɪdʒiːn] - гигиена

Ii

identities [aɪˈdentɪtɪz] – тождества
impart [ɪmˈpɑːt] – передавать, сообщать
implement [ˈɪmplɪment] – выполнять, осуществлять
impurity [ɪmˈpjʊərɪtɪ] – примесь, нечистота
indestructible [ɪndɪˈstrʌktɪb(ə)l] – неразрушимый
industrial applications [ɪnˈdʌstrɪəl ˌæplɪˈkeɪʃənz] – применение в промышленности
ink [ɪŋk] - краска
insecticide [insecticide] - инсектицид, средство для истребления насекомых
insulation properties [ɪnsjʊˈleɪʃ(ə)n] – изоляционные свойства
interaction [ɪntərˈækʃ(ə)n] – взаимодействие
intermingled atom [ɪntəˈmɪŋg(ə)ld] – смешанный
intertwine [ɪntəˈtwaɪn] - переплетать
intimately [ˈɪntɪmətli] - близко
ion-exchange [ɪksˈtʃeɪndʒ] – ионный обмен
ionic charge [aɪˈɒnɪk] – ионный заряд
irritants [ˈɪrɪtənts] – химикаты, вызывающие раздражение

Ll

lab coats [læb kəʊts] – лабораторный халат
lab gear [læb gɪə] – лабораторное оборудование
lac insect [lak ˈɪnsekt] - насекомое семейства Kerriidae, лаковых насекомых
large-scale [ˈlɑːdʒskeɪl] – в крупном масштабе
leave [liːv] - оставлять
lignin - лингин
liquid [ˈlɪkwɪd] – жидкий, жидкость
liquid crystal [ˈlɪkwɪd ˈkrɪst(ə)l] – жидкий кристалл
liquids - жидкости
low yield [jiːld] – низкая продуктивность
lungs [lʌŋz] - легкие

Mm

maintenance [ˈmeɪnt(ə)nəns] – техническое обслуживание
malleable - плавкий
manganese oxide [ˈmæŋgəniːz ˈɒksaɪd] - полуторная окись марганца;
mapping [ˈmæpɪŋ] – отображение, построение модели
mass produce [mæs prəˈdjuːs] – запускать массовое производство
matter [ˈmætə] – вещество
mercury [ˈmɜːkjərɪ] – ртуть
metalloid - металлоиды
mixtures [ˈmɪkstʃəz] – смеси
mobile phase [ˈməʊbaɪl] – подвижная фаза
momentum-transfer operations [məˈmentəm trænsˈfɜː(r)] – операции передачи импульса движения
monomers [ˈmɑːnəmərz] - мономер

Nn

Nitrile gloves [ˈnaɪtraɪl glʌvz] – нитриловые перчатки
nitrogen [ˈnaɪtrədʒ(ə)n] – азот
noble gases [ˈnəʊb(ə)l] – благородные газы
nonflowing [non ˈfləʊɪŋ] solvent [ˈsɒlv(ə)nt] – нетекучий растворитель
nonrenewable resources [nanrɪˈnuːəbəl rɪˈzɔːsɪz] – невозобновляемые ресурсы
nucleic acids [nucleic ˈæsɪdz] - нуклеиновые кислоты
nucleus - ядро

Oo

observation [ɒbzəˈveɪʃ(ə)n] – наблюдение, изучение
occure [əˈkɜːrɪŋ] – возникать
ochre [ˈəʊkə] – охра, золото
odor [ˈəʊdə] – запах
ointment [ˈɔɪntm(ə)nt] – мазь
organic solvents [ɔːˈgænɪk ˈsɒlvənts] - органические растворители
oxygen [ˈɒksɪdʒ(ə)n] – кислород

Pp

particle [ˈpɑːtɪk(ə)l] – частица
physical basis [ˈfɪzɪk(ə)l] – физическая основа
plant [plɑːnt] – строительная площадка
polymer backbone [ˈpɒlɪmə ˈbækbəʊn] – полимерная основа
precipitate [prɪˈsɪpɪtət] – осадок
prevent [prɪˈvent] - предотвращать
process [ˈprəʊses] - обрабатывать
process engineer [ˈprəʊses endʒɪˈnɪə] – инженер-технолог
processing [ˈprəʊsesɪŋ] - обработка
production chain [prəˈdʌkʃ(ə)n tʃeɪn] – серийное производство
property [ˈprɒpətɪ] – свойство, качество
pure substance – чистое вещество

Qq

quantity [ˈkwɒntɪtɪ] – количество

Rr

reactants [rɪˈæktənts] - реагент
reduce [rɪˈdjuːs] - снижать
regulations [ˌregjʊˈleɪʃənz] – нормы, правила
relationship [rɪˈleɪʃ(ə)nʃɪp] – взимоотношение
relative molecular mass [ˈrelətɪv] - относительная молекулярная масса
remediation [rɪˌmiːdɪˈeɪʃ(ə)n] – исправление, восстановление
repeating units [rɪˈpiːtɪŋ] - звенья полимера
research efforts [rɪˈsɜːtʃ ˈefəts] – объем исследований
resolving power – разрешающая сила
rubbers [ˈrʌbəz] – резина, каучук
safety goggles [ˈseɪftɪ gɒglz] – защитные очки
safety storage cabinets - шкафы для безопасного хранения

scissors [ˈsɪzəz] – ножницы
sealant [ˈsiːlənt] – герметик, уплотнитель
separate [ˈseprət] – отделять
serious injury [ˈsɪərɪəs ˈɪn(d)ʒ(ə)rɪ] – серьезная травма
sheen level [ʃiːn ˈlev(ə)l] - уровень блеска
"showcase" reaction [rɪˈækʃ(ə)n] – «реакция демонстрации»
signs [saɪnz] – признаки
silica [ˈsɪlɪkə] – кремнезем
single-replacement [rɪˈpleɪsm(ə)nt] – единое замещение
smoother [ˈsmuːðə] – смягчающее вещество
sodium chloride [ˈklɔːraɪd] – хлористый натрий, поваренная соль
solid film [ˈsɒlɪd] – плотная пленка
solids – твердые вещества
solute [ˈsɒljuːt] – растворенное вещество
solvent [ˈsɒlv(ə)nt] - растворитель
specialty chemicals [ˈspeʃ(ə)ltɪ ˈkemɪkəlz] — химические продукты тонкого органического синтеза
spills [spɪlz] – утечка
stable - стабильный
stir [stɜː] – помешивать, размешивать
subatomic domain [də(ʊ)ˈmeɪn] – внутриатомная область
subscript [ˈsʌbskrɪpt] – подстрочный индекс
substrate [ˈsʌbstreɪt] – субстрат, подложка
synthetic fibres [sɪnˈθetɪk ˈfaɪbəz] – синтетические волокна
synthetically [sɪnˈθetɪkəli] – синтетически

Tt

technological approaches [teknəˈlɒdʒɪk(ə)l əˈprəʊtʃɪz] – технологические подходы
thinner [ˈθɪnə] – разбавитель, разжижитель
to shift - сдвигаться
trace amounts [treɪs] – следовые количества
treat [triːt] – зд. обрабатывать что-то
tweezers [tweezers] – пинцет, щипчики

Uu

undergo [ʌndəˈgəʊ] – испытывать, переносить, претерпевать
under-hood [ˈʌndə hʊd] – внутренний
undoubtedly [ʌnˈdaʊtɪdlɪ] - несомненно
unequal [ʌn ˈiːkw(ə)l] – неравномерный

unit operations [ˌɒpəˈreɪʃənz] – операции, объединенные в одном производственном шаге

Vv

vanish [ˈvænɪʃ] – растворитель
variety [vəˈraɪətɪ] – многообразие
vary [ˈveərɪ] – варьироваться
vehicle [ˈviːɪk(ə)l] – зд. растворитель, связующее вещество
versatile [ˈvɜːsətaɪl] – универсальный, многогранный
violent reaction [ˈvaɪəl(ə)nt rɪˈækʃ(ə)n] – бурная реакция
viscosity [vɪˈskɒsɪtɪ] – вязкость, тягучесть

Ww

walks of life - сферы жизни
waste streams [weɪst striːmz] **-** поток отходов (кол-во различных отходов, образующихся на какой-либо территории в течение определенного времени)
waste tags [weɪst tægz] – метка для отходов
watercolor [ˈwɒtərˌkələ] – акварель, акварельные краски
weight distribution [weɪt dɪstrɪˈbjuːʃ(ə)n] – распределение нагрузки
word [wɜːd] - слово
worst offenders [wɜːst əˈfendəz] – «злостные нарушители»

Xx

xylene [zaɪliːn] - ксилол

Application 2. Table of Irregular verbs[28]

Base form	Past simple	Past participle	Translation
A			
arise	arose	arisen	возникать, появляться
awake	awakened / awoke	awakened / awoken	будить, проснуться
B			
backslide	backslid	backslidden / backslid	отказываться от прежних убеждений
be	was, were	been	быть
bear	bore	born / borne	родить
beat	beat	beaten / beat	бить
become	became	become	становиться, делаться
begin	began	begun	начинать
bend	bent	bent	сгибать, гнуть
bet	bet / *betted*	bet / *betted*	держать пари
bind	bound	bound	связать
bite	bit	bitten	кусать
bleed	bled	bled	кровоточить
blow	blew	blown	дуть
break	broke	broken	ломать
breed	bred	bred	выращивать
bring	brought	brought	приносить
broadcast	broadcast / broadcasted	broadcast / broadcasted	распростра-нять, разбрасывать
browbeat	browbeat	browbeaten / browbeat	запугивать
build	built	built	строить
burn	burned / burnt	burned / burnt	гореть, жечь
burst	burst	burst	взрываться, прорываться
bust	busted / bust	busted / bust	разжаловать
buy	bought	bought	покупать
C			

can	could	could	мочь, уметь
cast	cast	cast	бросить, кинуть, вышвырнуть
catch	caught	caught	ловить, хватать, успеть
choose	chose	chosen	выбирать
cling	clung	clung	цепляться, льнуть
clothe	clothed / clad	clothed / clad	одевать (кого-либо)
come	came	come	приходить
cost	cost	cost	стоить, обходиться (в какую-либо сумму)
creep	crept	crept	ползать
cut	cut	cut	резать, разрезать
D			
deal	dealt	dealt	иметь дело
dig	dug	dug	копать
dive	dove / dived	dived	нырять, погружаться
do	did	done	делать, выполнять
draw	drew	drawn	рисовать, чертить
dream	dreamed / dreamt	dreamed / dreamt	грезить, мечтать
drink	drank	drunk	пить
drive	drove	driven	управлять (авто)
dwell	dwelt / dwelled	dwelt / dwelled	обитать, находиться
E			
eat	ate	eaten	есть, кушать
F			
fall	fell	fallen	падать
feed	fed	fed	кормить
feel	felt	felt	чувствовать

fight	fought	fought	драться, сражаться, бороться
find	found	found	находить
fit	fit	fit	подходить по размеру
flee	fled	fled	убегать, спасаться
fling	flung	flung	бросаться, ринуться
fly	flew	flown	летать
forbid	forbade	forbidden	запрещать
forecast	forecast	forecast	предсказывать предвосхи-щать
foresee	foresaw	foreseen	предвидеть
foretell	foretold	foretold	предсказывать прогнозиро-вать
forget	forgot	forgotten	забывать
forgive	forgave	forgiven	прощать
forsake	forsook	forsaken	покидать
freeze	froze	frozen	замерзать
G			
get	got	gotten / *got*	получать, достигать
give	gave	given	давать
go	went	gone	идти, ехать
grind	ground	ground	молоть, толочь
grow	grew	grown	расти
H			
hang	hung / hanged	hung / hanged	вешать, развешивать
have, has	had	had	иметь
hear	heard	heard	слышать
hew	hewed	hewn / hewed	рубить
hide	hid	hidden	прятаться, скрываться
hit	hit	hit	ударять, поражать

hold	held	held	держать, удерживать, фиксировать
hurt	hurt	hurt	ранить, причинить боль
I			
inlay	inlaid	inlaid	вкладывать, вставлять, выстилать
input	input / inputted	input / inputted	входить
interweave	interwove	interwoven	воткать
K			
keep	kept	kept	держать, хранить
kneel	knelt / kneeled	knelt / kneeled	становиться на колени
knit	knitted / knit	knitted / knit	вязать
know	knew	known	знать, иметь представление (о чем-либо)
L			
lay	laid	laid	класть, положить
lead	led	led	вести, руководить, управлять
lean	leaned / leant	leaned / leant	опираться, прислоняться
leap	leaped / leapt	leaped / leapt	прыгать, скакать
learn	learnt / learned	learnt / learned	учить
leave	left	left	покидать, оставлять
lend	lent	lent	одалживать, давать взаймы
let	let	let	позволять, предполагать
lie	lay	lain	лежать
light	lit / lighted	lit / lighted	освещать
lose	lost	lost	терять
M			
make	made	made	делать, производить,

			создавать
may	might	might	мочь, иметь возможность
mean	meant	meant	значить, иметь ввиду
meet	met	met	встречать
miscast	miscast	miscast	неправильно распределять роли
misdeal	misdealt	misdealt	поступать неправильно
misdo	misdid	misdone	делать что-либо неправильно или небрежно
misgive	misgave	misgiven	внушать недоверия, опасения
mishear	misheard	misheard	ослышаться
mishit	mishit	mishit	промахнуться
mislay	mislaid	mislaid	класть не на место
mislead	misled	misled	ввести в заблуждение
misread	misread	misread	неправильно истолковы-вать
misspell	misspelled / misspelt	misspelled / misspelt	писать с ошибками
misspend	misspent	misspent	неразумно, зря тратить
mistake	mistook	mistaken	ошибаться
misunderstand	misunderstood	misunderstood	неправильно понимать
mow	mowed	mowed / mown	косить
O			
offset	offset	offset	возмещать, вознаграждать компенсиро-вать
outbid	outbid	outbid	перебивать цену
outdo	outdid	outdone	превосходить
outfight	outfought	outfought	побеждать в бою

outgrow	outgrew	outgrown	вырастать из
output	output / outputted	output / outputted	выходить
outrun	outran	outrun	перегонять, опережать
outsell	outsold	outsold	продавать лучше или дороже
outshine	outshone	outshone	затмевать
overbid	overbid	overbid	повелевать
overcome	overcame	overcome	компенсиро-вать
overdo	overdid	overdone	пережари-(ва)ть
overdraw	overdrew	overdrawn	превышать
overeat	overate	overeaten	объедаться
overfly	overflew	overflown	перелетать
overhang	overhung	overhung	нависать
overhear	overheard	overheard	подслуш-(ив)ать
overlay	overlaid	overlaid	покры(ва)ть
overpay	overpaid	overpaid	переплачивать
override	overrode	overridden	отменять, аннулировать
overrun	overran	overrun	переливаться через край
oversee	oversaw	overseen	надзирать за
overshoot	overshot	overshot	расстрелять
oversleep	overslept	overslept	проспать, заспаться
overtake	overtook	overtaken	догонять
overthrow	overthrew	overthrown	свергать
P			
partake	partook	partaken	принимать участие
pay	paid	paid	платить
plead	pleaded / pled	pleaded / pled	обращаться к суду
prepay	prepaid	prepaid	платить вперед
prove	proved	proven / proved	доказывать
put	put	put	класть, ставить,

			размещать
Q			
quit	quit / *quitted*	quit / *quitted*	выходить, покидать, оставлять
R			
read	read	read	читать
rebind	rebound	rebound	перевязывать
rebuild	rebuilt	rebuilt	перестроить
recast	recast	recast	изменять, перестраивать
redo	redid	redone	делать вновь, переделывать
rehear	reheard	reheard	слушать вторично
remake	remade	remade	переделывать
rend	rent	rent	раздирать
repay	repaid	repaid	отдавать долг
rerun	reran	rerun	выполнять повторно
resell	resold	resold	перепродавать
reset	reset	reset	возвращать
resit	resat	resat	пересиживать
retake	retook	retaken	забирать
retell	retold	retold	пересказывать
rewrite	rewrote	rewritten	перезаписать
rid	rid	rid	избавлять
ride	rode	ridden	ездить верхом
ring	rang	rung	звонить
rise	rose	risen	подняться
run	ran	run	бегать
S			
saw	sawed	sawed / sawn	пилить
say	said	said	сказать, заявить
see	saw	seen	видеть
seek	sought	sought	искать
sell	sold	sold	продавать
send	sent	sent	посылать

set	set	set	ставить, устанавливать
sew	sewed	sewn / sewed	шить
shake	shook	shaken	трясти
shave	shaved	shaved / shaven	бриться
shear	sheared	sheared / shorn	стричь
shed	shed	shed	проливать
shine	shined / shone	shined / shone	светить, сиять, озарять
shoot	shot	shot	стрелять, давать побеги
show	showed	shown / showed	показывать
shrink	shrank / shrunk	shrunk	сокращаться, сжиматься
shut	shut	shut	закрывать, запирать, затворять
sing	sang	sung	петь
sink	sank / sunk	sunk	тонуть, погружаться (под воду)
sit	sat	sat	сидеть
slay	slew / slayed	slain / slayed	убивать
sleep	slept	slept	спать
slide	slid	slid	скользить
sling	slung	slung	бросать, швырять
slink	slunk	slunk	красться, идти крадучись
slit	slit	slit	разрезать, рвать в длину
smell	smelled / smelt	smelled / smelt	пахнуть, нюхать
sow	sowed	sown / sowed	сеять
speak	spoke	spoken	говорить
speed	sped / speeded	sped / speeded	ускорять, спешить
spell	spelled / spelt	spelled / spelt	писать или читать по буквам
spend	spent	spent	тратить, расходовать

spill	spilled / spilt	spilled / spilt	проливать, разливать
spin	spun	spun	прясть
spit	spit / *spat*	spit / *spat*	плевать
split	split	split	расщеплять
spoil	spoiled / spoilt	spoiled / spoilt	портить
spread	spread	spread	распространиться
spring	sprang / sprung	sprung	вскочить, возникнуть
stand	stood	stood	стоять
steal	stole	stolen	воровать, красть
stick	stuck	stuck	уколоть, приклеить
sting	stung	stung	жалить
stink	stunk / stank	stunk	вонять
strew	strewed	strewn / strewed	усеять, устлать
stride	strode	stridden	шагать, наносить удар
strike	struck	struck	ударить, бить, бастовать
string	strung	strung	нанизать, натянуть
strive	strove / strived	striven / strived	стараться
sublet	sublet	sublet	передавать в субаренду
swear	swore	sworn	клясться, присягать
sweep	swept	swept	мести, подметать, сметать
swell	swelled	swollen / swelled	разбухать
swim	swam	swum	плавать, плыть
swing	swung	swung	качать, раскачивать, вертеть
T			
take	took	taken	брать, взять
teach	taught	taught	учить, обучать
tear	tore	torn	рвать
tell	told	told	рассказать

think	thought	thought	думать
throw	threw	thrown	бросить
thrust	thrust	thrust	колоть, пронзать
tread	trod	trodden / trod	ступать
U			
unbend	unbent	unbent	выпрямляться, разгибаться
underbid	underbid	underbid	снижать цену
undercut	undercut	undercut	сбивать цены
undergo	underwent	undergone	испытывать, переносить
underlie	underlay	underlain	лежать в основе
underpay	underpaid	underpaid	оплачивать слишком низко
undersell	undersold	undersold	продавать дешевле
understand	understood	understood	понимать, постигать
undertake	undertook	undertaken	предпринять
underwrite	underwrote	underwritten	подписывать-ся
undo	undid	undone	уничтожать сделанное
unfreeze	unfroze	unfrozen	размораживать
unsay	unsaid	unsaid	брать назад свои слова
unwind	unwound	unwound	развертывать
uphold	upheld	upheld	поддерживать
upset	upset	upset	опрокинуться
W			
wake	woke / waked	woken / waked	просыпаться
waylay	waylaid	waylaid	подстерегать
wear	wore	worn	носить (одежду)
weave	wove / weaved	woven / weaved	ткать
wed	wed / wedded	wed / wedded	жениться, выдавать замуж

weep	wept	wept	плакать, рыдать
wet	wet / *wetted*	wet / *wetted*	мочить, увлажнять
win	won	won	победить, выиграть
wind	wound	wound	заводить (механизм)
withdraw	withdrew	withdrawn	взять назад, отозвать
withhold	withheld	withheld	воздерживать-ся, отказывать
withstand	withstood	withstood	противостоять
wring	wrung	wrung	скрутить, сжимать
write	wrote	written	писать

Application 3. List of Topics for Projects

1. Innovative materials.
2. Ecologically sustainable materials.
3. The modern cooperation of chemical and computer technologies.
4. The most important element (substance) in the world.
5. The technologies of production.
6. The modern inventions of chemistry.
7. Chemical technology and food industry.
8. Natural ingredients in chemical industry.
9. Famous chemists of the world.
10. Ways of optimization of chemical technological processes.
11. Chemical Technologies in Space Industry

Application 4. Useful language: Emergency

To ask and react in emergency	To warn
How is it going? – Как дела?	Make sure – проверьте
What`s wrong? – Что случилось?	Please remember – не забывайте
Oh, my Gosh! – Ого?	Always remember – помните
What`s happened? – Что случилось?	Never – никогда
Hazard! – Опасность!	Immediately – срочно, немедленно
	Don` use – не пользуйтесь
	Notify – обратите внимание

Application 5. Writing Annotation

Summary/Annotation – a short outline of the main ideas of the text, it has simple and clear structure and is written with the use of discourse markers.

Аннотация – краткое изложение основных идей текста, имеет простую и четкую структуру с использованием определенных фраз (дискурсивных маркеров), отражающих структуру текста.

Таблица. The List of Discourse Markers Used for the Summary:

Discourse Marker	*Example*
1. The title of the texts (article) is …- текст называется …	*The article is called* "Paints and Lacquers".
2. It *outlines*/*presents* the problem of … - В нем представлена проблема …	*It presents the problem of* the methods used for distillation of water for accumulator batteries.
3. It addresses the issue of … - В нем затронут вопрос о …	*It addresses the issue of* purification of wastewater.
4. Firstly, it speaks about … - Во первых, в нем говорится о …	*Firstly, it speaks about* the types of chemical reactions.
5. Firstly, it is said that… - Во первых, в нем говорится о …	*Firstly, it is said that* the types of chemical reaction depends on catalizator.
6. Secondly, there is some information about … - Во вторых, представлена информация о …	*Secondly, there is some information* about the types of solidifiers.
7. Further on it concerns the idea of … - Далее рассматривается вопрос о …	*Further on it concerns the idea* of using special reactants in the reaction.
8. Also, it is said that … - Также говорится о том, что …	*Also, it is said that* water can make the solution thinner.
9. After that the author highlights the issue of … - Далее автор подчеркивает идею о том, что …	*After that the author highlights the issue of* the importance of following all safety rules..
10. The information about …. was the most *useful/interesting* for me, because…- Информация о … была наиболее *важной/интересной* для меня, потому что …	*The information about* the application of different types of lacquers for different layers of finisher *was the most interesting for me, because* I didn`t know about it before.
11. The text (article) may be taken from … - Статья может быть взята из (источник) …	The text (article) may be taken from the professional site for the specialists in chemical processes and for engineesr in general.
12. The text (article) may be interesting for those who … - Текст (статья) может быть интересной для тех, кто … .	*The text (article) may be interesting for those* who studies Chemistry or who undergoes professional development courses in the sphere of chemical technology.

ЗАКЛЮЧЕНИЕ

В результате практического применения материалов учебного пособия «Английский язык для студентов направления «Химическая технология»» в ходе учебного процесса по дисциплине «Иностранный язык» обучающиеся научатся работать с профессионально-ориентированной информацией в текстовом и аудиоформате, понимать содержание текстов на английском языке, анализировать их и продуцировать собственное монологическое высказывание на базе изученных тем по направлению «Химическая технология».

Приводимые в пособии задания составлены с учетом современных методических рекомендаций для обучения студентов английскому языку в техническом вузе, тематика уроков пособия согласована с тематикой учебных дисциплин, осваиваемых студентами по направлению «Химическая технология», а также профессиональных интересов обучающихся, их учебного опыта.

После изучения уроков пособия студенты приобретут достаточный объем вокабуляра для осуществления профессионального общения на английском языке в форме монологической и диалогической речи о сущности химии как науки, о таких базовых понятиях, как химический элемент, вещество, химическая реакция. Границы их профессионального общения смогут охватывать такие сферы, как особенности технологии производства лакокрасочных материалов, полимеров, процессы хроматографии. Важным практическим применением предложенного в пособии материала является область безопасности рабочего места сотрудника химической лаборатории. Знание английской терминологии и понимание правил поведения на рабочем месте, представленных на английском языке, позволит будущим специалистам в будущем выполнять работу более качественно, эффективно, сохраняя при этом собственное здоровье и здоровье остальных сотрудников.

Студенты познакомятся и научатся строить собственные высказывания на английском языке на тему профессии химика-технолога, его сферы деятельности, а также актуальных на сегодня аспектов экологической безопасности предприятий химической промышленности.

Осуществление процесса обучения профессиональному английскому языку на основе *аутентичных* текстов и видеоматериалов по направлению «Химическая технология» позволит обучающимся достичь необходимого уровня профессиональной компетенции, позволяющим пользоваться профессиональными информационными источниками на английском языке в профессиональной деятельности, обсуждать результаты проведенных исследований с иностранными коллегами, делиться собственными практическими и научными достижениями с профессиональным научным сообществом из других стран.

Выполнение упражнений пособия, входящих в раздел Revision обеспечит активизацию пройденного материала обучающимися, а также проверит его объем и качество усвоения, позволит определить темы, заслуживающие повторного внимания.

Материал уроков пособия служит прочной основой для формирования навыков и развития умений по всем четырем направлениям речевой деятельности: аудирование, говорение, чтение, письмо в рамках профессиональной области студентов химиков-технологов. Обучение данного учебного пособия способствует достижению обучающимися необходимого уровня профессиональных общекультурных, учебно-познавательных, ценностно-смысловых, информационных, коммуникативных и других видов компетенций для успешной профессиональной деятельности, осуществляя общение на английском языке, как на отечественном производстве, так и на международной арене.

List of Sources

1. Usselman, Melvyn C. and Rocke, Alan J.. "Chemistry". Encyclopedia Britannica, 23 Jan. 2020, https://www.britannica.com/science/chemistry. Accessed 6 May 2021.
2. Britannica, URL: https://www.britannica.com/science/chemical-element (время обращения - 10.02.2021).
3. Source: Helpics. Org. URL: https://helpiks.org/9-53307.html (время обращения - 22.04.2021).
4. Chemistry Leaner, URL: https://www.chemistrylearner.com/chemical-reactions (время обращения – 24.03.2021).
5. New Inside Out Upper Intermediate Teacher`s Book, Macmillan Publishers Limited 2009, p. 178.
6. Britannica, URL: https://www.britannica.com/science/polyvinylidene-chloride (время обращения - 10.05.2021).
7. Wikipedia. The free Encyclopedia, URL: https://en.wikipedia.org/wiki/Polymer (время обращения - 10.05.2021).
8. Wikipedia, URL: https://en.wikipedia.org/wiki/Paint (время обращения - 29.07.2021).
9. Wikipedia, URL: https://en.wikipedia.org/wiki/Lacquer (время обращения - 01.08.2021).
10. Sciencedirect, URL: https://www.sciencedirect.com/topics/chemistry/lacquer(время обращения - 01.08.2021).
11. Chemical World, URL: http://chem-technology.blogspot.com/2010/01/about-chemical-technology.html (время обращения - 11.07.21).
12. Khan Academy, URL: https://www.khanacademy.org/science/class-11-chemistry-india/xfbb6cb8fc2bd00c8:in-in-organic-chemistry-some-basic-principles-and-techniques/xfbb6cb8fc2bd00c8:in-in-methods-of-purification-of-organic-compounds/a/principles-of-chromatography (время обращения – 08.05.2021).
13. Chemistry Dictionary, URL: https://chemdictionary.org/chromatography/ (время обращения – 08.05.2021).
14. Britannica, URL: https://www.britannica.com/science/chromatography (время обращения - 08.05.2021).
15. Chemical World, URL: http://chem-technology.blogspot.com/2010/01/about-chemical-technology.html (время обращения - 11.07.21).
16. Lab Supply Network, URL: https://www.laboratory-supply.net/blog/laboratory-safety-equipment/ (время обращения – 12. 08.2021).
17. EPA Unites States Environmental Protection Agency, URL: https://www.epa.gov/greenchemistry#:~:text=Green%20chemistry%20is%20the%20

design,innovation%20and%20a%20strengthened%20economy (время обращения – 10.08.2021).
18. Wikipedia. URL: https://en.wikipedia.org/wiki/Green_chemistry(время обращения – 10.08.2021).
19. Special Chem, URL: https://coatings.specialchem.com/coatings-properties/adhesion (время обращения - 17.08.2021).
20. NewScientistsJobs URL: https://jobs.newscientist.com/en-gb/article/a-day-in-the-life-of-a-chemical-engineer/ (время обращения – 17.08.2021).
21. Ehs.gatech, URL: https://www.ehs.gatech.edu/chemical/lsm/7-6 (время обращения - 17.08. 2021).
22. Britannica, URL: https://www.britannica.com/biography/Dmitri-Mendeleev (время обращения - 15.08.2021).
23. News, URL: http://news.bbc.co.uk/2/hi/technology/7085092.stm (время обращения - 15.08.2021).
24. Britannica, URL: https://www.britannica.com/science/distillation (время обращения - 18.08.2021).
25. Britannica, URL: https://www.britannica.com/science/alkali (время обращения - 17.08.2021).
26. Wikipedia, URL: https://en.wikipedia.org/wiki/Alkali (время обращения - 17.08.2021).
27. Thomas, URL: https://www.thomasnet.com/articles/chemicals/wastewater-chemical-treatment/ (время обращения – 17.08.2021).
28. Begin English, URL: http://begin-english.ru/study/irregular-verbs/ (время обращения – 11.08.2021).

Illustrations

1. Yandex.ru, URL: https://yandex.ru/images/search?pos … (время обращения – 12.08.2021).

Sources of Video

1. Youtube, URL: https://www.youtube.com/watch?v=-HjMoTthEZ0 (время обращения – 21.08.2021).
2. Youtube, URL: https://www.youtube.com/watch?v=ApJvQQLL2iY (время обращения – 24.03.2021).
3. Youtube, URL: https://www.youtube.com/watch?v=sp4AWe4UIgA (время обращения – 10.05.2021).
4. Youtube, URL: https://www.youtube.com/watch?v=gyKTUmnHH-M (время обращения – 29.07.2021).
5. Youtube, URL: https://www.youtube.com/watch?v=I5FyGxtjOYw (время обращения – 01.08.2021).

6. Youtube, URL: https://www.youtube.com/watch?v=2kttVyakHN4 (время обращения – 11.07.2021).
7. Youtube, URL: https://www.youtube.com/watch?v=uOhefwQBAbI (время обращения – 08.05.2021).
8. Youtube, URL: https://www.youtube.com/watch?v=k-7B_YfHWXQ (время обращения – 11.07.2021).
9. Youtube, URL: https://www.youtube.com/watch?v=gi3DeFY0cfw (время обращения – 12.08.2021).
10. Youtube, URL: https://www.youtube.com/watch?v=TZ7qx7KPTFY (время обращения – 10.08.2021).

Учебное издание

Лавриненко Ирина Юрьевна
Козлова Виктория Вячеславовна

АНГЛИЙСКИЙ ЯЗЫК ДЛЯ ХИМИКОВ-ТЕХНОЛОГОВ

Учебное пособие

Отпечатано в авторской редакции

Рисунок на обложке Алексея Гридина

Подписано в печать 28. 01. 2022.
Формат 60x84 1/16. Бумага для множительных аппаратов.
Уч.-изд. л. 7,2. Усл. печ. л. 6,7. Тираж 350 экз. Заказ № 3.

ФГБОУ ВО «Воронежский государственный технический университет»
394006 Воронеж, ул. 20-летия Октября, 84

Участок оперативной полиграфии издательства ВГТУ
394026 Воронеж, Московский проспект, 14