МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
ЧЕРКАСЬКИЙ НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ
ІМЕНІ БОГДАНА ХМЕЛЬНИЦЬКОГО

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English for Chemists

(part I)

Навчальний посібник з англійської мови
для студентів І курсу спеціалізації хімія

Черкаси – 2013

УДК 811.111(075.8)
ББК 81.2 Ан-923
К 23

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Рекомендовано до друку Вченою радою Черкаського національного університету імені Богдана Хмельницького (протокол № 4 від 29 квітня 2013 року)

Карловська Г. В.

К 23 English for Chemists (part I) : Навчальний посібник з англійської мови для студентів І курсу спеціалізації хімія. / Г. В. Карловська. – Черкаси : ЧНУ імені Богдана Хмельницького, 2013. – 64 с.

Навчальний посібник призначений для вивчення англійської мови (за професійним спрямуванням) студентами 1 курсу спеціалізації хімія.

Матеріал розташовано згідно послідовності тем, які визначені програмою вивчення дисципліни. Навчальний посібник включає вісім основних тем, які містять у собі тексти з граматичними та лексичними вправами. Мета посібника – формування вмінь та навичок читання, письма, розуміння професійних англійських текстів, розвиток навичок усного мовлення в межах тем, які вивчаються.

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CONTENTS

ВСТУП

Навчальний посібник призначається для студентів-хіміків першого курсу. Мета даного посібника: набуття студентами універсальних вмінь та навичок практичного володіння професійною лексикою на англійській мові, вміння одержувати та передавати іншим інформацію, розширення граматичного та лексичного мінімуму. Реалізується мета комплексного оволодіння всіма видами мовленнєвої діяльності. Запроваджено комунікативний підхід.

Матеріал поділено на вісім розділів, тексти яких охоплюють інформацію про: науку хімію, хімічні елементи та сполуки, різні хімічні процеси.

Кожний розділ складається з тексту, який містить спеціальну наукову термінологію, та лексичних післятекстових вправ, за допомогою яких формуються навички говоріння, читання, письма, розуміння англійських текстів в межах поданих тем.

Вправи дають змогу студентам закріпити нову лексику та розвивають вміння використовувати її в усному та писемному мовленні.

Граматичні вправи вміщують основну інформацію про часи *Indefinite, Continuous* та дієслова *to be* і *to have*, їх особливості та специфіку вживання. Граматичні вправи спрямовані на ефективне засвоєння нового граматичного матеріалу та розвивають вміння застосовувати отримані знання на практиці.

У розділі *Home reading* розміщені тексти для додаткового читання, які можуть бути застосовані як матеріал для домашнього читання для самостійного опрацювання студентами.

У кінці посібника міститься таблиця з назвами більш вживаних хімічних елементів і зразки читання хімічних формул та рівнянь хімічних реакцій.

Всі теми даного посібника викликають зацікавленість та розвивають самостійну пізнавальну діяльність студентів.

UNIT I

1. Read and translate the text:

The Science of Chemistry

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

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

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

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

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

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

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

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

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

2. Translate into Ukrainian:

deal with – мати справу з, розглядати

Both chemistry and physics **deal with** matter and energy.

as well as – також, як і

Chemistry **as well as** physics are our key subjects.

be concerned with – стосуватись, мати відношення до

Physics **is concerned with** the production, nature and effects of different forms of energy.

have to do with – мати відношення до …

Many of the most interesting and important things in nature **have to do with** solutions.

in part – частково

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

result in – приводить до ...

A physical change may **result in** a change of the properties of a substance.

on the one hand – з одного боку

on the other hand – з другого боку

On the one hand chemistry is connected with biology, and **on the other –** with physics.

so far – до теперішнього часу

So far no chemical reaction has ever converted one element into another.

such as – такий, як

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

since – так як; через те, що

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

whereby – з допомогою чого

Distillation is the process **whereby** liquids are purified.

in some way – у деякому відношенні

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

3. Translate into Ukrainian and learn:

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

4. Answer the following questions

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

4. Find the equivalents in the first and second colomns

1. джерело	а) deal with
2. розглядати	б) in part is composed of
3. часково складається з	в) have to do with
4. відношення	г) branch
5. особливо	д) source
6. бути зв'язаним з	е) particularly
7. мати відношення до	ж) be concerned with
8. кількісний	з) quantitative
9. галузь	і) relation

5. Translate the words in brackets info English:

1. Chemistry (розглядає) the properties of the materials (з яких складається світ).
2. The connection of chemistry with energy (зв'язана зі змінами енергії) that accompany chemical transformations of matter.
3. All changes of one kind of matter into another (супроводжується) by the absorption or liberation of energy.
4. Physical chemistry (розглядає) those parts of chemistry (які тісно зв'язані з фізикою).

6. Put the questions to the italicized words:

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

7. Make your topic "The Science of Chemistry".

Grammar exercises

The Present Indefinite Tense

Exercise 1. Put the following into the plural.

Model: The boy goes to school. – The boys go to school.

1. The girl learns English.
2. My friend gets up early.
3. The worker comes home at six.
4. My brother works at a factory.
5. His uncle lives in Poltava.
6. The bus runs quickly.
7. He knows all about engines.
8. She loves her parents.
9. His sister knows Spanish.
10. The taxi goes through the town.

Exercise 2. Put the following into the singular.

Model: The pupils work hard. – The pupil works hard.

1. The engineers go to the plant.
2. The pupils do their homework.
3. The trees grow well.
4. The boys go in for sports.
5. My friends study English.
6. The girls sing very well.
7. My friends call me Vic.
8. The pupils look straight into my face.
9. The old women talk about the weather.
10. The schoolgirls here wear striped jackets and blue skirts.

Exercise 3. Make the following sentences interrogative and negative.

1 .The children drink coffee in the evening.
2. Her sister dances very well.
3. Our grandmother grows potatoes.
4.The pupils remember this rule.
5. Nick goes to bed at ten.
6.They listen to the radio in the morning.
7. You meet him every day.
8. It often snows in November.
9. You want to play chess with him.
10. His mother teaches geography at school.
11. My cousin wants to become a doctor.
12. She takes a bus.

Exercise 4. Put questions to the italicized words.

1. The children go to bed *at ten o'clock.*
2. His son knows English *well.*
3. My father reads *newspapers* in the evening.
4. Her aunt lives *in Lutsk.*
5. Our parents grow *wheat.*
6. This man works *at a machine-building plant.*
7. It snows *in winter.*
8. We buy *bread* at this shop.
9. *My* sister learns many poems by heart.
10. *Ann* helps her mother about the house.
11. At the lessons we *read and speak* English.
12. Her mother teaches *Ukrainian.*

Exercise 5. Translate into English.

1. Я вивчаю англійську мову. Мій друг також вивчає англійську мову.
2. Де ти живеш? Де живе твій товариш?
3. Ми не працюємо на заводі. Ми ходимо до школи.
4. Моя сестра не вивчає англійської мови. Вона вивчає французьку мову.
5. Твій брат працює в лікарні.
6. Де працюють твої батьки?
7. В якій школі вчиться цей хлопець?
8. Ви читаєте французькі книжки?
9. Що ви робите після уроків?
10. Коли ви граєте в шахи?
11. Де працює цей інженер?
12. Мені не подобається ця книжка.
13. Моєму товаришеві не подобається це оповідання.
14. Її батько викладає математику в нашій школі.
15. Чому ти пропускаєш уроки?
16. Ця дівчина працює на фабриці і вчиться у вечірній школі.
17. О котрій годині ви встаєте?
18. О котрій годині ваш син лягає спати?
19. У суботу ми ходимо в театр або в кіно.
20. Хто живе в цьому будинку?
21. Хто викладає англійську мову в вашій школі?
22. Як вчиться її син?
23. Чия сестра знає іспанську мову?
24. Хлопчик хоче іти в ліс?
25. Хіба ви не вивчаєте фізики?
26. Хіба твій брат не ходить до школи?
27. Ця дівчина дуже добре співає.
28. Хто допомагає тобі вивчати англійську мову?
29. Скільки водіїв працює тут?
30. Як учні проводять літні канікули?

UNIT II

1. Read and translate the text:

The States of Matter

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

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

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

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

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

Notes

1. **chemist must have a thorough knowledge** – хімік повинен добре знати

2. Translate into Ukrainian:

as – у той час як; коли; так як; в якості; як

1. **As** he was making his experiments he observed an interesting phenomenon.
2. **As** the reaction goes on the reacting substances are used up (використовуються) and new ones are formed.
3. **As** chlorine is 2.5 times heavier than air it may be collected by displacing (витискуванням) air.
4. In the laboratory, time is usually measured and expressed **as** the unit.
5. **As** we have already learned, the molecules of ideal gases do not interact with each other.

be a common knowledge – бути загальновідомим

That water is a universal solvent **is a common knowledge.**

be familiar with – бути знайомим з, знати

We **are most familiar with** water in its liquid state.

3. Translate into Ukrainian and learn:

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

4. Answer the following questions:

1. In what way is it possible to change matter from one state to another?
2. What is a piece of ice called?
3. What substance has never been liquefied?
4. What is all matter composed of?
5. What is the essential difference between the states of matter?

5. Fill in the blanks:

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

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

6. Ask questions as in the model and answer them:

Model: Ask me if common salt exists normally as a solid.

– Does common salt exist normally as a solid?
– Yes, it does.

1. if matter may exist in three physical states.
2. if it is possible to change matter from one state to another.
3. if all kinds of matter can be obtained in three physical states.
4. if solids have a definite volume and a definite shape.

7. Retell the text "The States of Matter" using the words and expressions from the Ex. 3.

Grammar exercises

The Verbs to be and to have in the Present Indefinite Tense

Exercise 1. Fill in the blanks with *am, is, are.*

1. I ... a school boy.
2. This man ... a farmer.
3. My friend ... in the garden.
4. We ... students.
5. My father ... a tractor driver.
6. The pupils ... in the classroom.
7. She ... an engineer.
8. I... busy.
9. Our teacher ... young.
10. They ... in the park.

Exercise 2. Make the following interrogative and negative

1. You are an engineer.
2. His little brother is a schoolboy.
3. Her parents are at home.
4. Our teacher is at the library.
5. The cars are in the street.
6. The theatre is in the centre of the town.
7. My cousin is at school.
8. They are good sportsmen.
9. His father is a worker.
10. The street is narrow.

Exercise 3. Translate the following into English

1. Мій батько – тракторист.
2. Наш учитель зараз у Києві.
3. Твоя сестра дома?
4. Петро не хворий.
5. Де твій брат? Його нема в кімнаті.
6. Ми в школі.
7. Трактори в полі.
8. Ольга вдома?
9. Його батько зараз дуже стомлений.
10. Хто твоя сестра? Вона лікар.
11. Її дочка в Києві? Ні, вона не в Києві, вона у Львові.
12. Учні в залі? Ні, їх нема в залі, вони в класах.
13. Де твоя ручка? Вона в портфелі.
14. Де твої книжки? Вони в портфелі.
15. Де географічна карта? Вона на стіні.

16. Газети на столі.
17. Якого кольору твоя ручка? Моя ручка червона.
18. Якого кольору парти? Вони білі.
19. Де ти? Я в кухні.
20. Чому тут нема Петра? Він у школі.

Exercise 4. Fill in the blanks with *have* or *has.*

1. We... a good flat.
2. My neighbor... a car.
3. They ... a TV set.
4. I ... eight English books.
5. She ... a new dress.
6. You ... a good dictionary.
7. Our room ... two windows.
8. Many collective farmers ... motor cycles.
9. Our teacher ... two daughters.
10. I... a very special reason to go there.

Exercise 5. Make the following interrogative and negative.

1. Peter has a tape recorder.
2. You have many relatives there.
3. My sister has music lessons once a week.
4. The children have many toys.
5. We have coffee in the afternoon.
6. Her daughter has a piano.
7. The children have lunch at eleven.

Exercise 6. Translate into English

1. У мене є фотоапарат.
2. У мого товариша є мотоцикл.
3. У нас є авторучки.
4. У тебе є кольорові олівці?
5. У Віктора є велосипед?
6. У мене немає вільного часу.
7. У них немає англо-українських словників.
8. У мене немає цієї статті.
9. У тебе є брат у Києві?
10. У неї є родичі в Сочі?
11. У нас немає часу піти туди.
12. Що у тебе в кишені?
13. Скільки в неї братів і сестер?
14. О котрій годині ви снідаєте?
15. Ви обідаєте вдома чи в шкільній їдальні?

UNIT III

1. Read and translate the text:

Substances

Substances are *distinguished* by their *properties–colour,* smell, taste, *specific gravity,* greater or lesser *hardness, melting* and *boiling points, volatility,* etc.

For example, in describing the properties of sugar, one can state that sugar is a hard, *brittle* substance, white in colour, sweet to the taste, without *odour,* easily *soluble* in water, *heavier* than water and it turns brown when it is heated, etc.

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

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

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

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

Notes

1. **are not those of water –** не є властивостями води
2. **set of properties –** ряд властивостей

2. Translate into Ukrainian:

to turn + black (прикметник) – чорніти, ставати чорним
Acids are substances that **turn** blue litmus **red.**

to learn – учити
All the students of our Institute **learn** chemistry.

to learn – пізнавати
We **learned** the news from the newspapers and the radio.

3. Translate into Ukrainian and learn:

admixture, amount, ash, boiling point, brittle, case, clouded, contain, distinguish, enumerate, feldspar, hardness, heavy, homogeneous, heterogeneous, melting point,

mica, mixture, odour, property, pure, retain, sample, set, soluble, specific gravity, substance, transparent, varying, volatility

4. Answer the following questions:

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

5. Find the equivalents:

1. домішки	а) brittle
2. карбон	б) enumerate
3. зразок	в) distinguish
4. полевий шпат	г) transparent
5. стороння речовина	ґ)specific gravity
6. неоднорідний	д) property
7. властивість	е) heterogeneous
8. питома вага	є) foreign substance
9. прозорий	ж) feldspar
10. розрізняти	з) sample
11. перераховувати	и) carbon
12. крихкий	і) admixture

6. Fill in blanks:

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

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

7. Translate into English:

1. Всі предмети, що оточують нас, складаються з речовин. Вони складаються з одинакових молекул.
2. Граніт складається з кількох речовин. Тому граніт складається з різних молекул
3. Хімія вивчає речовини та їх склад. Вона також вивчає процеси і закони, по яким проходять зміни їх складу.

8. Retell the text "Substances".

Grammar exercises

The Past Indefinite Tense

Exercise 1. Form the Past Indefinite of the following regular verbs.

to look, to seem, to dress, to love, to cry, to jump, to profit, to enjoy, to hurry, to clear, to regret, to carry, to cook to repair, to shout, to scatter, to rob, to stir, to compel, to peel.

Exercise 2. Put the verb in brackets into the right form of the Past Indefinite Tense

1. I (to see) my friends yesterday and (to accept) their invitation.
2. I (to write) to my cousin three weeks ago and (to get) no reply.
3. She (to look) pleased because George (to give) that lovely ring to her.
4. He (to meet) you both in here about two month ago.
5. I (to call) you at five, but you (to be) not in.
6. I (to teach) that girl to drive myself when she (to be) fifteen.
7. His mother (to die) three or four years ago but he (not to tell) anybody about it.
8. I should like to tell you what (to happen) eighteen months ago.
9. I'm not much of a theatre-goer myself, but my wife (to go) along and (to see) the play last week.

Exercise 3. Make the following interrogative and negative.

1. The teacher repeated the question.
2. The boys played football in the afternoon.
3. The girl caught cold.
4. Mother turned off the gas.
5. They slept in the open air.
6. The pupils answered at once.
7. The boy broke the window.
8. The woman changed her clothes.
9. The tourists reached the village before dark.
10. The clock struck five.
11. Our team won the match.
12. The doctor allowed you to go out.

Exercise 4. Change the following into the Past Indefinite.

1. His father works at a plant.
2. I often see them in the park.
3. Do your pupils read English books?
4. Her mother teaches chemistry at school.
5. We don't know his address.
6. He gets up, washes, dresses, has breakfast and goes to school.
7. Does the doctor speak English?
8. We understand the rule.
9. My friend doesn't like such films.
10. In summer we pick berries and mushrooms.
11. They don't change trains there.
12. This worker repairs his car himself.

Exercise 5. Translate into English.

1. Діти допомагали батькам.

2. Батько прийшов додому пізно.

3. Що ви робили в неділю?

4. Де ти був учора ввечері? – Я ходив у кіно. Тобі сподобався фільм? – Так, фільм мені дуже сподобався.

5. Що ви робили на уроці англійської мови? – Ми читали новий текст, відповідали на запитання і перекладали речення з української мови на англійську.

6. Коли ви почали вивчати англійську мову? – Ми почали вивчати англійську мову три роки тому.

7. Скільки сторінок ви прочитали минулого тижня?
– Минулого тижня я прочитав десять сторінок. Мені подобається ця книжка.

8. Де ви були позавчора? – Ми їздили на екскурсію на машинобудівний завод. Екскурсія була дуже цікавою.

9. О котрій годині ти звичайно встаєш? – Я встаю о сьомій годині.

10. О котрій годині ти встав учора? – Вчора я встав о восьмій. Я завжди встаю о восьмій у неділю.

11. Коли твої друзі приходили до тебе? Хто приходив до тебе вчора?

12. Я увійшов до кімнати, увімкнув світло і почав виконувати домашні завдання.

13. Вчора ми не послали їй телеграми, бо не знали її адреси.

14. Які іноземні мови ви знаєте? – Я знаю англійську і французьку мови. У школі я вивчав також німецьку мову, але знаю її погано.

15. Де ви купили цей годинник? – Я купив його сім років тому в центральному універмазі.

UNIT IV

1. Read and translate the text:

Changes of Matter

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

Chemical Changes

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

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

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

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

Physical Changes

When physical changes occur, some of the properties of a substance may be altered for a time, but no new substances are formed. The following are the examples of a physical change: 1) the melting of ice and the condensation of steam; 2) the mixing of sugar with water to form a solution; 3) the change observed when a platinum wire[4] is heated to redness. In each of these there is a change in properties.

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

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

The platinum wire changes, when heated[5], from a silvery lustrous metal that reflects light to one that emits[6] light. But there is no alteration of the fundamental character of any of the substances during these changes.

Sugar dissolved in water retains[7] its original properties and only forms a mixture from which it is readily obtained again in its crystalline form by allowing the water to evaporate.

Notes

1. **they cannot be undone** – вони не можуть бути знищеними
2. **substances formed persist** – речовини, що утворилися, існують
3. **and another chemical change would be necessary –** і потрібне було б інше хімічне перетворення
4. **wire** ['waɪə] – дріт, дротинка
5. **when heated –**при нагріванні
6. **emit [**ɪ'mɪt] – випромінювати
7. **retain** [rɪ'tein] – зберігати

2. ***Translate into Ukrainian:***

effect n –дія; влив; результат

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

effect v – виробляти; виконувати; здійснювати

1. They effected a change in the plan of their work.
2. The scientists effected the plan of their research before the time appointed.
3. They effected the isolation of a new substance.

to affect v – впливати на

Moisture **affects** many metals.

it takes – потрібно, вимагається

It takes energy to move a body.

to mean — значить, означати

The word "chemistry" **means** the science which deals with the properties, composition and structure of the materials our world.

means n – засіб; засоби

1. Now I have no **means** to buy a new computer.
2. At present we have many **means** of defence against air and chemical danger.

by means of – за допомогою

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

3. Translate into Ukrainian and learn:

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

4. Answer the following questions:

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

5. Fill in the blanks:

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

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

6. a) Find the synonyms:

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

b) Find the antonyms:

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

7. Find the equivalents in the first and second colonies:

1. означати	а) by means of
2. перетворюватися на іржу	б) necessary
3. змінюватися	в) to turn into rust
4. здійснювати, виробляти	г) rust
5. мати місце	ґ) it took a chemical change
6. завдяки	д) although
7. якщо ... не	е) to allow
8. необхідний	є) outward
9. застосування	ж) to determine
10. піддавати дії	з) to subject to
11. визначати	и) application
12. зовнішній	і) unless
13. дозволяти	ї) to take place
14. хоча	й) to effect
15. знадобилась хімічна зміна	к) to mean
16. іржа	л) to alter

8. Translate into English:

1. Плавлення, кипіння речовин, зміна їхньої форми, нагрівання чи охолодження – всі ці явища (phenomena) називаються фізичними. У результаті фізичних змін склад речовин не змінюється. Такі зміни, у результаті яких з одних речовин одержуються інші, називаються хімічними явищами або хімічними реакціями. У природі хімічні реакції іноді протікають дуже повільно, тому ми їх не завжди помічаємо.

9. Tell the difference between chemical and physical changes.

Grammar exercises

The Verb to be and to have into the Past Indefinite Tense

Exercise 1. Change the verb to be into the Past Indefinite.

1. I am a pupil.
2. They are at school.
3. His father is a worker.
4. She is a schoolgirl.
5. You are tired.
6. His parents are farmers.
7. The girls are at the theatre.
8. Peter is ill.
9. Is the doctor at the hospital?
10. Are you ready to go there?

Exercise 2. Make up five sentences from each table.

I	Was	here	yesterday.
He	was not	there	last week.
She	(wasn't)	in London	at that time.
We	Were	at school	the other day.
You	were not	at home	on Sunday.
They	(weren't)	busy	in the evening

Was	I	At the cinema	Last summer?
Were	He	In the country	Last night?
	She	In the forest	Two days ago?
	We	At the doctor`s	On Saturday?
	You	Here	Yesterday?
	They	There	

Exercise 3. Make the following interrogative and negative.

1. Nick was at home at that time.
2. You were angry with me.
3. The little girl was afraid of the dog.
4. We were ready to have a test in English.

5. The baby was asleep.
6. The boys were at the stadium yesterday.
7. You were glad to hear this news.
8. Her parents were at the theatre last night.
9. Their house was the finest in the street.
10. They were silent for a while

Exercise 4. Ask questions as in the models.

Models: *Ask* me if *I was at* home *at* ten.
– *Were* you *at* home *at ten?*
Ask me when *I was at* home.
– When *were* you *at* home?

Ask me:

1. if I was at the doctor on Thursday;
2. when I was at the doctor;
3. whether I was in Siberia last year;
4. when I was in my native village;
5. if I was busy yesterday;
6. where I was yesterday;
7. whether I was at home last night;
8. where I was last night;
9. if my daughter was at the theatre last night;
10. when I was in Minsk;
11. if I was ill the day before yesterday;
12. when my brother was in Chernihiv.

Exercise 5. Answer the following questions.

1. Whee you at school yesterday?
2. Were you in the Crimea last summer?
3. Was your mother at home last Sunday?
4. Were you in the country in July?
5. Were you at the cinema last night?
6. When were you at the cinema last time? What was on?
7. When were you at the theatre last time?
8. With whom were you at the theatre?
9. When were you born?
10. Where were you born?

Exercise 6. Change into the Past Indefinite and make the following interrogative and negative.

1. Jane has a bookshelf.
2. I have a bath once a week.
3. I have his textbook on physics.
4. We have much snow this winter.
5. They have breakfast at half past seven.
6. His uncle has a garden.
7. I have enough paper to write three letters.

UNIT V

1. Read and translate the text:

The General Apparatus of Chemical Laboratory

Yesterday we were shown the laboratory of general chemistry and were given instructions how to work there. The laboratory is the *place* where experiments as well as scientific research may be carried out. It usually consists of one large room with a weighing room, a reagent room and sometimes a dark room. The reagent room is used for *storing chemicals* and apparatus, and contains shelves of reagent *bottles.* The weighing room is specially constructed *so as* not to *be affected* by *external disturbances*[1] and the *balances* generally stand on *firm* stone shelves. The analytical balance, which is *kept* in a glass *case,* consists of a *beam,* which *swings* on a knife *edge,* and has two *pans suspended,* one from each end. The material which is to be weighed is transported to and from the balance room in a *dessicator.* Chemical laboratory operations deal with gases[2], liquids and solids, and *require* a *variety* of specialized apparatus for their manipulation[3].

The laboratory is *furnished* with many long tables or benches, as they are usually called. On each of these benches there are shelves and *racks* for keeping apparatus, materials, etc.

On the shelves there are many bottles with different chemical substances. Some bottles contain solids, others–liquids. In the racks we see different glass tubes, *test-tubes, condensers,* flasks of different shapes and sizes, *bowles,* glass *rods, crucibles,* etc. Some crucibles are made of *porcelain,* others of quartz or platinum.

The apparatus used for carrying out experiments are *clamped* to *ring-stands.* The ring-stand consists of a *stem* having a *ring* with a copper *gauze.* Every working place is *fitted* with a Bunsen *burner*[4]. The flame of the burner can be regulated by means of a *tap.* All the burners are connected with the *main* gas line by a rubber tube. Sometimes steam-baths, water-baths and air-baths are used for heating. The laboratory is also provided with gas and *running water.* There is a *ventilating hood* for the escape of *disagreeable* odours and *harmful* vapours.

Notes

1. **external disturbances –** зовнішні перешкоди
2. **chemical laboratory operations deal with gases –** робота в лабораторії пов'язана з газами
3. **for their manipulation** – для роботи з ними
4. **Every working place is fitted with a Bunsen burner –** на кожному робочому місці є бунзенівська пальничка.

2. Translate into Ukrainian:

carry out – виконувати, проводити

The experiments **carried** out with hydrogen have shown to us that the gas is inflammable.

as far as – оскільки, що стосується

As far as chemical properties of sulphur are concerned, it unites with common metals, except gold and platinum.

take precautions – приймати міри безпеки

We must **take precautions** when we deal with poisonous substances.

provide – забезпечувати

All polar expeditions **are provided** with special equipment

3. Translate into Ukrainian and learn:

affect, balance, bath, beam (тут коро́мисло), bottle, bowl, burner, case (тут ящик), clamp (тут закріпляти), condenser, crucible, chemicals, dessicator, disagreeable, disturbance, edge, external, firm, fit, furnish, gauze, harmful, keep, main, pan, place, porcelain, rack (тут стелаж), require, ring, ring-stand, rod, running water, so as, stem, store, suspend, swing, tap, test-tube, variety, ventilating hood

4. Answer the following questions:

1. Where is scientific research carried out?
2. How many rooms does a laboratory usually consist of?
3. What is the reagent room used for? Where do balances generally stand?
4. What does the analytical balance consist of?
5. In what way is the material which is to be weighed transported?
6. What substances do chemical laboratory operations deal with?
7. What is the laboratory furnished with?
8. What is every working place fitted with?
9. What can the flame of the burners be regulated with?
10. Are all liquids colourless and odourless?
11. Where are liquids kept?
12. What is a crucible made of?
13. What are the apparatus used for carrying out experiments clamped to?
14. What is the laboratory provided with?

5. Fill in the blanks:

1. The reagent room is used for ... (storing, weighing) chemicals.
2. The weighing room is ... (specially, generally) constructed ... (so as, because) to be free from external disturbances.
3. Chemical laboratory operations ... (deal with, require) liquids, gases and solids.
4. The apparatus used for ... (transporting, carrying out) experiments are clamped to ring-stands.
5. The laboratory ... (is operated, is provided) with gas and running water.

6. a) Find the synonyms:

to demand, generally, to furnish, to require, by means of, usually, to be concerned with, to provide, to deal with, to store, form, to perform, in order to, shape, so as, to carry out, to equip, with the help of

b) Find the antonyms:

external, similar, usually, internal, agreeable, seldom, different, disagreeable

7. Make the topic "Chemical Laboratory".

Grammar exercises

The Future Indefinite Tense

Exercise1. Change the following into the Future Indefinite.

1. The pupils have dictations twice a week.
2. I spend my summer holidays in the country.
3. Our engineer left for Kyiv on Monday.
4. She agrees with him.
5. Our school year begins on the 1st of September.
6. We do our homework in the afternoon.
7. My brother is a driver.
8. I saw him at school.
9. We sleep in the open air.
10. Her husband worked at the factory.
11. They are at home.
12. I am busy on weekdays.

Exercise 2. Make the following interrogative and negative.

1. The meeting will begin at eight.
2. They will be in Brussels the day after tomorrow.
3. She will cook breakfast for us.
4. We shall start at dawn.
5. The boy will be seven next year.
6. The plane will take off in five minutes.
7. We shall climb the mountain next week.
8. I shall see you on Monday.
9. I'll buy a camera next month.
10. They'll tell us about it.

Exercise 3. Put questions to the italicized words.

1. Our friends will come to see us *today***.**
2. *They* will arrive in some minutes.
3. His parents will be *at home* after six.
4. The peace talks will be held *next month* in Vienna.
5. Jack won't go to the cinema *because he is busy*.
6. *We'll* play chess this evening.
7. We'll get up *at seven* tomorrow.
8. The plant will make *agricultural machines*.

Exercise 4. Replace the infinitives in brackets by the Future Indefinite or the Present Indefinite.

1. Jane will look after her little brother till her mother *(to come)* back.
2. We *(to go)* to the theatre the day after tomorrow if we *(to get)* tickets.
3. As soon as the teacher *(to enter)* the classroom, the pupils will stand up.
4. Wait for me till I (to *return).*
5. We *(not to go)* on an excursion tomorrow, if the weather *(to be)* nasty.
6. The children *(to stay)* at home next Sunday if it *(to rain).*
7. Don't get off the tram before it *(to stop).*
8. We'll go to the Carpathians after we *(to pass)* all our examinations.

Exercise 5. Combine the given sentences as in the model.

Model: He will get tickets. We shall go to the theatre.
– If he gets tickets, we shall go to the theatre.

1. The weather will be fine. The children will go on a trip.
2. Peter will come to see me. We'll play chess.
3. Mother will not allow us to go to the cinema. We'll see the film on the television.
4. The wind will blow from the west. It will rain.
5. You won't wake me up. I'll miss the train.
6. We'll take a taxi. We'll catch the train.
7. I shall fall ill. I'll call a doctor.
8. He won't come in time. We'll go without him.
9. It will rain on Sunday. The children will stay at home.
10. I'll see her. I'll invite her to our conference .

Exercise 6. Put the verb in brackets into the right form of the Future Indefinite Tense:

1. But I (to be) fine tomorrow, I (to do) everything you (to tell) me.
2. You (to go) with me tomorrow?
3. I (not to do) anything to make him mad, I promise.
4. I (to explain) everything tomorrow, about six.
5. I (to say) something to the press in some days, not now, later.
6 You have no business to sit up so late. You (to be) very sleepy tomorrow morning.
7 "You (to go) and (to get) his things ironed, he ordered.
8. They (to come) back in half an hour. Wait and you (to talk) to them then.
9. You fear that he never (to return). But I know that he (to return).
10. It (to be) clear tomorrow and hot as in June.

UNIT VI

1. Read and translate the text:

Air

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

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

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

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

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

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

Notes

1. **a little** – небагато
2. **single** – *тут* простий
3. **distil over in a single fraction** – перегоняються в одну фракцію
4. **far too great a density** – дуже велика густина

2. Translate into Ukrainian:

due to – завдяки

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

be due to – обумовлене, відбуватися через

The change of colour is **due to** heating.

slightly – злегка

The colour of this liquid changes **slughtly** on heating.

3. Translate into Ukrainian and learn:

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

4. Answer the following questions:

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

5. Finish the sentences:

1. If we analysed the bubbles of dissolved air, (ми б побачили, що вони за об'ємом складаються на 1/3 з кисню).
2. If we wrote the formula N_4O for air, (вона не показала б точних співвідношень, у яких кисень і азот присутні в повітрі).
3. If the composition of air were analysed at sea level, (можна було б побачити, що він трохи багатший киснем і бідніший азотом, чим на висоті в кілька миль).
4. If we separated air into its components, (ми б одержали кисень, азот і невелику кількість інших газів).

6. Fill in the blanks:

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

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

7. Find the antonyms in the text:

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

8. Retell the text "Air".

Grammar exercises

The Present Continuon Tense

Exercise 1. Make the following interrogative and negative.

1. The teacher is explaining a grammar rule.
2. The woman is playing with a child.
3. The boys are skating.
4. I am waiting for them.
5. The children are having supper.

6. It is raining.
7. I am cleaning the blackboard.
8. My sister Chris and David are getting married today.
9. I'm always thinking about her these days.
10. Ingrid and Dorothy are giggling and whispering together.

Exercise 2. Put questions to the italicized words.

1. The children are planting *trees.*
2. They are working *in the garden.*
3. The girl is trying on *a dress.*
4. *Nick* is talking with his friends.
5. The students *are reading.*
6. The man is sitting in the *armchair.*
7. The girl *is drawing.*
8. The woman is wearing *a blue dress.*
9. *Peter's* brother is riding a bicycle.
10. They are talking *about the film.*
11. *He* is speaking over the telephone.
12. The boy is running fast *because it is raining.*

Exercise 3. Replace the infinitive in brackets by the Present Indefinite or the Present Continuons.

1. We (to gather) mushrooms in summer.
2. The children are in the forest now. They (to gather) mushrooms.
3. Where is Kate? She (to do) her homework. She always (to do) her homework in the evening.
4. The pupils (to write) compositions once a month.
5. Don't shout. The pupils of the ninth form (to write) compositions.
6. Water (to boil) at 100°C.
7. Turn off the gas. The milk (to boil).
8. Mary (to dance) all modem dances very well.
9. Look! Peter (to dance) with Jane.
10. Where you (to hurry)?
11. Helen usually gets up late. She always (to hurry) to school.
12. As a rule Paul (to prepare) his reports in time.
13. Don't disturb him. He (to prepare) for his examination.
14. Take along your umbrella. It (to rain).
15. It often (to rain) in England.

Exercise 4. Paraphrase the following sentences as in the model.

Model: I shall buy a car. – I am going to buy a car.

1. Ann will spend the summer holidays in the country.
2. The pupils will visit the Art gallery.

3. We'll learn Spanish next year.
4. She will take a taxi.
5. The pupils will decorate their school.
6. I'll take part in the sports competition.
7. I'll think about it.
8. He will show her the house and the garden.
9. I shall talk French four days a week and Russian in the remaining three.
10. We'll talk about this some other time.

Exercise 5. Translate into English

1. Що ви робите?
– Ми готуємося до концерту.
2. Куди ти йдеш?
– Я йду в бібліотеку.
3. Де Микола?
– Він у читальному залі. Він там виконує домашні завдання. Микола часто виконує домашні завдання в читальному залі.
4. Що зараз робить Петро?
– Він ремонтує свій радіоприймач.
6. Олена вдома?
– Ні, її немає вдома. У неї зараз урок музики. У неї завжди уроки музики в цей час.
7. Хто зараз у спортзалі?
– Там тренуються учні нашого класу. Вони тренуються двічі на тиждень.
7. Не шуміть. Коваленко говорить по телефону.
8. Не заходьте до тієї кімнати. Там учні нашого класу складають екзамен з математики.
9. Як часто учні складають екзамени?
– Учні складають екзамени один раз на рік.
10. Дощ іде?
– Ні, дощу немає, але дме сильний вітер.
11. Коли ми вирушаємо,
– Ми вирушаємо завтра вранці.
12. Ким збирається стати його син?
– Його син збирається стати агрономом.
13. Що ви збираєтеся робити?
– Ми збираємось саджати дерева?
14. Я зараз поясню їм це правило.

UNIT VII

1. Read and translate the text:

The Relation of the Volume of a Gas to Its Temperature

It is a familiar *observation*[1] that a gas expands *as* the temperature rises. If a gas is *allowed* to expand[2] with *increasing* temperature *against* constant pressure, one *observes* a very definite *relation* between the rise in temperature and the increase in volume. The change in volume of a *fixed* quantity of a gas is *equal* to 1/273 (one two hundred and seventy-third) of its volume at *zero* for each degree change[3] in temperature, provided the pressure is constant. Should this *uniform* change in volume *continue during* the cooling of a gas to a very low temperature, the gas sample would have no volume *at all* at –273°, because the concentration in volume would now be 273/273 of its volume. Could a substance be cooled to –273° the molecules would be *motionless. Obviously,* no lower temperature than this can exist. This point is therefore called the absolute zero. However, as all gases liquefy at temperature above –273° no gas can exist at this temperature. Absolute zero is the temperature at which a gas if it had existed, theoretically would have possessed zero volume.

The relation of the volume of a gas to its temperature is *stated* in the following law: the volume of a given quantity of a gas varies directly with the absolute temperature, *provided that* there is no change in pressure. The volume which a *measured* gas sample would occupy at some different temperature may be calculated by the *application* of this law. However, one has to remember that this law does not hold for[4] very low temperatures.

Notes

1. it is a familiar observation – добре відомо
2. is allowed to expand – дають можливість розширюватися
3. for each degree change – на кожний градус змін
4. to hold for – поширюватися на …

2. Translate into Ukrainian:

provided – якщо; за умови, що; **provide** – постачати

1. No chemical change will occur **provided** the temperature is kept constant.
2. The management **provided** our laboratory with all the necessary equipment.

at all – зовсім

Salt and paraffin do not act on each other **at all.**

3. Translate into Ukrainian and learn:

against, allow, application, as, at all, continue, during, equal, fixed, increase, measure, motionless, observation, observe, obviously, provided that, relation, state, uniform, zero

4. Answer the following questions:

1. Under what conditions does a gas expand?
2. At what temperature would the molecules be motionless?
3. What is the absolute zero?
4. Why cannot a gas exist at –273°?

5. a) Translate into English:

добре відомо, на кожний градус, певна кількість, ніякий газ не може існувати, цей закон не поширюється на …

b) Translate into Ukrainian:

constant pressure, a fixed quantity of a gas, a measured gas sample, a very definite relation, at some different temperature

6. Translate words in blanks into English:

1. –237° is the lowest temperature that (може існувати).
2. At –237° the molecules are (нерухомі).
3. One has to remember that this law (не можна застосувати) for very low temperatures.
4. We know that gas (розширюється) as the temperature (підвищується).
5. The volume of (даної кількості газу) varies (прямо пропорційно) with the absolute temperature, provided that there is no change (під тиском).

7. Find the synonyms in the text:

well-known, provided, permit, go on, as, matter, formulate, employ, keep in mind

8. Retell the text "The Relation of the Volume of a Gas to Its Temperature".

Grammar exercises

The Past Continuous Tense

Exercise 1. Make the following interrogative and negative

1. She was standing alone before the fire.
2. They were crossing the street at the wrong place.
3. I was listening to their conversation.
4. They were talking about our party.
5. George was preparing for his examination the whole day.
6. She was playing the piano when you came in.
7. The children were doing their homework at six.
8. Their son was going to be a painter.

Exercise 2. Change the following into the Past Continuous.

1. The man is standing near the door.
2. Tom told a story.

3. The children swam in the river.
4. Is Mary wearing a white dress?
5. She went to the cinema.
6. They did not work in the garden.
7. We are not sitting by the window.
8. The workers built a bridge.
9. The girl tried on a dress.
10. The old man spoke in a low voice.

Exercise 3. Put questions to the italicized words.

1. The man *was* reading *a magazine* when somebody knocked at the door.
2. He was waiting *for a bus.*
3. *The boy* was skating.
4. The students were dancing *when I opened the door.*
5. The girl was eating *ice-cream* when we came in.
6. She was looking *after her little brother.*
7. The pupils were discussing *a story.*
8. The man was passing the theatre *when the clock struck ten.*
9. It was snowing *when* we *went out.*
10. The boy was running *very fast.*

Exercise 4. Paraphrase the following sentences as in the model.

Mode1: He intended to work there. – He *was* going to work here.

1. We intended to spend our holidays at a camp.
2. She intended to visit the picture gallery.
3. I intended to call on him on Sunday.
4. His son intended to enter an agricultural college.
5. The tractor driver intended to buy a car.
6. They intended to congratulate him.
7. We intended to take a taxi.
8. They intended to send their son to Oxford.
9. We intended to buy ice-cream for dessert.
10. I thought you intended to find a new job.

Exercise 5. Translate into Enghsh.

1. Ми бачили її вчора. Вона працювала в саду
2. Коли годинник пробив дванадцять, ми всі сиділи за столом.
3. Де ти був о третій годині? Я дзвонив тобі, але ніхто не відповів. – Я ремонтував велосипед.
4. Коли я зайшов до залу, Ольга грала на скрипці.
5. Що вона робила, коли ви прийшли до неї? – Вона прибирала в кімнаті.
6. Коли я вийшла з дому, ішов сильний дощ.
7. Що робив учитель, поки ви писали твір?
8. Що робив ваш син о дев'ятій годині вечора? – Читав якусь книжку. В цей час він завжди читає книжки, дивиться телевізійні передачі або слухає радіо.
9. Я бачив тебе, коли ти біг вулицею. Куди ти поспішав?
10. Ми повертались додому пізно. Дощу не було, але дув сильний вітер.

UNIT VIII

1. Read and translate the text:

Water Purification

The *abundance*[1] of water in liquid, *solid* and gaseous state is a matter of common observation[2]. Not only is water the most *abundant*, compound, but it is also very important for life. *To be sure*[3] life would be impossible without water.

From the chemical *point of view* water has many points of interest[4], for it enters into chemical reactions which are of fundamental[5] importance. Not only does water react with many substances, but it has also a marked *influence* upon many chemical reactions.

For many purposes it is desirable that water should be pure. The purest natural water is rain. It would be *wrong*, however, to consider it as being[6] really pure. Nor is ground water pure. It contains *a great deal* of *impurities* which *fail* to *settle* [7]. *Dissolved* substances do not settle, nor do they evaporate with water, which[8] makes their *removal* difficult.

One of the most important problems is to obtain water sufficiently pure to meet our needs [9]. The choice as to what process [10] is to be used for *purification* of water depends upon the uses for which it is intended as well as the impurities it contains. Water used for steam boilers should be free from substances that cause corrosion and scale formation. Water for washing should not contain substances that react with soap. When water is to be used for drinking it is necessary that the microbes which it may contain should be killed. *To achieve* this, water which is to be *purified* is *thoroughly* filtered. Another way to purify water is to boil it.

None of these methods is fit for producing pure water in the chemical sense, since most of the soluble salts are unaffected by the *treatment.* To *remove* these [11] and to *prepare* chemically pure water *suitable* for scientific use, we take advantage of the fact that water is easily changed to steam *while* most of the dissolved substances as *already* mentioned are not volatile. By condensing the steam, we are *thus* able to remove all the impurities except *volatile* ones. This process is called distillation. Distilled water has many uses, both in the laboratory and in industry, when even small quantities of impurities would be undesirable.

Notes

1. **abundance** – поширення
2. **a matter of common observation** – добре відомо
3. **to be sure** – безперечно
4. **has many points of interest** – цікава в багатьох відношеннях
5. **fundamental –** тут великий
6. **consider it as being –** вважати, що вона
7. **fail to settle –** не осідають
8. **which –** тут що
9. **to meet the needs** – відповідати вимогам
10. **the choice as to what process –** вибір процесу, який
11. **to remove these** – щоб видалити їх

2. Translate into Ukrainian:

both – обидва

Argon and helium are **both** inert gases.

both –... and як ... так і, і ... і

Both above **and** below 4°C the density of water decreases.

fail (у поєднанні з інфінітивом) – не

Molecular nitrogen **fails** to react with many elements at all.

3. Translate into Ukrainian and learn:

abundance, abundant, achieve, a great deal, already, dissolve, fail to, for many purposes, impurity, influence, point of view, prepare, purification, purify, removal, remove, settle, solid, suitable, thoroughly, thus, to be sure, treatment, volatile, while, wrong

4. Answer the following questions:

1. In what states does water occur?
2. Why is water so important for life?
3. Why is ground water not pure?
4. What is one of the most important problems as regards water?
5. What kind of water should be used for drinking?
6. What methods are used for purifying water?
7. Where is distilled water used?

5. a) Translate into English:

добре відома, безперечно, цікава в багатьох відношеннях, відповідати вимогам, широко використовуються, не осідають

b) Translate into Ukrainian:

a marked influence, for many purposes, to fail to settle, to be of fundamental importance, a matter of common observation, from the chemical point of view, to meet one's needs, to have many points of interest, as already mentioned, to take advantage of, valence bond theory

5. Find the antonyms in the text:

liquid, non-volatile, purity, right, desirable, rare, possible, dilute, unimportant

6. Translate into English:

1. Вода приймає участь в багатьох хімічних реакціях.
2. Можно довести, що повітря – це суміш.
3. Повітря можна розкласти на кілька його частин
4. Усі гази зріджуются за температури вище –273°С.)

7. Make you topic "Water Purification".

Grammar exercises

The Future Continuous Tense

Exercise 1. Turn the following into Future Continuous.

1. They were having dinner at three yesterday.
2. I am sending him invitation to dinner now.
3. The children will ski in some days.
4. The girl was reciting a poem when delegation entered the hall.
5. I shall wait for you at the metro station.
6. This team plays hockey twice a day.
7. The students will discuss the article on Friday.

Exercise 2. Make the following interrogative and negative.

1. John will be coming soon.
2. We shall be flying to Kherson at this time tomorrow.
3. You will be meeting him every day.
4. We shall be packing our things when you come.
5. He'll be going to school soon.
6. Jack will be looking for you all afternoon.
7. Mother will be cooking all day tomorrow.
8. We'll be walking among the New York skyscrapers this time tomorrow.
9. He'll be waiting for you.
10. They will be sending you invitations to dinner all summer.

Exercise 3. Turn the following into the Future Continuous.

1. They were having dinner at three.
2. I am doing my morning exercises.
3. The children will ski in the afternoon.
4. The girl was reciting a poem.
5. I shall wait for you at the metro station.
6. The boys will play hockey.
7. The students will discuss it on Friday.

Exercise 4. Answer the following questions.

1. What will you be doing at four o'clock tomorrow?
2. What will you be doing at this time tomorrow?
3. What will you be doing at this time on Sunday?
4. What will your mother be doing at this time on Sunday?
5. Suppose I come to your place at nine this evening. What will you be doing?
6. Will you be learning German next year?

Exercise 5. Replace the infinitive in brackets by the Future Continuous.

1. I (see) you again.
2. –I'll come at three o'clock. – Good, I (expect) you.
3. You'd better go back now; your mother (wonder) where you are.
4. It won't be easy to get out of the country. The police (watch) all the ports.
5. In fifty years' time we (live) entirely on pills.
6. We'd better go tomorrow because Mary (practice) the piano all day.
7. When you come next time I (wear) my new dress.

Exercise 6. Replace the infinitive in brackets by the Future Indefinite or the Future Continuous.

1. I (to do) my homework tomorrow.
2. I (to do) my homework at six o'clock tomorrow.
3. When I come home tomorrow, my family (to have) supper.
4. When you come to my place tomorrow, I (to read) your book.
5. Don't come to my place tomorrow. I (to write) a composition the whole evening.
6. I (not to go) to the cinema tomorrow. I (to watch) TV the whole evening.
7. – What you (to do) tomorrow? – What you (to do) at eight o'clock tomorrow? – You (to play) volley-ball from 6 till 8 tomorrow?
8. When you (to go) to see your friend next time?
9. Tomorrow I (to begin) doing my homework as soon as I come from university. I (to do) my homework from 3 till 6.

HOME READING

THE HISTORY OF CHEMISTRY

I

Many suggestions have been, made as to[1] the origin of the word *chemistry*. One of them derives the word from the ancient name for Egypt,[2] *khem or chem*, which means "black" and was given to Egypt because of the dark soil of that country. We do not know if it is true. But we know that the ancient Egyptians[3] knew more chemical operations than any other nation of antiquity, and that therefore the *Egyptian Science* as a name for chemistry is very appropriate. Egypt, however, had no monopoly of chemistry, for the Chaldeans, Chinese and Hindus[4] had had much chemical knowledge of an empirical nature, and it is very probable that each nation of the ancient world contributed its share to the development of the science.

Metallurgy, glassmaking, dyeing, the manufacture of pigments and poisons, soap-making and embalmment,[5] the preparation of drugs for medicinal purposes were the principal subjects of the ancient chemists. Chemistry was, therefore, mainly practical and empirical; theory lagged behind and was neither closely connected with practice nor[6] supported by experiment.

The first theoretical chemistry was the chemistry of the Greek[7] chemists. Pythagoras, Heraclitus, Hippocrates, Democritus, Plato, Aristotle,[8] as well as many more, covering a period of about 1000 years from 600 B. C.,[9] all made chemical speculations and occasionally practical chemical observations as well.[10] But the empirical chemical facts got by the Greeks were obtained by some men whose names have not come down to us.[11] They were craftsmen-metal workers, dyers and the like.[12]

Notes

1. **as to** – що стосується
2. **Egypt** ['i:dʒipt] *pr n* – Єгипет
3. **Egyptians** [ɪ'dʒipʃənz] – єгиптяне
4. **Chaldeans** [kæl'di:ənz] – халдеї
   Chinese [tjaɪ'ni:z] – китайці
   Hindus ['hin'du:sj – індуси
5. **embalmment** [ɪm'bɑ:mənt] *n* – бальзамування
6. **neither ... nor** ['naɪðə'nɔ:] – ні ... ні
7. **Greek** [gri:k] *a* – грецький
8. **Pythagoras** [paɪ' θægəræs] – Пифагор
   Heraclitus [ˌherə'klaɪtəs] – Гераклит
   Hippocratus [hi'pɔkrəti:z] – Гиппократ
   Democritus [dɪ'mɔkrɪtəs] – Демокрит
   Aristotle ['ærɪstɔtl] – Аристотель
   Plato ['pleɪtou] – Платон
9. **B. C.** ['bi: 'si:] **before Christ** – до нашої ери
10. **as well** – також
11. **have not come down to us** – не дішли до нас
12. **and the like** – та інші

II

When the empires of Byzantium and Persia[1] were overthrown by the armies of Islam[2] (the 7th century A. D.[3]), the Muslim conquerors[4] began to encourage learning, and so translations of all important Greek works were made. These translations were made either[5] directly from Greek into Arabic[6] or more often from Greek into Syriac[7] and then into Arabic. Greek chemistry was thus introduced to the Arabs. And as the Arabs were also masters of Egypt they united the theory of Greece[8] with the practice of Egypt.

Traces of Arabic influence on chemistry are still found in many of our chemical terms. For example, *alchemy*[9] is merely *chemistry* with the prefix *al-*, the Arabic word for *the,* and *alcohol*[10] comes from the Arabic *al-khul. Al-khul* was the name given to the black powder with which the Muslim ladies blackened their eyebrows and eyelids – possibly lead and antimony sulphides.[11]

The westernmost province of the Muslim Empire was Spain[12] and chemistry first flourished in it. From Spain, the study of chemistry gradually spread over the rest of Europe,[13] and the European chemists of the Middle Ages frankly admitted their debt to the Arabs. They did not, however, realize what they owed[14] to the Greeks until after the Renaissance,[15] when Greek manuscripts were found. It was then possible to see the modifications of Greek chemistry produced by its passage through Islam.

Notes

1. **Byzantium** [bi'zæntɪəm] – Візантія
   Persia ['pə: ʃə] – Персія
2. **Islam** ['ɪzla:m] *n* – іслам, мусульманство, магометанство
3. **A. D**. ['eɪ 'di:] = **anno Domini** – *лат*. нашої ери
4. **the Muslim conquerors** ['muslɪm 'kəŋkərəz] – мусульмани-завойовники
5. **either … or** – або... або
6. **Arabic** ['ærəbɪk] *n.* – арабська мова
7. **Syriac** ['sɪr ɪæk] *n* – древнесирійська мова
8. **Greece** [gri:s] *pr n* – Греція
9. **alchemy** ['ælkɪmɪ] *n* – алхімія
10. **alcohol** ['ælkəhɔl] *n* – спирт
11. **lead** [led] – свинець
    antimony ['æntɪmənɪ] – сурьма
    sulphides ['sʌlfaɪdz] – сульфиди
12. **Spain** [speɪn] *pr n* – Іспанія
13. **Europe** ['juərəp] *pr n* – Европа
14. **what they owed** – чим вони зобов’язані
15. **the Renaissance** [rə'neɪsəns] – епоха Відродження, Ренесанс

III

When chemistry became thoroughly established in Europe rapid advance took place. The great chemists of the Middle Ages in Europe were Roger Bacon[1] (1214–1292) and Paracelsus[2] (1493–1541). By the time of Paracelsus chemistry became temporarily the handmaid of medicine, and the efforts of chemists were mainly directed to[3] the preparation and investigation of drugs. This was the period of medical chemistry (1500–1700).

Towards the end of this time appeared the famous Robert Boyle[4] (1527–1691). Boyle was a scientist of the first rank, and his works were the extremely valuable contribution to chemical theory. In them he questions the truth of the old theory of the constitution of matter, which regarded Fire, Air, Earth and Water as the Four Elements. He defines an element as a substance that cannot be split up into other substances; he suggests that matter is composed of small particles of different shapes and sizes called atoms, combination and separation of which take place in chemical changes. Boyle was, however, in advance of his age,[5] and his ideas had not the immediate great effect because chemists at that time studied a theory of combustion which was called the Phlogiston Theory.[6]*

Towards the end of the 18th century the Phlogiston Theory was overthrown chiefly by the work of Antoine Lavoisier[7] (1743–1794). It had for long been known that the residue left after the combustion of a metal weighed more than the metal taken originally. After many years of patient and brilliant experimental work, Lavoisier was able to convince the chemical world that probably in all cases of combustion an increase of weight occurred. (According to the Phlogiston Theory a decrease was expected.) Lavoisier was also able to show that a newly discovered gas, dephlogisticated air,[8] was present in the atmosphere and, in all cases of combustion in air, combined with the burning substance, and therefore its weight was increased. He later called this gas oxygen.[9]

A few years later John Dalton[10] (1766—1844) made the greatest step in the history of chemistry by his work on the Atomic Theory. With the aid of this theory and the new theory of combustion perfected by Lavoisier, the 19th century made a marvellous advance.

Notes

1. **Roger Bacon** ['rɔdʒə 'beɪkən] – Роджер Бекон
2. **Paracelsus** ['pærə'selsəs] – Парацельс
3. **were mainly directed to** – були в загальному спрямовані на
4. **Robert Boyle** ['rɔbət 'bɔɪl] – Роберт Бойль
5. **in advance of his age** – попереду свого століття (віку)
6. **the Phlogiston Theory** [flɔ'dʒɪstən 'θɪərɪ] – теория флогістона
7. **Antoine** ['æntwɑ:n] **Lavoisier** – Антуан Лавуазьє

8. **dephlogisticated** [ˌdɪflɔ'dʒɪstɪkeɪtɪd] **air** – повітря, позбавлене флогістону

9. **oxygen** ['ɔksɪdʒən] *n* – кисень

10. **John Dalton** ['dʒɔn 'dɔ:ltən] – Джон Дальтон

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* The substance which was lost on combustion was called *phlogiston*

THE HISTORY OF ORGANIC CHEMISTRY

I

The name *organic chemistry*[1] originally implied the chemistry of substances obtained directly or indirectly from living or dead organisms, that is plants and animals. Later it was found that practically all of these substances are compounds of carbon so that the significance of the name gradually changed, and we now mean by it the chemistry of the compounds of carbon. It is still true that organic chemistry deals mainly with animal and plant constituents or products, and the most noteworthy modern advances in the subject (our knowledge of antibiotics, proteins,[2] plant colouring-matters,[3] vitamins and polysaccharides[4]) have brought *biochemistry*[5] to the foremost place in organic chemistry as a whole.

Carbon is an extraordinary element in its power of forming compounds – at least half a million of them are known — and these *organic* substances show certain characteristic properties which mark them off[6] from compounds which do not contain carbon, that is *inorganic*[7] compounds. Organic chemistry is therefore a distinct branch of the science. The general laws of chemistry apply to organic and inorganic substances alike but in the study of organic substances we meet with new and strange phenomena. Organic chemistry is a modern science. Investigation of animal and vegetable substances was, of course, carried out from very early days, but carbon compounds present certain difficulties which could not be successfully overcome until the Atomic and Molecular Theories had been well established. And the isolation of organic substances in a state of purity is a problem that requires a special technique. Thus only at the beginning of the 19th century chemists were able to study carbon compounds.

A comparatively small number of organic compounds had been prepared and investigated by the alchemists, and a great many more were discovered in the 18th century. Alcohol, for example, has been known since the 12th century. Another organic substance of great antiquity is soap, the sodium or potassium salt of stearic[8] and similar acids, which were prepared by boiling olive oil[9] or mutton fat[10] with a solution[11] of plant ashes,[12] that is, crude potassium carbonate.[13] Many dyes, perfumes and poisons were obtained from plants and animals, and most of these substances are compounds of carbon. Ether, a volatile liquid[14] well known on account of its use as an anaesthetic,[15] was discovered in the 15th century.

Notes

1. **organic chemistry** [ɔ:'gænɪk 'kemɪstrɪ] – органічна хімія
2. **antibiotics** [ˌæntɪbaɪ'ɔtɪks] – антибіотики
   proteins ['prouti:nz] – протеїни (білки)
3. **plant colouring-matters** ['kʌlərɪŋ'mætəz] – речовини, що забарвлюють рослини
4. **vitamins** ['vɪtəmɪnz] – вітамини
   polysaccharides [ˌpolɪ'sækəraidz] – поліцукри
5. **biochemistry** ['baiou'kemɪstrɪ] *n* – біохімія
6. **mark them off** – відрізняти їх
7. **inorganic** [inɔ:gænɪk] *a* – неорганічний
8. **stearic acid** [stɪ'ærɪk 'æsid] – стеаринова кислота
9. **olive oil** ['ɔlɪv 'ɔil] – оливкове масло
10. **mutton fat** ['mʌtn 'fæt] – бараній жир
11. **solution** [sə'lu:ʃən] *n* – розчин
12. **ashes** ['æʃɪz] *n* – зола, попіл
13. **crude potassium** ['kru:d pə'tæsijəm 'ka:bənit] – поташ
14. **ether** [i':θə] – простий етер (ефір)
    a volatile liquid ['vɔlətai 'lɪkwɪd] – летка рідина
15. **anaesthetic** [ˌænɪs'θetɪk] *n* – анестезуючий засіб

II

Towards the end of the 18th century conditions began to change. Laboratory methods had been improved and the practical skill of chemists was very much greater. Many organic substances were isolated in a more or less pure state during this period by many different workers.

Lavoisier (1743–1794) began to analyse organic compounds. He proved that their essential constituent[1] was carbon, while hydrogen and oxygen were usually present as well, and occasionally nitrogen, sulphur,[2] and phosphorus.[3] However, it was still considered that the formation of organic substances was occasioned by a mysterious "vital force,"[4] and that it was impossible to synthesize it or build it up from its elements in the laboratory. It is true that many naturally occurring substances, such as oxalic acid[5] and formic acid,[6] had been prepared artificially by chemists, but the startingpoint[7] in each of these preparations had been other organic substances, and no one had made any organic compound from inorganic material. The solution of this problem was very slow.

The next great advance in organic chemistry is due to Liebig[8] (1803–1873). In 1830 he invented his famous method of analysing carbon compounds by combustion. He took a known weight of the substance and found the weights of carbon dioxide[9] and water produced on burning it. In a modified form, Liebig's method is still used, and its ease and simplicity made possible the accurate analysis of innumerable substances in a comparatively short time.

The attention of chemists was attracted by the existence of substances whose molecules consisted of the same number of the same atoms, although the substances themselves were different from one another in chemical and physical properties.

In the middle of the 19th century the research brought about the general acceptance of the theory of valency which played the chief part in the astonishing development of chemistry in the following years.

During the 20th century progress was so rapid that we cannot attempt to follow it in detail.

Notes

1. **constituent** [kən'stɪtjuənt] *n* – складова частина
2. **sulphur** ['sʌlfə] *n* – сірка
3. **phosphorus** ['fɔsfərəs] *n* – фосфор
4. "**vital** ['vaɪtl] **force**" – «життєва сила»
5. **oxalic** [ɔk'sælɪk] **acid** – оксалатна кислота
6. **formic** ['fɔ:mɪk] **acid** – мурашина кислота
7. **starting-point** *n* – вихідна речовина
8. **Liebig** ['li:bɪg] – Лібіх
9. **carbon dioxide** ['ka:bən daɪ'ɔksaid] – карбон діоксид

Atoms

The Greek philosophers said: suppose a piece of gold is cut into small pieces and one of these pieces is again cut into smaller pieces, and suppose this cutting is repeated many times, then ultimately an end will be reached when further division is impossible unless our gold is to disappear into nothingness.[1] We shall then have pieces of gold so small that they can no longer be subdivided. These final small particles of gold the Greeks called atoms. In 1804 John Dalton, a Manchester[2] scientist and teacher, put these ideas into a form which we know as Dalton's Atomic Theory.

At the beginning of this century Marie Curie[3] isolated radium,[4] an element which was radioactive and was disintegrating into other elements. It was finally realized that atoms were not always indivisible and a new form of the Atomic Theory was given by scientists such as Rutherford[5] and Bohr.[6] On the basis of this work we can now give two important definitions:

An atom is the smallest part of an element that can take part in a chemical change.

We have a new word for the smallest part of a substance that can exist separately, this is called a molecule, and we must understand clearly that we can have molecules of elements or compounds while we can have atoms only of elements.

A molecule is the smallest part of a substance, element or compound, which can normally exist in a free state.

Notes

1. **nothingness** ['nʌθɪŋnɪs] – ніщо
2. **Manchester** ['mæntʃɪstə] – Манчестер
3. **Marie Curie** ['mɑ:ri ˌkju:ri:]– Марія Кюрі
4. **radium** ['reɪdjəm]– Радій
5. **Rutherford** ['rʌðəfəd] – Резерфорд
6. **Bohr** [bɔ:]– Бор

Symbols

The alchemists employed a system of signs or pictures to represent different substances. Such signs helped to preserve the atmosphere secrecy which surrounded their work. Metals were represented by the signs for various heavenly bodies.

Dalton's Atomic Theory made it necessary to have some simple method of representing atoms of the different elements. Dalton himself invented a set of symbols and combined them to show the elements present in a compound.

Today they are only of historical interest and were never in general use.

In 1811 the symbols in use today were introduced by Berzelius, [1] a Swedish chemist [2]. They consist of one or two letters from the name of the element.

Firstly, we have the symbols which are the initial letters of the name of the element, for example H, O, N, S, C, P, A, I, U.

Secondly, since there are over 100 elements known and there are not letters enough in the alphabet, it is obvious that a number of elements will begin with the same letter. Thus, while carbon is represented by C, for other elements beginning with C we use two letters, the second is a small letter selected from the name of the element. Thus calcium becomes Ca, chlorine CI and chromium[3] Cr.

We must understand clearly that the symbol of an element represents one atom of the element.

From the symbols introduced by Berzelius, we can adopt a simple method of denoting the molecules of a compound or an element.

Most of the elementary gases consist of molecules each containing two atoms. Thus for a molecule of hydrogen we write H_2, which means a molecule consisting of two atoms. Similarly, molecules of oxygen, nitrogen, and chlorine are written O_2, N_2 and $C1_2$ respectively. If we write 2H this means two separate atoms of hydrogen, a condition in which it does not normally exist. However, if we wish to denote three molecules of oxygen we do so as $3O_2$.

Notes

1. **Berzelius** ['bə:ʒəl'əs] – Берцеліус
2. **a Swedish chemist** ['swi:d'ʃ 'kem'st] – шведський хімік
3. **chromium** ['kroumjəm] *n* – хром

Formulas

Let us consider two formulas which everyone knows, namely water H_2O and sulphuric acid H_2SO_4.

When we denote water by H_2O we mean one molecule of water containing two atoms of hydrogen and one atom of oxygen. Similarly, H_2SO_4 denotes one molecule of sulphuric acid containing two atom of hydrogen, one atom of sulphur and four atoms of oxygen.

Therefore in order to write the formula of a compound we must know of what elements it consists, how many atoms of each element there are in one molecule of our compound and finally we must know the generally accepted manner in which the elements are arranged the formula. For example, water and sulphuric acid might be written OH, and H_2SO_4, but it has been found convenient to keep; certain groups of elements together and to arrange the symbols it a conventional order which must be learned by practice.

The formula of water is H_2O and this tells us that one atom of oxygen combines with two atoms of hydrogen. We express the combining power of an element by the number of hydrogen atoms the combine with one atom of the element and call this number the valency of the element. Thus the valency of oxygen is 2.

However, some elements, often metals, do not usually combine with hydrogen. For example, zinc does not combine with hydrogen, but one atom of zinc combines with one atom of oxygen to form zinc oxide [1] ZnO. But if the valency of oxygen is 2 it follows that the valency of zinc is also 2. Thus if we know the valency of a metal we should be able to write the formula of its oxide.

Notes

1. **oxide** ['ɔksaɪd] *n.* – оксид

Equations

We know many changes which occur when chemical reactions take place. We must now learn to express briefly and conveniently such reactions by means of chemical equations.

Here is a simple reaction – magnesium ribbon [1] burns in oxygen with a brilliant flame to give a white powder of magnesium oxide. This could be expressed in words as:

Magnesium and Oxygen give Magnesium oxide

or Magnesium + Oxygen Magnesium oxide

In converting this to a chemical equation we must observe the following points:

l. On the left-hand side we write the formulas of one molecule of the elements or compounds which are to react. "On the right-hand side we write the formulas of one molecule of the elements or compounds which are produced by the reaction. To do this we use our knowledge of the valency table. This gives us our first stage:

$$Mg + O_2 \rightarrow MgO$$

2. There must be the same number of atoms after the reaction has taken place as there were before it began. In other words we must now make sure tnat the number of atoms of each kind on each side of the equation is the same. We say we are now balancing the equation.[2]

As it stands at present there are two atoms of oxygen on the left contained in the single oxygen molecule and only one atom of oxygen on the right in the molecule of magnesium oxide. To balance the oxygen we increase the magnesium oxide to two molecules.

Now we have:

$$Mg + O_2 \rightarrow 2MgO$$

The oxygen is now balanced but the magnesium atoms are unbalanced. However if we write two molecules of magnesium on the left-hand side we finally get our balanced equation:

$$2Mg + O_2 = 2MgO$$

Notice that we can finally use the "equals" sign.[3] Using the same method and following each stage carefully we can build up equations for other reactions.

Notes

1. **magnesium ribbon** – магнієва смужка
2. **balancing the equation** – урівнюємо рівняння реакции
3. **the** "**equals**" **sign** – знак «рівності»

Organic and Mineral Acids

Acids may be divided into two groups – organic and mineral acids – according to how they are obtained.

Organic Acids. Many of these can be obtained from plant or animal sources:

Lactic acid[1] from milk which has gone sour. Acetic acid[2] (vinegar) from sour wine. Citric acid[3] from lemons. Tartaric acid[4] from grapes.

They are weak acids and in dilute solutions are consumed when vinegar or fruits or their juices are drunk. Their chemical formulas are rather complicated but they all contain carbon, hydrogen and oxygen.

Mineral Acids. These are often much stronger and more corrosive and are usually prepared from minerals obtained from the ground. Here are three of the commoner mineral acids with their formulas:

Hydrochloric acid[5] – HC1.

Sulphuric acid – H_2S0_4.

Nitric acid[6] – $HN0_3$.

You will notice that they all contain hydrogen. They are often used in a concentrated form and are then very strong and extremely corrosive. If an acid is mixed with two or three times its own volume of water we say the acid is dilute. (To make dilute sulphuric acid suitable for use in a school laboratory, concentrated acid is mixed with about 17 times its own volume of water.) All acids should be handled very carefully, especially when they are concentrated since they can cause serious

burns on the skin and holes in clothes If you get some acid on your hand or clothes, immediately apply plenty of running cold water.

Dilution of a Concentrated Acid. This operation is not simple. The method is to add water to a concentrated acid. However, this can be very dangerous since considerable heat is given out[7] when water and concentrated acid are mixed. This heat causes the first drops of water poured on the acid to vaporize and the expanding vapour in turn[8] causes the acid to splash about. It is far safer to add the concentrated acid to the water. This should be done slowly.

Experiment. Pour a little water into a small beaker until it is about one-third full. Place the beaker on the back of the hand – it is quite cool. Now slowly add concentrated sulphuric acid, stirring with a glass rod. Again place the beaker on the back of the hand and you find that the liquid has become quite warm.

Notes

1. **Lactic acid** ['læktik 'æsɪd] – молочна кислота
2. **Acetic** [ə'si:tɪk] **acid** – ацетатна (оцтова) кислота
3. **Citric** ['sɪtrɪk] **acid** – лимонна кислота
4. **Tartaric** [tɑ:'tærɪk] **acid** – винна кислота
5. **Hydrochloric** ['haɪdr ə'klɔrik] **acid** – гідроген хлоридна (соляна) кислота
6. **Nitric** ['naɪtrɪk] **acid** – нітратна (азотна) кислота
7. **is given out** – виделяється
8. **in turn** – у свою чергу

Indicators

An indicator is a substance which, by its colour, indicates whether a solution is acidic or alkaline.[1] The best-known indicator is litmus[2] which may be used in solution or in the form of coloured strips of paper. Litmus solution or paper is blue in alkaline solutions but red in acid solutions. Two other indicators used in the laboratory are methyl-orange[3] and phenol-phthalein.[4] There are many such dyes which could be used as indicators since they are one colour in acids and another distinct colour in alkalis. Most of them are of vegetable origin.

Properties of Acids

Acids are substances which

1) have a sour taste;
2) turn litmus red, methyl-orange red, phenol-phthalein colourless;
3) react with washing soda[5] (a carbonate) to give carbon dioxide;
4) react with magnesium to give hydrogen;
5) have a corrosive action on organic matter, such as paper, cloth or flesh.

Tests will confirm that acids will react with any carbonate to give carbon dioxide and that with some other metals, such as zinc and iron, hydrogen is produced as with magnesium. The dilute acids, however, will not react in this way with the more noble metals, such as copper or silver.

Notes

1. **alkaline** ['ælkalain] *a* – лужний
2. **litmus** ['litməs] *n* – лакмус
3. **methyl-orange** *n* – метилоранж
4. **phenol-phthalein** *n* – фенолфталеїн
5. **washing soda** ['wɔʃɪŋ 'soudə] – каустична сода

Uses of Acids

The three main mineral acids – sulphuric, hydrochloric and nitric–are most important in industry. It is probable that sulphuric acid is our most important chemical. Most of the uses of these acids are complicated but we can get some idea of the scope of their uses from the following lists.

Sulphuric Acid. Production of artificial fertilizers, manufacture of explosives, dyes, drugs, plastics, petroleum refining[1], and crop spraying[2] . There are few industries which directly or indirectly do not depend at some stage on sulphuric acid.

Hydrochloric Acid. Decomposing bones for use in the manufacture of gelatin[3], bleaching textiles[4], and the production of glucose[5] from starch.

Nitric Acid. Large quantities are used in the manufacture of explosives, dyestuffs, metallic nitrates[6] and fertilizers.

Some organic acids have important uses. Acetic acid is used in the manufacture of artificial silk and for making other chemicals and solvents used in dyeing, pickling fish or vegetables, leather tanning[7] and oil refining. Formic acid is used in certain textile dyeing and printing processes as well as in the rayon[8] industry.

Notes

1. **petroleum refining** – очистка нафти
2. **crop spraying** – оприскування врожаю
3. **the manufacture of gelatine –** виробництво желатину
4. **bleaching textiles –** білок тканей
5. **the production of glucose** ['ɡlu:kous] – виробництво глюкози
6. **nirates** ['naɪtreɪts] – нітрати
7. **leather tanning** – дублiння шкіри
8. **rayon** *n* – штучний шовк

Silicon

Silicon, after oxygen, is the most plentiful element on the earth. The two outer layers[1] of the earth contain mainly silicon and aluminium, and silicon and magnesium, respectively. Although silicon is never found in the free state,[2] its compounds, particularly the oxide silica,[3] are present in nearly all rocks. On the average[4] the earth's crust contains 26 per cent of silicon combined with other elements. The oxide has been known from the earliest times, but only in 1854 the pure element was obtained.

Silicon occurs in nature either as silica or silicates.[5]

Silica occurs in the pure crystalline form as quartz.[6] Because it is transparent to ultra-violet light it is used to make prisms and lenses in optical instruments, and as it has very high melting-point it is used to make laboratory apparatus which must be transparent and capable of resisting[7] high temperatures. Quartz has a very low coefficient of expansion and does not break if it is suddenly heated or cooled. A piece of red-hot silica tubing[8] can be plunged into cold water without breaking.

Quartz is the principal constituent of granite and of sand. Coloured forms of quartz are gems.

Potassium aluminium silicate is an important raw material for the preparation of alum; in Italy the ground mineral[9] is used as a fertilizer.

Micas[10] are complex silicates containing aluminium, potassium, magnesium, and sometimes other elements. Mica is found in thin transparent sheets which can be split into very thin flakes. It is an excellent electrical insulator, and because it is also resistant to heat it is used as an insulator in the elements of electric irons. In former times it was sometimes used in place of glass in windows.

Notes

1. **outer layers** – зовнішні щари
2. **in the free state** – у вільному стані
3. **oxide silica** – силіцій оксид
4. **on the average** – у середньому
5. **silicates** *n* – силікати
6. **quartz** – кварц
7. **capable of resisting** – здатний витримувати
8. **red-hot silica tubing** – розжарені труди з силіцію
9. **the ground mineral** – подрібнений мінерал
10. **micas** *n* – слюда(-и)

Phosphorus

In the 17th century alchemists used many materials in their search for[1] the philosopher's stone.[2]

In 1669, while trying to make[3] the philosopher's stone by distilling a mixture containing urine,[4] one alchemist discovered a new element – phosphorus. It dripped from the retort in waxy yellow drops. They caught fire[5] when warmed very slightly, and glowed in the dark.

A few years later the English scientist Robert Boyle also prepared phosphorus, and he taught the method to a London chemist, who supplied the precious material to the whole of Europe[6] under the name of "English Phosphorus".

In 1737 a better method of obtaining phosphorus from urine was developed in France, but only in 1774 phosphorus became plentiful when it was discovered that it could be made by distilling bones with sand and charcoal.

Later investigators showed that phosphorus could be obtained from many of its compounds, such as phosphate rock,[7] by heating them to very high temperatures with carbon.

Phosphorus prepared by distillation is a yellow, waxy solid which is very highly inflammable and can be kept under water. By another process there can be obtained a red, powdery form called red phosphorus which is less inflammable, and much safer[8] to handle.[9] These two forms of phosphorus are called allotropes. There is a third, rare, allotropic form of phosphorus which is made by heating the red form under pressure; this is called black phosphorus.

White phosphorus ignites at a temperature of about 60° C; it is highly inflammable and is also extremely poisonous. Red form is much less poisonous, and does not glow in air.

Phosphorus is a very reactive element and is not found free in nature. It is present as phosphate in many types of rock. The most usual mineral form of the element is calcium phosphate,[10] which is mined in great quantities for use as an agricultural fertilizer. Calcium phosphate also makes up[11] the largest part of the dry weight of bones. Phosphorus is essential for life, and traces of phosphate are found in all living tissues.

Phosphorus is used in the manufacture of special bronzes called phosphor-bronzes. These are mainly used for bearings[12] in machinery, for the manufacture of matches, and as a chemical for the preparation of several types of insecticides.[13] Millions of tons of phosphate are used annually as a fertilizer.

Notes

1. **in their search for** – у пошуках
2. **the philosopher's stone** – філософський камінь
3. **while trying to make** – намагаючись зробити
4. **urine** *n* – сечовина
5. **caught fire** – загорілись
6. **to the whole of Europe** – усій Європі
7. **phosphate rock** – фосфорит
8. **much safer** – значно безпечніше
9. **to handle** – використовувати
10. **calcium phosphate** – фосфат кальцію
11. **makes up** – складає
12. **bearings** *n pi* – підшипники
13. **insecticides** n *pi* – інсектициди; засоби від комах

Laboratory Rules

Everybody working in the laboratory has to observe the following rules [1]:

1. Every vessel [2] used for the experiment must be absolutely clean.
2. One has to be very careful in handling [3] glass things.

3. One must pay special attention to [4] the flame. Every precaution has to be taken [5] to place the bottles containing inflammable or explosive substances as far as possible from any flame.

4. While making experiments it is necessary to register all the phenomena one observes. The yield [6] of the substance obtained and the result of each experiment is to be registered too.

5. After finishing work, all containers and apparatus used have to be washed, dried and put back in their places, the benches have to be cleaned too, so as to leave the working place in proper order [7].

Notes

1. **to observe the following rules –** дотримуватися таких правил
2. **vessel** ['vesl] – сосуд
3. **handle** ['hændl] – мати справу з
4. **pay ... attention to** – звертати ... увагу на
5. **precaution has to be taken –** необхідно потурбуватися
6. **yield** [ji:ld] – вихід речовини
7. **proper order –** належний порядок

Distillation

Distillation may be carried out simply in a retort or in a distilling flask connected through a condenser to a receiver, often cooled by means of a freezing mixture in an ice bowl. In the Liebig condenser the vapour condenses in a long tube which is surrounded by a water jacket in which the cold water circulates. The stream of cold water flows in at the bottom or cool end of the condenser and out at the top or hot end, so that the coolest part of the tube meets the coldest water, and as the water reaches the hottest part of the condenser it is less cool. By this application of the counter-current principle a uniform temperature-drop along the condenser is ensured, and hence as efficient cooling as possible is provided.

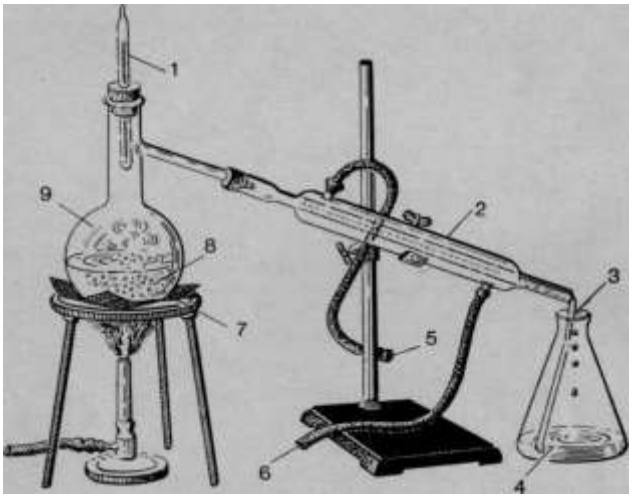


Fig. 1. Distillation
1 – thermometer; 2 – condenser; 3 – receiver;
4 – distillate; 5 – to drain; 6 – from faucet;
7 – wire screen; 8 – glass or porcelain boiling chips;
9 – residue

Kipp's Apparatus Used for Obtaining Hydrogen

In order to obtain hydrogen Kipp gas generator (Kipp's apparatus) may be used. The upper spherical funnel contains the solution of hydrochloric acid. Iron or zinc is placed in the middle bulb of the generator. When the tap is turned on the acid flows down from the funnel and interacts with the metal. When the tap is turned off the hydrogen formed displaces the acid into the lower part of the gas generator from which the acid passes up the inner tube into the spherical funnel. Hydrogen comes out through the outlet.

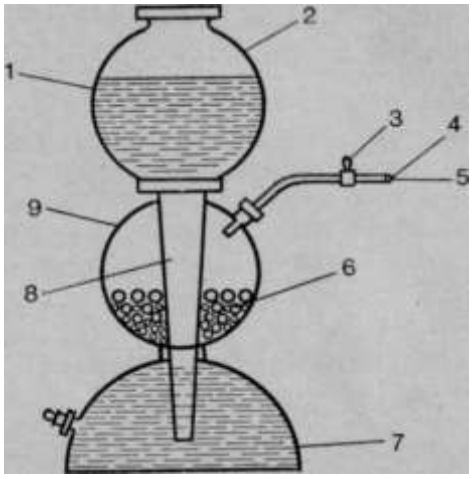


Fig. 2**.** Kipp Gas Generator
1 – hydrochloric acid;
2 – upper spherical funnel;
3 –tap;
4 **–** gas outlet;
5 **–** hydrogen;
6 **–** zink or iron;
7 **–** lower part;
8 – inner tube;
9 – middle bulb

The Way of Determining the Amount of Oxygen in Air

Let us light some red phosphorus in an iron spoon which is placed above water contained in a glass vessel and quickly cover the spoon with a glass cylinder. After the phosphorus has burnt out and the gas left in the cylinder cools we shall see that the water in the vessel will rise about 1/5 (one fifth) its former volume (level). The volume of gas in the cylinder decreases (diminishes) because of the combination of oxygen with phosphorus. Hence air contains about 1/5 oxygen by volume. The gas left is mainly nitrogen

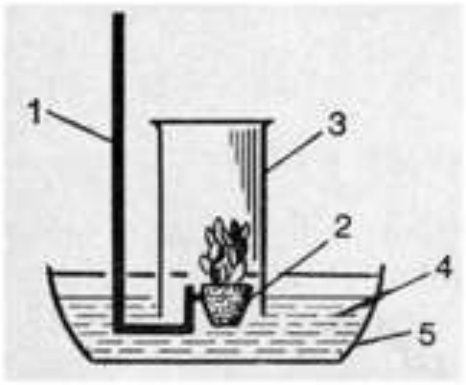


Fig 3. The Way of Determining
the Amount of Oxygen in Air
1 – an iron spoon;
2 – red phosphorus;
3 – a cylinder;
4 – water;
5 – a bowl

Boyle's Law

The quantity of matter in a given body is generally determined by weight, but it is often convenient, when the given body is a gas or a liquid, to measure the quantity of matter indirectly by volume. Volumetric analysis is based on such measurements; and the analysis of gases is nearly always connected by volume measurements. The main advantage[1] of measurement by volume is rapid execution[2]; the main advantage of measurement by weight arises from the fact that the result is largely independent of the physical and chemical conditions of the body in question[3]. The weight of a gas is usually so small in comparison with its volume that it is generally possible to determine the quantity of a gas more accurately by volume than by weight.

The volume of a gas is very sensitive[4] to changes of pressure. While investigating the relation between the pressure and the volume of a gas, Robert Boyle found that the volume of a gas kept at one uniform temperature varies inversely[5] as the pressure.

This is Boyle's law. Later on some deviations[6] from Boyle's law have been found.

Notes

1. **advantage** – перевага
2. **execution** – виконання
3. **in question** – що обговорюється
4. **sensitive** – чуттєвий
5. **inversely** – обернено пропорційно
6. **deviation** – відхилення

MIKHAIL VASILEYVITCH LOMONOSOV
(1711-1765)

M. V. Lomonosov, the great Russian scientist and poet, was born in 1711 in a small village near the town of Kholmogori. Now this village is called Lomonosovo.

Lomonosov's father was a fisherman and at an early age the boy often went with his father to the White Sea and learned much about fishing. The boy did not go to school but he was eager to learn [1] and learned to read at an early age.

At the age of 19 he left his home and went on foot [2] to Moscow. After many difficulties he entered the Slavonic-Greek-Latin Academy [3] where he studied hard for five years. As Lomonosov was extremely capable and made great progress,[4] he was sent to Petersburg to study at the Gymnasium of the Academy of Sciences. There he studied mathematics, physics, foreign languages and other subjects.

In 1736 the Academy of Sciences sent Lomonosov to Germany where he studied chemistry and metallurgy. When he came back to Petersburg in 1741 he began his scientific work, taught chemistry and other subjects at the Academy of Sciences. In those days it was difficult for a Russian scientist to work for his country because of [5] foreign scientists who were in the majority at the Academy and everywhere and hindered the advance of Russian science. In spite of [6] great difficulties Lomonosov founded the first chemical laboratory in Russia where he produced stained glass.[7] He formulated the main principles of the Law of Conservation of Matter and Motion. He studied natural resources of the earth and made experiments with atmospheric electricity. Lomonosov developed the Russian literary language – he wrote the first Russian grammar and wrote poetry, introduced such terms *as thermometer, formula, atmosphere*, and others into the Russian scientific language.

Many members of the Academy of Sciences despised Lomonosov for his peasant origin [8] and were his enemies but they could not but admire [9] his talent.

In 1745 Lomonosov was made academician and appointed professor of chemistry. Lomonesov's works were known abroad. He was one of the most learned men in Europe and foreign academics honoured the great Russian scientist Lomonosov by electing him honorary member of the Swedish Academy of Sciences and of the Bologna Academy of Sciences.

The Moscow University was founded in 1755 on the initiative of Lomonosov. "Lomonosov was a great man. He founded our first university. To be more exact,[10] he himself was our first university," said the great Russian poet Pushkin.

Lomonosov was Rector of the Petersburg University during the last years of his life. He devoted his whole life to the development of Russian science. He wrote many books on various problems of science, technique and culture. And all that he did, he did for his people and for his country.

Notes

1. **was eager to learn** – дуже прагнув вчитися
2. **go on foot** – ідти пішком
3. **the Slavonic-Greek-Latin Academy** – Славяно-греко-латинська академія
4. **make great progress** – досягнути великих успіхів
5. **because of** – через
6. **in spite of** – не дивлячись на
7. **stained glass** – недивлячись на кольорове стекло
8. **peasant origin** – сільського походження
9. **could not but admire** – не могли не восхищаться
10. **to be more exact** – точніше говорячи

DMITRY IVANOVITCH MENDELEYEV
(1834–1907)

Dmitry Ivanovitch Mendeleyev, the great Russian scientist, the father of the Periodic Table of Elements, was born in Tobolsk in 1834 in the family of the director of the town Gymnasium. He received a secondary education at the Tobolsk Gymnasium. At the age of 16 he finished school and went to Petersburg where he entered the Pedagogical Institute and graduated from it with a gold medal in 1855.

After graduation Mendeleyev worked as a teacher for two years, first in the Simferopol and then Odessa Gymnasiums. In 1859 Mendeleyev received his master's degree and went abroad on a two-year scientific commission.[1] In 1860 he took part in the World Chemical Congress in Karlsruhe.

When Mendeleyev returned to Russia he was elected professor of the Petersburg Technological Institute and two years later professor of the Petersburg University where he carried his scientific and pedagogical activities for twenty-three years. Mendeleyev taught chemistry. His lectures were always interesting and the students of that time listened to them with great interest and attention. Besides lectures[2] Mendeleyev made a lot of[3] experiments in his laboratory and in his classes. He put down[4] the results of his experiments and later grouped all those data.

Mendeleyev described more than 60 elements and found that all the elements could be divided into nine groups. Each of these groups may be divided into five rows. The elements of one group possess more or less similar properties, i In 1869 Mendeleyev published»his Periodic Table of Elements which began a new era in chemical thought.

Mendeleyev also paid much attention to many subjects. He was the first to put forward[5] the idea of studying[6] the upper layers of the atmosphere.

In 1893 Mendeleyev was appointed Director of the Bureau of Weights and Measures.[7] He was elected member of many academies abroad.

In February 1907 at the age, of 75 Mendeleyev died of pneumonia.[8] Mendeleyev always combined theory and practice. He gave a great deal of attention[9] throughout his life to the development of the industry of his country. He wrote: "Science and industry – there lie my dreams!"

Notes

1. **scientific commission** – наукова командировка
2. **besides lectures** – окрім лекцій
3. **a lot of** – дуже багато
4. **put down** – записувати
5. **he was the first to put forward** – він першим висунув
6. **of studying** – вивчення
7. **the Bureau of Weights and Measures** – Палата мір і вагів
8. **pneumonia** *n* – запалення легенів
9. **a great deal of attention** – велика увага

Additional material

Some Chemical Elements

№	Element	Sym-bol	Pronunciation	Ukrainian Equivalent
1	***2***	***3***	***4***	***5***
1.	Aluminium	Al	['ælju'minjəm]	Алюміній
2.	Antimony (Stibium)	St	['æntimən'] ['st'b'əm]	Стибій, Сурма
3.	Argon	Ar	['ɑ:gɔn]	Аргон
4.	Arsenic	As	['ɑ:snɪk]	Арсен, Миш'як
5.	Barium	Ba	['bɛərɪəm]	Барій
6.	Beryllium	Be	[be'rɪljəm]	Берилій
7.	Bismuth	Bi	['bɪzməθ]	Бісмут
8.	Boron	B	['bɔ:rɔn]	Бор
9.	Bromine	Br	['broumi:n]	Бром
10.	Cadmium	Cd	['kædmɪəm]	Кадмій
11	Calcium	Ca	['kælsɪəm]	Кальцій
12.	Carbon	C	['kɑ:bən]	Карбон
13.	Cerium	Ce	['si:rɪəm]	Церій
14.	Cesium (Caesium)	Cs	['si:zjəm]	Цезій
15.	Chlorine	Cl	['klɔ:ri:n]	Хлор
16.	Chromium	Cr	['kroumjəm]	Хром
17.	Cobalt	Co	[kə'bɔ:lt]	Кобальт
18.	Copper	Cu	['kɔpə]	Купрум
19.	Curium	Cm	['kjuərɪəm]	Кюрій
20.	Einsteinium	Es	[aɪn'staɪnɪəm]	Ейнштейній
21.	Erbium	Er	['ə:bɪəm]	Ербій
22.	Europium	Eu	[ju:'roupɪəm]	Європій
23.	Flourine	F	['fluəri:n]	Флуор
24.	Gallium	Ga	['gælɪəm]	Галій
25.	Germanium	Ge	[dʒə:'meɪnɪəm]	Германій
26.	Gold (=Aurum)	Au	[gould] ['ə: rəm]	Аурум
27.	Helium	He	['hi:ljəm]	Гелій

1	*2*	*3*	*4*	*5*
28.	Hydrogen	H	['haɪdrɪdʒən]	Гідроген
29.	Iodine	I	['aɪədi:n]	Іод
30.	Iridium	Ir	[aɪ'rɪdɪəm]	Іридій
31.	Iron (=Ferrum)	Fe	['aɪən] ['ferəm]	Ферум
32.	Krypton	Kr	['krɪptɔn]	Криптон
33.	Lanthanum	La	['lænθənəm]	Лантан
34.	Lead (=Plumbum)	Pb	[led] ['plʌmbəm]	Плюмбум
35.	Lithium	Li	['lɪθɪəm]	Літій
36.	Magnesium	Mg	[mæg'ni:zɪəm]	Магній
37.	Manganese	Mn	[,mæŋgə'ni:z]	Манган
38.	Mercury (=Hydrargyrum)	Hg	['mə:kjurɪ] [haɪ'drɑ:dʒɪrəm]	Меркурій, Гідраргірум
39.	Molybdenum	Mo	[mə'lɪbdɪəm]	Молібден
40.	Neon	Ne	['ni: ən]	Неон
41.	Neptunium	Np	[nep'tju:jəm]	Нептуній
42.	Nickel	Ni	['nɪkl]	Нікель
43.	Nitrogen	N	['naɪtrɪdʒən]	Нітроген
44.	Osmium	Os	['ɔzmɪəm]	Осмій
45.	Oxygen	O	['ɔksɪdʒən]	Оксиген
46.	Palladium	Pd	[pə'leɪdjəm]	Паладій
47.	Phosphorus	P	['fɔsfəres]	Фосфор
48.	Platinum	Pt	['pl ætɪnəm]	Платина
49.	Plutonium	Pu	[plu:'tonjəm]	Плутоній
50.	Polonium	Po	[pə'lounɪəm]	Полоній
51.	Potassium (=Kalium)	K	[pe'tæsjəm] ['keɪləm]	Калій
52.	Protoactinim	Pa	[,proutəæk'tɪnɪəm]	Протактиній
53.	Radium	Ra	['reɪdjəm]	Радій
54.	Radon	Rn	['reɪdɔn]	Радон
55.	Rubidium	Rb	[ru: 'bɪdɪəm]	Рубідій
56.	Scandium	Sc	['skændɪəm]	Скандій
57.	Selenium	Se	[sɪ'li:nj əm]	Селен

1	*2*	*3*	*4*	*5*
58.	Silicon	Si	['sɪlɪkən]	Силіцій
59.	Silver (=Argentum)	Ag	['sɪlvə] [ɑ:'dʒentem]	Аргентум
60.	Sodium (=Natrium)	Na	['soudjəm] ['neɪtrɪəm]	Натрій
61.	Strontium	Sr	['strɔnʃjəm]	Стронцій
62.	Sulphur	S	['sʌlfə]	Сульфур
63.	Tantalum	Ta	['tæntələm]	Тантал
64.	Tin (=Stannum)	Sn	[tɪn] ['stænəm]	Станум
65.	Titanium	Ti	[taɪ'teɪnjəm]	Титан
66.	Tungsten (=Wolfram)	W	['tʌŋsten] ['wulfrəm]	Вольфрам
67.	Uranium	U	[juə'reɪnjəm]	Уран
68.	Vanadium	V	[və'neɪdjəm]	Ванадій
69.	Xenon	Xe	['zenɔn]	Ксенон
70.	Zinc	Zn	[zɪŋk]	Цинк
71.	Zirconium	Zr	[zə:'kounjəm]	Цирконій

Some Rules of Reading Chemical Formulas[1]

Symbol or Formula	How to read	Meaning
2 O	two O	Two separate atoms of oxygen
O_2	O two	One molecule of oxygen, consisting of two atoms joined together by chemical force
2 O_2	two O two	Two such molecules of oxygen
H_2O	H two O	One molecule of water, consisting of two hydrogen atoms and an oxygen atom joined together by chemical force
HNO_3	H N O three	A molecule of nitric acid

$2H_20$ — ['tu: 'molikju:lz av 'eitj 'tu: 'ou] or: two molecules of water

$(NH_4)_2\ S0_4$ – ['en 'eitʃ] four twice, ['es 'ou] four

$2KC10_3 = 2KC1 + 30_2$ – two molecules of potassium chlorate produce (form, give) two molecules of potassium chloride and three molecules of oxygen

$\rightarrow$ – give, pass over to, lead to

$\rightleftarrows$ – forms and is formed from .. ' ,

$N_2 + 3H_2 \rightleftarrows 2NH_3$ – [en] two plus three molecules of [eitʃ] two form and are formed from two molecules of ['en 'eitʃ''] three

= – give, form

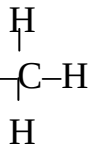
+ – plus, together with

$4HC1 + O_2 = 2C1_2 + 2H_2O$ – four molecules of ['eitʃ 'si: 'el 'plΛs 'ou 'tu:] give two molecules of ['si: 'el 'tu:] and two molecules oU'eitj 'tu: 'ou]

—— is not read (meaning one bond)

= is not read (meaning two bonds)

( ) is not read (for example, $(S0_4)$ — ['si:'ou] four)



['si:'eitʃ'fo:]

[1] У формулах латинські літери читаються як англійські, наприклад: c [si:]; Ca ['si:'ei]; Ag ['eɪ'di:].

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ДЛЯ НОТАТОК

Навчальне видання

Карловська Ганна Володимирівна

English for Chemists

(part I)

Навчальний посібник з англійської мови
для студентів І курсу спеціалізації хімія

Комп'ютерне верстання
Г. В. Карловська

Підписано до друку 12.08.2013. Формат 60х84/16
Ум. друк. арк. 2,5. Тираж 50 пр. Зам. № 4719

Видавець і виготовлювач
Черкаський національний університет імені Богдана Хмельницького
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Свідоцтво про внесення до державного реєстру
суб'єктів видавничої справи ДК № 3427 від 17.03.2009 р.