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INNOVATIONS OF THE REPUBLIC OF UZBEKISTAN**

GULISTAN STATE UNIVERSITY

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Essential English for Biology students

BIOLOGIYA

5140100 - ta'lim yo'nalishi talabalari uchun o'quv qo'llanma

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Essential English for Biology students: Oliy ta’lim muassasalari bakalavriat bosqichining Biologiya 5140100 - ta’lim yo‘nalishi talabalari uchun o‘quv qo‘llanma

“Essential English for Biology students” the textbook is envisioned for the students of Biology speciality 5140100-baccalaureate speciality. The most stimulating topics for modern biological science are reflected in the original texts, on the base of which the students train the skills of scientific, oral, written speech, get acquainted and integrate general scientific and biological vocabulary. This manual straightly be appropriate to the students of the 5140100 direction of bachelor degree.

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Mazkur o'quv qo'llanma ingliz tilini o'rganuvchi biologiya ta'lim yo'nalishi talabalari uchun mo'ljallangan. Qo'llanmada yo'nalish talabalarining og'zaki hamda yozma nutqlarini rivojlantirishga qaratilgan zamonaviy biologiya fani uchun qiziqarli bo'lgan mavzular va yo'nalish talabalarining og'zaki va yozma nutqlarini rivojlantirishga yo'naltirilgan autentik matnlardan parchalar keltirilgan bo'lib, talabalar umumilmiy va biologik leksika bilan tanishish va ularni o'zlashtirish imkoniyatiga ega bo'ladi. Qo'llanmada asosiy e'tibor ingliz tilini bilish darajasi bo'yicha o'rta va yuqori o'rta darajaga ega bo'lgan talabalarining yozma hamda og'zaki nutqlarida uchraydigan grammatik xatolarni to'g'irlashga qaratilgan. Talabalar til o'rganish jarayonida ilmiy matnlar tarjimasi, shuningdek, ilmiy matnlarni mukammal gapirib bera olish qobiliyatlarini rivojlantirish imkoniyatiga ega bo'lishadi. Ushbu o'quv qo'llanmani biologiya ta'lim yo'nalishining bakalavr, magistrant talabalari ingliz tilini mukammal o'rganishlari uchun foydalanishlari mumkin.

Это учебное пособие предназначено для студентов-биологов, изучающих английский язык. В пособии собраны интересные современную биологию темы, направленные на развитие устной и письменной речи студентов специальности, а также отрывки из аутентичных текстов, направленные на развитие устной и письменной речи студентов специальности. смогут познакомиться с биологической лексикой и выучить их. Основное внимание в пособии уделяется исправлению грамматических ошибок в письменной и устной речи учащихся со средним и выше среднего уровнем владения английским языком. В процессе изучения языка студенты имеют возможность развивать умение переводить научные тексты, а также в совершенстве говорить научные тексты. Это учебное пособие может быть использовано студентами и аспирантами биологических факультетов для идеального изучения английского языка.

The textbook is intended for biology students studying English. The guide contains topics of interest for modern biology aimed at developing the oral and written speech of students of the major and excerpts from authentic texts aimed at developing the oral and written speech of students of the major. will be able to get acquainted with the biological lexicon and learn them. The main focus of the manual is on correcting grammatical errors in written and oral speech of students with intermediate and upper intermediate level of knowledge of the English language. In the process of language learning, students have the opportunity to develop the ability to translate scientific texts, as well as to speak scientific texts perfectly. This study guide can be used by undergraduate and graduate students of biology education to learn the English language perfectly..

KIRISH

Ushbu o‘quv qo‘llanma biologiya ta‘lim yo‘nalishidagi ingliz tilini bilish darajasi matnlarni tushunish, hamda tahlil qila olish darajasiga ega bo‘lgan talabalarining ilmiy matnlarni o‘qib tushuna olish qobiliyatlarini yanada yuksaltirish uchun mo‘ljallangan bo‘lib, talabalarning zamonaviy biologiya fanining rivojlanishini ko‘rsatuvchi Ingliz va Amerika ilmiy asarlaridan olingan matnlar va ilmiy-ommabop maqolalarni tarjima qila olishlariga qaratilgan.

Qo‘llanmada asosiy e‘tibor keltirilgan matnlarda aks ettirilgan biologik sohalar, hususan evolyutsiya, mikrobiologiya, neyrologiya, bakteriologiya va boshqa sohalarini muhokama hamda munozara qilish orqali og‘zaki nutqni takomillashtirishga qaratilgan.

Qo‘llanmada yana bir asosiy e‘tibor talabalarning ingliz tilidagi matnlar bilan ishlashga alohida e‘tibor qaratish qobiliyatini yuksaltirishga qaratilgan bo‘lib, shu asnoda talabaning og‘zaki nutqi ikki jihatdan, yani biologiya ta‘lim yo‘nalish talabasi har qanday ilmiy jihatdan nazarda tutilgan kontekstda hozirjavob bo‘la olishi va boshqa rasmiy vaziyatlarda, konferentsiyalarda ham nutq so‘zlay olish qobiliyatlariga ko‘maklashuvchi omil bo‘ladi.

Qo‘llanma 7 ta bo‘limdan va har bir bo‘lim ikki qismdan iborat, har biri ingliz tilida ilmiy-ommabop matnlar, zamonaviy kimyo sohasining muammolari bilan bog‘liq bo‘lgan matnlarni o‘z ichiga olib, quyidagi tartibda guruhlashtirilgan.

1-qism – Grammatika qismi bo‘lib, ingliz tilidagi asosiy grammatik qoidalar misollar orqali keltirilgan va kimyo faniga oid ma‘lumotlarga asosan tuzilgan mashqlar yordamida qoidalarni mustahkamlashga qaratilgan. Bundan tashqari, talabalarning nutqini rivojlantirish maqsadida ingliz tilidagi fanga oid so‘zlarning to‘g‘ri talaffuziga qaratilgan mashqlar ham mavjud.

2-qism – Fanga oid mavzular leksikasi - matnlarni o‘qigunlariga qadar bo‘lgan muhokama, munozaraga asoslangan va talabalarga asosiy matn haqida darak beruvchi savollardan tashkil topgan. Munozaraa spontan og‘zaki nutqni va matn terminologiyasini dastlabki muhokamasiga rivojlantirishga qaratilgan. Shuningdek, talabalarga har bir qismdagi matn kalit so‘zlari tarjimasi hamda talaffuzini tekshirish

tavsiya etiladi. Bundan tashqari, kalit soʻzlar va terminlardan tashkil topgan matnlarni kimyo yoʻnalish talabasi tez oʻqiy olish qobiliyatini rivojlantirishga yoʻnaltirilgan yangi soʻzlar, terminologiyani muhokama qilib mustahkamlash imkonini beruvchi sohaga mos spontan kontekstda yangi lugʻatni qoʻllay olish imkonini beruvchi qator mashq va topshiriqlardan iborat.

Har bir boʻlim oxirida oʻzbek va rus tillarida keltirilgan matn tarjimalariga yuzlanish orqali kimyo yoʻnalishi talabasi bir vaqtning oʻzida ona tilidan tashqari yana ikki tilda oʻz qobiliyatlarini rivojlantirish va matnning asosiy mazmunini keltira olish imkoniga ega boʻladi.

Qoʻllanmaning oxirida qoʻshimcha oʻqish uchun matnlar kiritilgan boʻlib, ushbu matnlardan dars jarayonida, uyga vazifa sifatida, hamda, qoʻshimcha mustaqil oʻqish topshirigʻi sifatida qoʻllash mumkin.

UNIT 1

SECTION 1

- GRAMMAR: 1. THERE + BE. 2. INDEFINITE PRONOUNS.
3. THE SIMPLE TENSE FORMS (PRESENT, PAST, FUTURE).
4. QUESTIONS FORMATION**

(There + be) and Indefinite Pronouns

Study and remember the following chart

Affirmative	Interrogative	Negative
some	any	not any, no
There are some books on the table	Are there any books on the table?	There are no (not any) books on the table.
<i>Derivatives of some, any, no</i>		
somebody someone something	anybody anyone anything	nobody, no one not anybody not anything nothing
Izoh. <i>Any</i> olmoshi va uning hosilalari tasdiq gaplarda ishlatilishi mumkin. Bunday hollarda <i>any</i> olmoshi <i>har qanday, qanday bo'lsa ham</i> ma'nolarini bildiradi. Примечание. Местоимение any , а также его произвольные могут употребляться в утвердительных предложениях. В этих случаях местоимение <i>any</i> имеет значение <i>любой</i> .		

1. Translate the sentences into your mother tongue .

1. There are many complicated problems in chemistry.
2. What up to date instruments are there in your laboratory?
3. Yesterday there was a very interesting lecture on organic chemistry.

4. She was there yesterday.
5. There are some test-tubes there on the laboratory bench.
6. There were some new words in the text.
7. There will be many difficulties in your work.
8. There is no absolute motion and no absolute rest.
9. There are some characteristics common to all metals.
10. Anybody can explain you this grammar rule.
11. He knows nothing about it.
12. You may take any dictionary to translate the text.
13. There are no classes on Sunday.
14. Nothing special happened yesterday.
15. The laboratory is empty. No students are in the evening there.
16. There are some articles on that subject in the magazine.
17. Are there any changes in your plan?
18. There are no substances which have absolutely the same properties.
19. There are many ways to prove that a substance is an element.
20. There is an enormous number of factors that influence the reaction rate .
21. There is a strong correlation between experimental results and theoretically estimated values.
22. There is only one electron in the hydrogen atom.
23. There are some elements which don't occur in nature, scientists obtained them in laboratory.
24. Originally there were fewer elements in the Periodic Table.
25. There is a great demand for petroleum in the world today.
26. There is a need for further research on this topic.
27. There is not enough evidence to support this hypothesis.
28. There were a lot of books on the shelves along the walls.

2. Suggest equivalents in your mother tongue to the following English sayings.

1. There is no smoke without fire.

2. There is a skeleton in every house.
3. There is no rule without exception.
4. There is always room for perfection.
5. While there is life, there is hope.
6. There is plenty more fish in the sea.
7. There is more to something than meets eye.
8. There is no rose without a thorn.

3. Use English equivalents for the words in brackets.

1. Do you have (*qandaydir/какой-нибудь*) English books on chemistry?
2. (*Har qanday/Любой*) young man or woman having secondary education may apply to the University.
3. I know (*hech kimni/никого*) in this group.
4. Does (*kimdir/кто-нибудь*) know the answer?
5. I did not hear (*hech narsa/ничего*) about this phenomenon.
6. He does not know (*hech qanday/никакого*) foreign language.
7. (*Hech bir/Ни один*) student of this group can speak French.

The Simple Tense Forms (Present, Past, Future).

Questions Formation

Simple Present

We study chemistry — Do you study chemistry?
 She studies chemistry — Does she study chemistry?

General Questions

Do you get to the University by underground? —

Yes, I do. — No, I do not (don't).

Does he speak English? — Yes, he does. —

No, he does not (doesn't).

4. Put general questions to the sentences.

1. Chemistry deals with the study of substances and their transformations.
2. Our classes start at 9.30.
3. They carry out a lot experiments every month.
4. Water boils at 100 °C under normal conditions.
5. We always take notes on the lectures.

5. Give the 3-rd person singular of the following verbs and divide them into 3 groups according to the rules of the pronunciation.

teach, undergo, change, get, ask, introduce, watch, observe, state, suggest, study, live, increase, hope, learn, pronounce, spend, want.

[z]

Undergoes

[s]

asks

[ɪz] (or [əz])

teaches

Present Simple

Present Progressive

1. He studies chemistry at the University. 2. Water boils at 100 °C. 3. He often conducts experiments in the laboratory of organic chemistry.	1. He is studying inorganic chemistry now. 2. Water in the kettle is boiling. 3. He is conducting an experiment with corrosive substances.
always, seldom, often, occasionally	now, at the moment

Special Questions

0	1	2	3	4
When	do	classes	start	at the university?
Where	do	you	study?	
How much time	do	you	spend	in front of your computer every day?
How often	do	you	work	
How many books	do	you	read	in the laboratory?
Where	does	your brother	study?	
What	does	he	do?	every month?
When	does	the library	start to work?	

Questions to the subject

Who studies at the University? I do (My friend does).
 Whose sister studies at the University? My sister does.
 What science studies chemical changes? Chemistry does.

Disjunctive questions

Chemistry studies substances and their transformations, doesn't it?
 Chemistry doesn't study elementary particles, does it?

Alternative questions

Does chemistry study chemical or physical changes?

6. Put all possible questions to the following sentences.

1. Chemistry plays an important part in the development of many fields of science.
2. A chemical change involves changes in composition and in properties.
3. Matter exists in three states: solid, liquid and gaseous.
4. The process of evaporation requires the addition of heat to the liquid.
5. A metal replaces hydrogen in an acid.
6. Chemistry creates new materials with necessary properties.
7. Organic chemistry deals with the transformations of carbon compounds.

Simple Past

Affirmative	Interrogative	Negative
They studied inorganic chemistry last year.	Did they study inorganic chemistry last year?	They did not study inorganic chemistry inorganic chemistry last year.
He attended all the lectures last month.	Did he attend all the lectures that month?	He did not attend all the lectures last month.

7. Put the following verbs into 3 groups according to the pronunciation of the suffix ed.

created, changed, translated, passed, carried, used, transformed, suggested, stated, worked, asked, lived, studied, hoped, played, entered, looked, tried, repeated, stopped, reminded

[d]	[t]	[ɪd] (or [əd])
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Simple Future

He will translate the article next week.	Will he translate the article next week?	He won't translate the article next week.
--	--	---

8. Open the brackets choosing the correct form of the verb.

1. The scientist (to work) in the field of the chemistry of solids.
2. He (to start) his experiments very soon.
3. She always (to bring) us interesting journals.
4. They (to obtain) interesting results last time.
5. We (to study) this law next term.
6. They (to finish) their work last month.
7. Chemistry (to play) an important role in the development of industry and science.
8. They (attend) the next conference on nanotechnology.
9. Science (use) research and experiments to explain various phenomena.

SECTION 2 CHEMISTRY

1. Tuning in.

1. What does chemistry study?
2. What fundamental terms are used in chemistry?
3. What outstanding scientists made a great contribution to the development of chemistry?
4. Scan the text below and fill in the following table.

Century	Famous scientists	What are the scientists famous for?
17-th	Boyle	Boyle's law, that states the quantitative relationship between volume of a gas and the external pressure upon it
...	La...	
...	D...	
19-th	A...	
...	M...	

Share your information with your fellow students.

5. Do you know other outstanding scientists who played an important part in the development of chemistry?

Match the names of scientists and their contribution to the development of chemistry.

Make sentences according to the model.

Model: *Mari Curie is famous for (is given the credit for) the discovery of radium and polonium.*

Names of the scientists	Their contribution to the development of chemical science
1. Mari Curie	1. introduction of structural theory of organic chemistry
2. N. Borh	2. the theory of chain reactions
3. F. A. Kekulle	3. discovery of the artificial radioactivity
4. Joseph Priestly	4. the theory of dissociation in water solutions
5. S. Arrhenius	5. the discovery of radium and polonium
6. A. M. Butlerov	6. the structural formula for benzene
7. H. M. Semenov	7. the discovery of oxygen
8. Irene Curie and Frederic Joliot	8. the orbital model of an atom

2. Pronounce the following words.

advantage [əd'vɑ:ntɪdʒ]

acid ['æsɪd]

alchemy ['zlkɑ:mɪ]

ancient [ˈeɪnf(ə)nt]

approach [ə'prəʊtʃ]

characteristic [ˌkærɪktəˈrɪstɪk]
chemistry [ˈkemɪstri]
composition [kəmˈpəʊzɪʃn]
concept [ˈkɒnsept]
deal with [ˈdi:lˈwið]
determine [dɪˈtɜːmɪn]
discovery [dɪˈskʌv(ə)rɪ]
equal [ˈiːkwəl]
frontier [frʌnˈtɪə]
geology [dʒiːˈɒlədʒi]
interdisciplinary [ɪntəˈdɪsɪplɪnəri]
introduce [ɪntrəˈdjuːs]
measurement [ˈmeʒəmənt]
observation [əbzəˈveɪʃn]
occur [əˈkɜː]
particle [ˈpɑːtɪkl]
phenomenon [fəˈnɒmɪnən]
pressure [ˈpreʃə]
property [ˈprɒpəti]
proportional [prəˈpɔːʃnəl]
radioactivity [ˈreɪdɪəvækˈtɪvəti]
regularity [ˈregjʊˈlærəti]
relation [rɪˈleɪʃn]
require [rɪˈkwaɪə]
research [rɪˈsɜːtʃ]
science [ˈsaɪəns]
structure [ˈstrʌktʃə]
successfully [ˈsəkˈsesfli]
synthesize [ˈsɪnθəˌsaɪz]
type [ˈtaɪp]

undergo [ˌʌndəʊˈgəʊ]

volume [ˈvɒljʊ:m]

Text 1

Chemistry

Chemistry can be defined as the science that deals with substances and changes that they undergo. Chemists are engaged in activities as diverse as examining the fundamental particles of matter, determining the relation between the properties of materials, their composition and structure, synthesizing and formulating new materials of all types with required characteristics.

Chemistry is one of the fundamental sciences. Most of the phenomena that occur in the world around us involve chemical changes where one or more substances transform into the other substances.

In course of its development chemistry had several stages. Since ancient times humans have used chemical changes to their advantage.

Ancient people were practicing the art of chemistry in making wine, glass, pottery, elementary metallurgy and so on. The Greeks suggested a philosophical approach to the study of matter. By about 400 BC they had proposed that all matter was composed of four fundamental substances: fire, earth, water and air. The next 2000 years of chemical history were dominated by alchemy. Alchemists were obsessed with searching an elixir of internal youth and the idea of turning basic metals (iron, zinc, copper) into gold.

Despite the fact that the principal goals of alchemists were unrealistic, discovery of mercury, sulphur, antimony and preparation of acids are their merit. But all these discoveries were made by trial and error without any scientific reasoning.

The modern chemistry started with the pioneering work of Robert Boyle (1627-1691). He studied the quantitative relationship between the volume of a gas and the external pressure upon it. According to Boyle's law the product of the pressure and volume of a gas equals a constant. He was the first scientist who recognized the importance of careful measurements.

Antoine Lavoisier (1743-1794) revolutionized the research in the field of chemistry by using a chemical balance to make quantitative measurements of the

weights of substances involved in chemical reactions. Chemistry was placed on quantitative experimental basis. A. Lavoisier made a great contribution to the establishment of the law of conservation of mass in chemical changes. Chemistry gained the further momentum with Dalton's Atomic Theory. According to Dalton (1766-1844) elements are made of tiny particles called atoms, atoms are not created or destroyed in chemical reactions, and a chemical reaction simply changes the way atoms are grouped together. Dalton's model successfully explained important observations such as the law of constant composition.

In 1811 the Italian scientist Amadeo Avogadro (1776-1856) postulated that for a gas at constant temperature and pressure the volume is directly proportional to the number of molecules of gas. He introduced the concept of molecules and stated that equal volumes of gases under the same conditions of temperature and pressure contain the same number of molecules.

In 1869 D. I. Mendeleev (1834-1907) discovered regularities in the properties of the elements. The Periodic Law suggested by Mendeleev stated that the properties of elements were a periodic function of their atomic masses. Mendeleev's Periodic Law opened a new era in the history of chemistry.

In the 20-th century outstanding achievements were made in the field of the structure of atom, radioactivity, understanding the biochemical fundamentals of life as well as in chemical and biochemical technology.

There are more than 30 branches in the modern chemistry. Chemistry plays an important part in development of physics, geology, biology, medicine. Significance of chemical knowledge in interdisciplinary fields and engineering couldn't be overestimated. Future of chemistry knows no frontiers.

3. Read the text thoroughly and answer the following questions

1. What is the subject of chemistry?
2. What activities are chemists involved in?
3. Why is chemistry one of the fundamental sciences?
4. What were the principal goals of alchemists?

5. When did the modern chemistry begin?
6. Who was the first to study quantitatively the relationship between the volume of a gas and external pressure upon it?
7. Who discovered the regularities in the properties of the elements?
8. What can you say about the links between chemistry and other sciences?
9. What subfields of chemistry do you know?
10. What does future hold for chemistry?
11. Is chemistry helpful in our day to day life?

4. Say if the following statements are true (T), false (F) or not mentioned (NM) in the text.

1. A physical change involves changes in composition and in properties.
2. Chemical changes are usually accompanied by the liberation or the absorption of energy, in the form of light, heat or electricity.
3. Atoms undergo changes in the course of chemical reactions.
4. The Periodic Law is the cornerstone of the modern chemistry.
5. Organic chemistry is the chemistry of carbon compounds.

5. Find in the text English equivalents to the following Uzbek-Russian words, word combinations and chemical terms.

- 1) aniqlamoq (определять)
- 2) ko‘rib chiqmoq, o‘rganmoq (рассматривать)
- 3) ajoyib yutuqlar (выдающиеся достижения)
- 4) xususiyat (свойства)
- 5) tarkib, birikma (состав)
- 6) tuzilish (структура)
- 7) rivojlantirish (разрабатывать) (рецептуру)
- 8) hodisalar (явления)
- 9) qadim zamonlardan beri (с древних времен)
- 10) – dan foyda olish (извлекать пользу из) (использовать с выгодой для себя)

- 11) qadimgi yunonlar (древние греки)
- 12) iborat bo‘lmoq (состоять)
- 13) alkimyo (алхимия)
- 14) (biror fikr bilan qiziqmoq) быть увлеченным идеей
- 15) loyqlik (заслуга)
- 16) yanada rivojlantirish (дальнейшее развитие)
- 17) hosila (произведение) (математическое)
- 18) tajriba asosi (экспериментальная основа)
- 19) ...dan to‘g‘ridan-to‘g‘ri proportsional bog‘liqlikda joylashish (находиться в прямо пропорциональной зависимости от...)
- 20) asoslar (основы)
- 21) tarozi (весы)
- 22) miqdoriy o‘lchovlar (количественные измерения)
- 23) kata hissa qo‘shish (вносить большой вклад)
- 24) kimyoviy transformatsiyalar uchun massa saqlanish qonuni
(закон сохранения массы при химических превращениях)
- 25) yanada rivojlantirish (получать дальнейшее развитие)
- 26) Daltonning atom nazariyasi (атомная теория Дальтона)
- 27) usul (способ)
- 28) bir xil sharoitlarda (при тех же самых условиях)
- 29) davriy qonun (периодический закон)
- 30) davriy funksiya (периодическая функция)

6. Find the word collocations matching the words from column A and column B.

A	B
1) principal	a) times
2) atomic	b) changes
3) quantitative	c) basis
4) ancient	d) pressure

- | | |
|-----------------------|-----------------|
| 5) fundamental | e) achievements |
| 6) experimental | f) observations |
| 7) external | g) fields |
| 8) tiny | h) volume |
| 9) constant | i) function |
| 10) chemical | j) science |
| 11) equal | k) relationship |
| 12) important | l) particles |
| 13) periodic | m) temperature |
| 14) outstanding | n) masses |
| 15) interdisciplinary | o) goals |

7. Match the synonyms in columns A and B.

A	B
1) explain	a) characteristics
2) open	b) importance
3) put forward	c) limits
4) frontiers	d) account for
5) deal with	e) basic
6) significance	f) be concerned with
7) property	g) reveal
8) fundamental	h) alter
9) change	i) include
10) field	j) be made of
11) postulate	k) take place
12) be composed of	l) branch
13) occur	m) advance, suggest
14) research	n) state
15) contain	o) investigation

8. Divide the text into logical parts and entitle them.

9. Write out of the text.

- 1) key words;
- 2) the sentences expressing the main idea(s) of each logical part.

10. Give the summary of the text using your plan.

11. Translate the following text into English.

Kimyo moddalarning o'zgarishi haqidagi fandır. U moddalarning tarkibi va tuzilishini, moddalarning xususiyatlarini ularning tarkibi va tuzilishi, moddalarning tuzilishi ularning tarkibiga bog'liqligini va ayrim moddalarni boshqalarga aylantirish shartlari va yo'llarini o'rganadi.

Kimyoviy o'zgarishlar har doim jismoniy o'zgarishlar bilan birga keladi, shuning uchun kimyo fizika bilan chambarchas bog'liq. Kimyo ham biologiya bilan bog'liq, chunki biologik jarayonlar doimiy kimyoviy o'zgarishlar bilan birga keladi.

Zamonaviy dunyoda kimyo juda muhim rol o'ynaydi. Kimyo bilan bog'liq bo'lmagan ishlab chiqarish sohasi yo'q. Tabiiy materiallarni kimyoviy qayta ishlashga topshirish orqali biz sanoat va qishloq xo'jaligi, tibbiyot, kundalik hayotda foydalanish uchun zarur bo'lgan turli xil moddalarni olamiz – o'g'itlar, metallar, plastik massa (plastics), bo'yoqlar, dorilar (pharmaceuticals) va boshqalar.

Химия — это наука о превращениях веществ. Она изучает состав и строение веществ зависимость свойств веществ от их состава и строения, условия и пути (pathways) превращения одних веществ в другие.

Химические изменения всегда сопровождаются изменениями физическими, поэтому химия тесно связана с физикой. Химия также связана с

биологией, поскольку биологические процессы сопровождаются непрерывными химическими превращениями.

В современном мире химия играет исключительно важную роль. Нет ни одной отрасли производства, не связанной с применением химии. Природа даёт нам лишь исходное сырьё - дерево, руду, нефть и др. Подвергая природные материалы химической переработке, мы получаем разнообразные вещества, необходимые для промышленности и сельского хозяйства, медицины, использования в быту- удобрения, металлы, пластические массы (plastics), краски, лекарственные препараты (pharmaceuticals) и т. д.

UNIT 2

SECTION 1

GRAMMAR: 1. THE PERFECT TENSES. 2. THE COMPARISON DEGREES OF ADJECTIVES AND ADVERBS

PRESENT PERFECT TENSE

Affirmative	Interrogative	Negative
She has graduated from the University already. U universitetni allaqachon tamomlagan Она уже окончила университет.	Has she graduated from the University yet? U universitetni allaqachon tamomlaganmi? Она уже окончила университет?	She has not graduated from the University yet. U universitetni hali tamomlamagan. Она ещё не окончила университет.

1. Look through the table below and compare the cases of using Present Perfect and Past Simple, try to formulate the rules. What is the principal difference?

Comparison of using Present Perfect and Past Simple

Present Perfect	Past Simple
1. Has he passed the exam yet?	1. When did he pass the exam?
2. She has never been to Moscow.	2. She was in Moscow last month.
3. Have you read anything interesting lately?	3. I read quite an interesting story on the Internet a few days ago.
4. I have already seen the new film.	4. I saw the new film yesterday.

5. He has attended all lectures this term. 6. They have lived there for 10 years (since 200...).	5. He attended all the lectures last year.
We use with Present Perfect	We use with Simple Past
already — allaqachon - уже always — doim - всегда Just — hozirgina - только что never — hech qachon - никогда ever — qachondir - когда-либо often lately - yaqinda - недавно recently – so‘nggi paytda за последнее время	when yesterday last time last week (month) last year (century) in the 20-th century in the 60-ties in 2005
We use with Present Perfect	We use with Simple Past
yet hali (inkor gaplarda) Ещё (в отрицательных предложениях) allaqachon (so‘roq gaplarda; уже (в вопросительных предложениях) today this week this year since — с тех пор, как; с ... for + period of time	a few minutes ago ten years ago

2. Read and translate the following sentences, then put general and special questions to the sentences.

1. We have not heard from them since they left for Germany.

2. He has never told us about his research.
3. They have prepared the apparatus they needed.
4. She has learned the new words.
5. They have already spoken to him about it.
6. He has already passed his driving test.
7. I have told him the story already.
8. He has just played football.
9. She has always kept her promises.
10. Chemistry has changed greatly since the Periodic Law was discovered.
11. International interest in nanoscience research has risen sharply in recent years.
12. J. Alferov has made a huge contribution to the development of the lasers.
13. Through the time Mendeleev's periodic table has undergone some changes.
14. The subject has not been fully researched before.

Past Perfect and Future Perfect

Past Perfect	Had + participle II
Future Perfect	Will (shall) + have + participle II

3. Translate the following sentences.

1. By 3 o'clock they had left the laboratory.
2. When she came into the laboratory they had already started the experiment.
3. He said that they had obtained good results.
4. They will have solved the problem by the end of the month.
5. By the time he comes back we shall have dissolved the substance and add the catalyst.
6. After they had found a suitable solvent, they could purify the substance by recrystallization.
7. He will have passed the all his exams by the end of June.

4. Make up sentences using the Perfect Tenses.

He	never to drive	through such heavy rain
I	not to see him	since he finished school
They	to do	the task by 5 o'clock
She	translate the article	before he could help her

5. Open the brackets using the Perfect Tenses.

1. I (finish) my research by the end of the next year.
2. We thought that the city (make) a great impression on you.
3. I (do) my best to master English this term.
4. My mother (answer, negative) the letter yet.
5. We (write) our test paper already.
6. They (solve, negative) the problem yet.
7. He (collect) some information we needed on the Internet.
8. Over time some bacteria (become) resistant to penicillin.
9. Life expectancy in the developed world (increase) significantly by the end of the end of the 20-th century.
10. I (read) the book by the time it is due back to the library.
11. There were other uncertainties that you (take, negative) into account.
12. They (refuse) to answer the further questions.
13. Much (change) since his last visit.
14. We (pay) always particular attention to the theoretical aspects of chemistry.
15. They (finish, negative) the research until the next month.
16. He (give) us an interesting piece of information before the discussion took place.
17. Perhaps he (become) a world-famous scientist by the age of forty.
18. Cars and factories (pollute) the air, so now many people have bad health problems.
19. Over the past 200 years the study of chemistry (make) an enormous contribution to the quality of our lives.

20. You (answer, negative) the question yet.

21. The classes (be over) by five, so I should be home about half past six.

The comparison degrees of adjectives and adverbs

Positive	Comparative	Superlative
big	bigger	(the) biggest
late	later	(the) latest
important	more important	(the) most important
easily	more easily	(the) most easily
good	better	(the) best
well		
bad	worse	(the) worst
badly		
much	more	(the) most
many		
little	less	(the) least
far	farther or further	(the) farthest or (the) furthest
old	older	(the) oldest
	elder	(the) eldest

6. Form the comparative and superlative degrees of the following adjectives.

Large, old, big, good, successful, high, cheap, busy, noisy, friendly, central, expensive, close, terrible.

7. Translate the sentences into your mother tongue.

1. Scientists try to penetrate deeper into the laws of Nature.
2. Some artificial materials possess better properties than natural ones.

3. Chemistry is no longer a collection of more or less unrelated facts, as it used to be.
4. This discovery provided more profound understanding to the structure of matter.
5. This experiment is not as difficult as the previous one.
6. These devices are much more reliable.
7. The results of our last experiment were worse than before.
8. Our laboratory has better equipment.
9. The periodic table of the elements is one of the most important tools of chemistry.
10. A molecule is the smallest unit of a compound that still displays the properties associated with that compound.
11. Pure silver has the highest electrical and thermal conductivity of all metals.

8. Put the adjective given in the brackets in the appropriate degree of comparison.

1. This substance is ... soluble than that one (little).
2. Gold is a ... conductor of heat and electricity than silver and copper (bad).
3. Electrolysis is the ... way to decompose water (good).
4. Inert gases are the ... active substances in nature (little).
5. The first method is ... than the second one (bad).

9. Fill in the gaps using words twice, three times, four times etc. depending on the figure given in the brackets.

Model: This text is ... long ... that one (2). This text is twice as long as that one.

1. The specific weight of water is ... much ... that of new polymer (3).
2. The diameter of the atom is ... great ... the diameter of the nucleus (10 000).
3. The atomic mass of nitrogen is... high ... that of hydrogen (14).
4. The volume of this container is ... small ... the volume of the other (3).
5. The speed of α -particles is ... high ... the speed of β -particles (7).

10. Translate the following sentences into your mother tongue.

1. The solubility of helium is much less than that of the nitrogen.

2. Some of uranium compounds emit radiation of much greater intensity than uranium itself.
8. The odor of burning sulphur is much more unpleasant than that of vinegar.
4. The work was much more interesting for us.
5. Aluminum is the most abundant element of the earth's crust.
6. More difficult tasks take more time.

11. Translate the following sentences into your mother tongue, paying attention to the translation of the comparison construction «the ... the».

1. The more you study, the better you know the subject.
2. The greater the atomic number of the element, the higher is the charge of the atomic nucleus.
3. The lower the temperature, the less is the volume of a gas.
4. The faster an object move, the greater is the air resistance.
5. The higher the division of a solid, the lower is its kindling temperature.
6. The higher the temperature, the higher is the reaction rate.

SECTION 2

THE SCIENTIFIC METHOD

1. Tuning in.

1. What have you heard about the scientific method?
2. What part does it play in the development of science?
3. What is scientific approach based on?
4. What theories do chemists use in their work?
5. Have you ever heard about any theories or hypotheses that were discarded?
6. Why have our ideas about laws of nature changed with the time?
7. What is the principal difference between the theory and the law?
8. What can you say about interaction of the theoretical knowledge and experimental work?

2. Look through the text and say how many ideas you have discussed it contains, what additional information is given in the text.

3. Look through the text and find adjectives in the comparative degree.

4. Look through the text and find sentences in Present Perfect Tense, translate them into your mother tongue.

5. Practice the pronunciation of the following words.

benefit [ˈbenɪfɪt]

include [ɪnˈkluːd]

hypothesis [haɪˈpɒθəsɪs]

breakthrough [ˈbreɪkθruː]

change [tʃeɪndʒ]

conservation [ˈkɒnsəˈveɪʃn]

detailed [ˈdiːteɪld]

development [di' veləpmənt]
effective [i'fektiv]
efficiently [i'fiʃntli]
expand [iks' pænd]
explanation [ekplə'neɪʃn]
distinguish [di'stiŋɡwiʃ]
available [ə'veiləbl]
interpretation [intɜ:pri'teɪʃn]
knowledge [nɒlɪdʒ]
law ['lɔ:]
level ['levl]
findings ['faɪndɪŋz]
innumerable [i'nju:mərəbl]
mass [mæs]
material [mə'tiəriəl]
observation [,ɒbzə'veɪʃn]
profit ['prɒfɪt]
remain [ri'meɪn]
recant [ri'kænt]
reasonable ['ri:znəbl]
scientific [,saɪən'tɪfɪk]
theory [θiəri]
(the) same ['seɪm]
explosive [iks' pləʊsɪv]
fertilizer ['fɜ:tə,laɪzə]

Text 2

The Scientific Method

The concepts of chemistry allow us to understand the nature of transformation of one substance into the others and thus use the knowledge to our advantage. The process that lies at the heart of any scientific research is the scientific method.

The scientific method includes several steps. First you state the problem and make observations (collect data), after that you can formulate hypotheses (explanation for the observation) and start perform the experiments to test the hypotheses.

Experiments always produce new observations and in this way bring us back to the beginning of the process and starting a new cycle in the scientific research. On the basis of a set of hypotheses that agrees with our various observations a theory that gives an overall explanation of some aspects of nature behavior can be developed.

It should be noted that it is important to distinguish between observations and theories. An observation is something that is witnessed and can be recorded. A theory is an interpretation — a possible explanation of why nature behaves in a particular way.

Theories inevitably change as more information becomes available. Our knowledge expands and becomes more detailed. But development of science includes not only accumulation of scientific findings, but it also experiences the periods of breakthroughs, that revolutionize our understanding of Natural Laws and put it on a higher level. The old ideas are replaced by new ones, which provide more reasonable and deeper penetration into the nature of things. For example, the motions of the moon and stars have remained virtually the same over the thousands of years during which humans have been observing them, but our explanations (theories) have changed greatly since the ancient times.

We use theories to make predictions and then do an experiment (make a new observation) to conclude whether they are true or not.

Theories represent our attempts to explain observed natural behavior in terms of our human experiences. As we observe nature, we often see that the same observation applies to many different systems. For example, studies of innumerable chemical changes have shown that the total mass of the materials involved in the change is the same as it has been at the start.

We often formulate such generally observed behavior into a statement called a natural law. The observation that the total mass of materials is not affected by a chemical change in those materials is called the law of conservation of mass. A law tells us what happens, a theory is our attempt to explain why it happens.

However, it is important to remember that science does not always progress smoothly and efficiently, science is affected by profit motives, budgets, wars and religious beliefs.

Galileo, for example, was forced to recant his astronomical Observations in the face of strong religious resistance. Lavoisier, the father of modern chemistry was beheaded because of his political affiliates. And a great progress in the chemistry of nitrogen resulted from the desire to produce explosives to fight wars, not fertilizers.

The scientific method is only as effective as humans using it.

6. Read the text thoroughly and answer the following questions.

1. What process lies at the core of scientific research?
2. What are the main steps of the scientific method?
3. How is the theory created?
4. Why is the scientific research a kind of the cyclic process?
5. Why has our knowledge of Nature always changed?
6. Why have some theories become out of date? Can you give any examples?
7. How are theories verified?
8. What do we call a natural law?
9. What natural law is mentioned in the text?
10. What factors influence the progress of science?

11. What idea about effectiveness of the scientific method expressed in the text? Do you share the opinion?

7. Choose one word from the box for each group of the words.

experience changes law explanation method information observation mass
--

1. effective ...

scientific ...

principal ...

2. chemical ...

physical ...

innumerable ...

3. human...

considerable ...

limited ...

4. astronomical...

detailed ...

systematic ...

5. total ...

critical ...

conservation of ...

possible ...

... overall ...

... of how to use smth

. availble ...

reliable ...

relevant ...

. natural ...

periodic ...

the ... of the jungle

9. Match the words from column A and column B. Translate the composed phrases into your mother tongue.

A	B
1) make 2) use 3) distinguish 4) behave 5) perform 6) agree 7) progress 8) include 9) remain 10) in terms of	1) an observation 2) serial steps 3) in a particular way 4) with our observations 5) the same 6) experiments 7) smoothly and efficiently 8) the knowledge to our benefit 9) between observations and theories 10) our experience

10. Match the words with their definitions.

A	B
1) hypothesis 2) theory 3) interpretation 4) law 5) observation	a) an explanation of meaning or importance of smth. b) a process of gaining knowledge or skill by doing or seeing things c) a process of determining qualitative value of smth, usually expressed in numbers of standard units d) a test or trial carried out carefully

6) explanation	in order to study what happens and gain a new knowledge
7) affiliation	e) a factual statement of what always happens in certain circumstances
8) experiment	f) an idea, suggestion, you believe is always true
9) measurement	g) the information you get as the result of some research
10) experience	h) a description of how smth work or i) connection with an organization especially a political or religious one
11) findings	j) the process of watching smth carefully, in order to find smth out
12) breakthrough	k) a discover or an achievement that comes after a lot of hard work l) the set of general principles that a particular subject is based on

11. Translate the sentences into your mother tongue, put general questions to the sentences.

1. They have set up a number of experiments to verify the working hypothesis.
2. Science has become the most important part of the modern world.
3. Chemistry has always been of a great value to medicine.
4. They have predicted the result on the basis of their experiments.
5. He has achieved a significant correlation between practical results and theoretical assumptions.
6. Our findings have supported the hypothesis.
7. The scientists have expected a major breakthrough in this field of technology.

8. He has carried out a promising research of the great theoretical and practical importance.

2. Translate the sentences into English.

1. Olimlar gipotezani eksperimental tekshirishga joriy qildilar.

1. Учёные подвергли гипотезу экспериментальной проверке (*checking*).

2. Agar gipoteza eksperimental ma'lumotlarga mos kelsa, u nazariyaga aylanadi.

2. Если гипотеза согласуется с экспериментальными данными, она становится теорией.

Davriy qonun hozirgi zamonaviy kimyoning asoslaridan biridir.

3. Периодический закон является одной из основ (*foundations*) современной химии.

Nazariya bilimlarni to'plashni tizimlashtiradi.

4. Теория систематизирует накопление знания.

Qonun tabiatda mavjud bo'lgan qonunlarni o'rnatadi, lekin ularni tushuntirmaydi.

5. Закон устанавливает закономерности, существующие в природе, но не объясняет их.

13. Give a summary and write an abstract of the text.

14. Fill in the gaps using words from the box.

distinguish attempts observation change model at the heart of properties (2)
--

It is important that we _1_ the observation (steel rusts) from _2_ to explain why the observed events occur (theories). The _3_ remains the same over the decades, but the theories (our explanations) _4_ as we gain a clearer understanding of how nature operates. A good example of this is the replacement of the Bohr _5_ for atoms by the wave mechanical model.

Because the observed behaviour of matter lies 6 of chemistry, it is necessary to understand thoroughly the characteristic 7 of the various elements and the systematic variations that occur in those 8.

UNIT 3

SECTION 1

GRAMMAR: 1. MODAL VERBS AND THEIR EQUIVALENTS.

2. THE EMPHATIC CONSTRUCTION: IT IS (WAS) ...

THAT (WHO)... 3. THE MEANINGS OF ONE (ONES) AND

THAT (THOSE)

Modal verbs and their equivalents

Can — jismoniy yoki aqliy qobiliyatga ega bo‘lmoq (обладать физической или умственной способностью)

May — ruxsat, tahmin, imkoniyat (разрешение ,предположение, возможность)

Must — zaruriyat, ma’naviy burch (необходимость моральная обязанность)

1. The students must conduct these experiments on time.
2. The chemists can obtain materials with the desired properties.
3. The supervisor may change the work plan.
4. The reaction rate must be increased.

	Present	Past	Future
can	can	could	---
to be able to	am is able to are	was able to were	shall able to will
may	may	might	---
to be allowed to	am is allowed to are	was allowed to were	shall allowed to will
must	must	---	---

to have to	have to has to	had to	shall have to will
to be to	am to is to are to	was to were to	---
should	should		

The students were to compare the substances.

The research workers had to submit their scientific report on the project.

2-nd meaning of the modal verbs.

Modal verbs +	Perfect infinitive
	Progressive infinitive

He must have gone to the laboratory.

She might have forgotten her evaluation record book.

You should have prepared better.

He must be still working in the laboratory.

She could not have made such a serious mistake.

1. Translate the sentences into your mother tongue. Find the sentences where modal verbs express logical conclusion.

1. He could not have finished the experiment.
2. I was allowed to use a new device.
3. She must be working in the library.
4. They have to carry out this experiment 3 times.
5. The meeting is to take place at 12 p. m.
6. Chemists have to use balances in their work.

7. As he was very busy he could not attend the lecture.
8. You may take part in this research project.
9. He should do it immediately.
10. You must have worked hard to receive such promising results.
11. You must work hard if you want to submit your diploma work on time.
12. He must be working in the same field.
13. Chemist has to take into the account the physical state of substances.
14. He is to apply new methods of investigation.
15. The substance could contain impurities.
16. The properties of alloys may vary in a wide range due to their chemical composition.
17. We must abandon our dependence on conventional fossil fuel and find new sources of energy.
18. The matter in the world about us is almost entirely made from 83 elements, which differ from each of her by the positive electric charge on their central nucleus and hence the number of electrons they are able to attract.
19. You must memorize the symbols that accord to each element name.
20. Molecules may contain two atoms of the same element, such as O₂ and H₂, or they may consist of two or more different atoms, such as HCl, H₂O, CH₄.
21. Too much or too small ozone in the atmosphere can cause problems.
22. You have to convert the temperature readings from Celsius to Kelvin.

2. Translate the sentences into your mother tongue paying attention to modal verbs and their equivalents.

1. They will be able to use the new achievements in their work.
2. They had to leave home early in the morning.
3. I was to send him a letter but I forgot.
4. You can borrow this textbook in our library.
5. I must speak to him at once.
6. He is to be congratulated on his success.

7. Anyone age 18 or over can vote in general election.
8. You must come and visit us some time.
9. Students are not allowed to use their mobile phones at the examinations.
10. You must answer all the questions.
11. There should be a comma in the letter after «your sincerely».
12. They are to announce the results at the end of the month.
13. You can't make an omelette without breaking eggs.
14. A fool may ask more questions, than a wise man can answer.

3. Fill in the gaps with modal verbs or their equivalents.

1. I... have finished the work next week or I will be late.
2. He ... post the letter at once.
3. The students ... take exams every term.
4. We (negative) live without water.
5. We... plan our work well.
6. The meeting ... have finished by now.
7. The machine ... translate simple messages into different languages.
8. They (negative) go on borrowing money when there is no hope of ever paying it back.
9. You ... work hard to submit the term paper in time.
10. I want ... to choose my own career.
11. The children ... to watch violent TV programmes.
12. You ... have taken my advice.

The Emphatic Construction

It is (was) ... that ...

who

which

4. Change the sentences according to the model to emphasize italicized words and then translate them into your mother tongue.

Model: **Mendeleev** discovered the Periodic System. — **It was Mendeleev who** discovered the Periodic System.

The different crystal structures determine the difference in properties of diamond and graphite. — **It is the different crystal structures that** determine the difference in the properties of diamond and graphite.

1. *The sun* gives us heat, energy and light.
2. *In 1869*, D. I. Mendeleev formulated the Periodic Law.
3. *Chemists* create many new materials for industry and medicine.
4. The first Earth satellite was launched *in the USSR*.
5. *Diamond* is a nearly perfect insulator.

5. Point out the sentences in which «it» is used as a part of the emphatic construction.

1. It was in 1896 that natural radioactivity was discovered.
2. It was found that some substances acted as catalysts.
3. It rained in the night but now the weather is wonderful.
4. It is necessary to understand what is meant by the rate of a chemical reaction.
5. It is desirable that you should translate this new text without a dictionary.
6. It is in Tobolsk that first school in Siberia was founded.
7. It was the year ago that he started working here.
8. It seems that no one wants to accept the responsibility for what has happened.
9. It was Dalton who suggested that matter was made up of atoms.
10. It was Roentgen who discovered X-rays.
11. It was nearly midnight when we get home.

6. Translate into your mother tongue.

1. It is the synthesis of new compounds that is one of the most important activities in chemistry.
2. It was not until the late 1800s that the essential nature of acids was discovered by Svante Arrhenius, then a Swedish graduate student in physics.
3. It was Dalton who stated the atomic theory in the early 1800s.
4. It is the quantity of matter present in an object, which can be defined as mass.
5. It is kilogram that is one of the fundamental SI units.
6. It was not until the 19-th century that the periodicity of elements was discovered.
7. It is on the basis of the kinetic molecular theory that the temperature influence on the rate of chemical reactions is explained.
8. It was the prediction of unknown then elements by Mendeleev that brilliantly confirmed the Periodic Law.
9. It was Wollner who showed that organic compounds could be obtained from non-living matter.
10. It is because of Le Chatelier's principle that we can predict the effects of changes in concentration, pressure, and temperature on a system at equilibrium.
11. It is the discovery of the Periodic System that is one of the greatest scientific discoveries.
12. It was not until almost 1900 that the experimental work on the structure of atoms became available.
13. It was the modern theory of the structure of an atom that gave the new interpretation of the Periodic Law.
14. It was a French chemist Antoine Lavoisier who introduced the concept of chemical elements.
15. It is the manner in which atoms are linked together that has a profound effect on the chemical and physical properties of substances.
16. It was penicillin (an important antibiotic) which was discovered accidentally by the Scottish bacteriologist Alexander Fleming.
17. It is the way subatomic particles are arranged that gives each atom its unique characteristics.

18. It was in 1828 that the St. Petersburg Institute of Technology was founded.
The meanings of one (ones) and that (those)

7. Translate the sentences paying attention to the word «one».

1. One can obtain oxygen by decomposing water by electrolysis.
2. One should be very careful using strong acids.
3. About one volume of carbon dioxide dissolves in one volume of water at room temperature.
4. One must study chemistry in order to produce materials with desired properties.
5. Aluminium is one of the lightest metals.
6. It was the problem, but not a major one.
7. London is one of the most exiting cities in the world.
8. Red phosphorus is less chemically active than yellow one.
9. This theory is more important for our experiment than that one.
10. It is a good book, but his last one was better.
11. Air is one fifth of oxygen by volume.
12. One could not be sure what lies ahead.
13. The students who do best in the examinations are not always the most talented ones.
14. It takes one much time to make the necessary experiments.
15. One doesn't like to have one's word doubted.
16. I am going to keep those files, the ones I want to get rid are sent to the waste bin.
17. Of these four suggestions, only one is correct.

8. Point out sentences where the word «that (those)» is a substitute of a noun.

1. That air is not a chemical compound is well known.
2. The density of hydrogen is one-fourteenth that of air.
3. In the 18-th century, it was proven that water is a compound.
4. It is owing to the carbon monoxide that a coal gas is so poisonous.
5. The reaction opposite to that of oxidation is reduction.

6. It is known that the moon has no atmosphere.
7. This method is more efficient than that used by your team.
8. Properties of water are quite different from those of oxygen and hydrogen.
9. When we heat water, it becomes steam.
10. It is necessary to perform that operation with great care.
11. Chemists, biochemists, materials scientists, biologists, and all those working in the pharmaceutical and chemical industries and related research institutions will find this book to be of a great value and importance.
12. Green chemistry is the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances.

SECTION 2

ELEMENTS, COMPOUNDS, MIXTURES

1. Tuning in.

1. Can you define elements?
2. T/F Atoms of different elements have different and unique characteristics.
3. T/F Atoms are the basic building blocks of matter.
4. T/F Compounds are composed of different kinds of atoms, two or more
5. T/F In a mixture, the constituents chemically combine to give a new substance.
6. T/F Mixtures can be separated into the constituent parts by various processes such as evaporation, distillation, and filtration.
7. What is the principal difference between compounds on the one side and mixtures on the other?

2. Pronounce the following words.

foundation [faun'deiʃn]

molecular [mə'lekjələ]

atomic [a'tɒmɪk]

pure ['pjʊə]

element[ˈeləmənt]
single [ˈsɪŋɡl]
differ [ˈdɪfə]
allotropy [ˈælətrəʊpi]
modification [ˈmɒdɪfɪˈkeɪʃn]
elementary[ˈeliˈment(ə)ri]
oxygen [ˈɒksɪdʒən]
carbon [ˈkɑːbən]
phosphorus [ˈfɒsfərəs]
to cause [ˈkɔːz]
diamond [ˈdaɪəmənd]
graphite [græfaɪt]
buckminsterfullerene [bʌkˈmɪnstəˈfʊlələn]
however[hauˈevə]
metal [ˈmetl]
behave [biˈheɪv]
exhibit [ɪgˈzɪbɪt]
occur [əˈkɜː]
contain [kənˈteɪn]
affinity [əˈfɪnəti]
bind [ˈbaɪnd]
compound [ˈkɒmpaʊnd]
definite [ˈdef(ə)nət]
proportion [prəˈpɔːʃn]
example [ɪgˈzɑːmpl]
hydrogen [ˈhaɪdrədʒən]
although [ɔːlˈðəʊ]
property [ˈprɒpəti]
entirely [ɪnˈtaɪəli]
virtually [ˈvɜːtʃuəli]

breathe ['bri:ð]
mixture ['mikstʃə]
variable ['veəriəb]
classify ['klæsi,fai]
homogeneous [,həʊməu' dʒi:niəs]
heterogeneous [hetərəu' dʒi:niəs]
solution [sə'lu:ʃn]
impurity [im'pjʊəreti]
optoelectronics [ɒp' tœlektro:nik]
promising ['prɒmisiŋ]
rapidly ['ræpidli}

Text 3

Elements, Compounds, Mixtures

One of the foundations of molecular-atomic theory is the concept of elements. Element is a substance that cannot be broken down into other substances by chemical methods. Each element is made up of atoms. Any pure sample of an element contains atoms of that element and no atoms of any other element.

An element in a free state forms a single substance. There are more than 120 elements, of which only 92 elements are found naturally on the earth and more than 400 single substances. This is because many chemical elements in a free state form several single substances which differ in their structure and properties.

This phenomenon is called allotropy, and the substances formed are called allotropic modifications or allotropes. For example, elementary oxygen has two allotropes O₂ and O₃, several allotropes are formed by carbon, phosphor, and sulphur. The allotropy can be caused by different number of atoms in the molecule of a single substance (O₂ or O₃) or by the formation of a different crystalline structure (diamond, graphite, buckminsterfullerene).

All elements are usually divided into metals and non-metals. However, this division is rather arbitrary. Under certain conditions, some metals can behave as non-metals, and some non-metals can exhibit metallic properties.

One should keep in mind that all matters in the world around us contain elements. The elements sometimes may occur in an isolated state, but more often they are combined with other elements. Most substances contain several elements combined together.

The atoms of certain elements have special affinities for each other. They can bind together in special ways to form compounds. Compound may be defined as a substance made up of a given combination of elements that can be broken down into elements through chemical changes. The chemical elements can combine with each other in a definite proportion. For example, water is a compound composed of hydrogen atoms and oxygen atoms, and there have to be always exactly twice as many hydrogen atoms as oxygen atoms because water consists of H_2O molecules. A compound, although it contains more than one type of atoms, always has the same composition — that is the same combination of atoms. The properties of a compound are very different from those of the elements it contains. For example, the properties of water are entirely different from the properties of pure oxygen and hydrogen.

Virtually all matter around us consists of mixtures of substances. The air, we breathe, is a complex mixture of such gases as oxygen, nitrogen, carbon dioxide, and water vapour.

On the contrast to a compound, a mixture has variable composition. For example, wood is a mixture, (its composition varies greatly depending on the tree from which it originates); wine is a mixture (it can be red or pale, sweet or dry). One must remember that water found in nature always contains other substances in addition to pure water, it is a mixture.

Mixtures can be classified as either homogeneous or heterogeneous. A homogeneous mixture is the same throughout. A homogeneous mixture is also called a solution. It is quite clear that different amounts of common salt (sodium chloride) and water can be mixed to form solution with various concentrations, but

homogeneous mixture does not vary in composition from one region to another. The air around us is a homogeneous mixture. Solids can also form solid solutions.

Brasses are a homogeneous mixture of copper and zinc. A heterogeneous mixture contains regions that have different properties from those of other regions.

Chemists have to distinguish mixtures from compounds. Besides that chemists have to determine and control the presence of impurities which can greatly influence the properties of materials. For many practical purposes (medicine, electronics, optoelectronics) the grade of substance purity should be very high. For example, the silicon which is to be used for production of computer chips must contain 99,999 999 per cent of silicon.

Chemist should be interested in high purification of substances along with chemical assembling on the atomic level of heterostructures with pre-set properties. Nanoscale chemistry is one of the most promising branches of chemistry, which is being rapidly developed and will have important applications in biochemistry, molecular biology, clinical diagnostics, drug development and materials science.

3. Look through the text and find sentences with modal verbs or their equivalents. Translate them into your mother tongue.

4. Read the text thoroughly and answer the following questions.

1. What is an element?
2. What phenomenon is called allotropy?
3. How can that phenomenon be explained?
4. What definition for chemical compounds can you suggest?
5. What is the principal difference between mixtures and compounds?
6. What kinds of mixtures can exist?
7. Why is the purity of substances one of the crucial problems in many cases?
8. What is one of the most promising branches of chemistry?

5. Find in the text English equivalents to the given Uzbek-Russian words or word combinations.

bir hilli aralashma	ГОМОГЕННАЯ СМЕСЬ
turli hilli aralashma	ГЕТЕРОГЕННАЯ СМЕСЬ
guruch	ЛАТУНЬ
xususiyatlar....	СВОЙСТВА, ОТЛИЧАЮЩИЕСЯ ОТ
maydon	ОБЛАСТЬ
misol uchun	НАПРИМЕР
birgalikda	ВМЕСТЕ В
suv bug'lari	ВОДЯНОЙ ПАР
o'zgarish	ИЗМЕНЯТЬСЯ
turli tarkib	РАЗЛИЧНЫЙ СОСТАВ
erkin shaklda	В СВОБОДНОМ ВИДЕ
ulanish	СОЕДИНЯТЬСЯ
aniqlash	ОПРЕДЕЛЯТЬ
asoslangan	ОСНОВАНО
parchalanish	РАЗЛАГАТЬ
allotropiya	АЛЛОТРОПИЯ
tozalash	ОЧИСТКА
kompyuter chiplari	КОМПЬЮТЕРНЫЕ ЧИПЫ
ko'pgina amaliy maqsadlar uchun	ДЛЯ МНОГИХ ПРАКТИЧЕСКИХ ЦЕЛЕЙ
aralashmalar	ПРИМЕСИ
ilova	ПРИМЕНЕНИЕ
nanokimyo	НАНОХИМИЯ
istiqbolli	ПЕРСПЕКТИВНЫЙ

6. Match the words or word combinations with opposite meaning in columns A and B.

A	B
Mixture	combined state
pure	amorphous
to vary	absence
free state	compound
presence	to remain the same
developed	atypical
typical	not every
promising	broken down into
pre-set	non prospective
heterogeneous	undeveloped
each	homogenous
made up of	impure
crystalline	uncontrolled

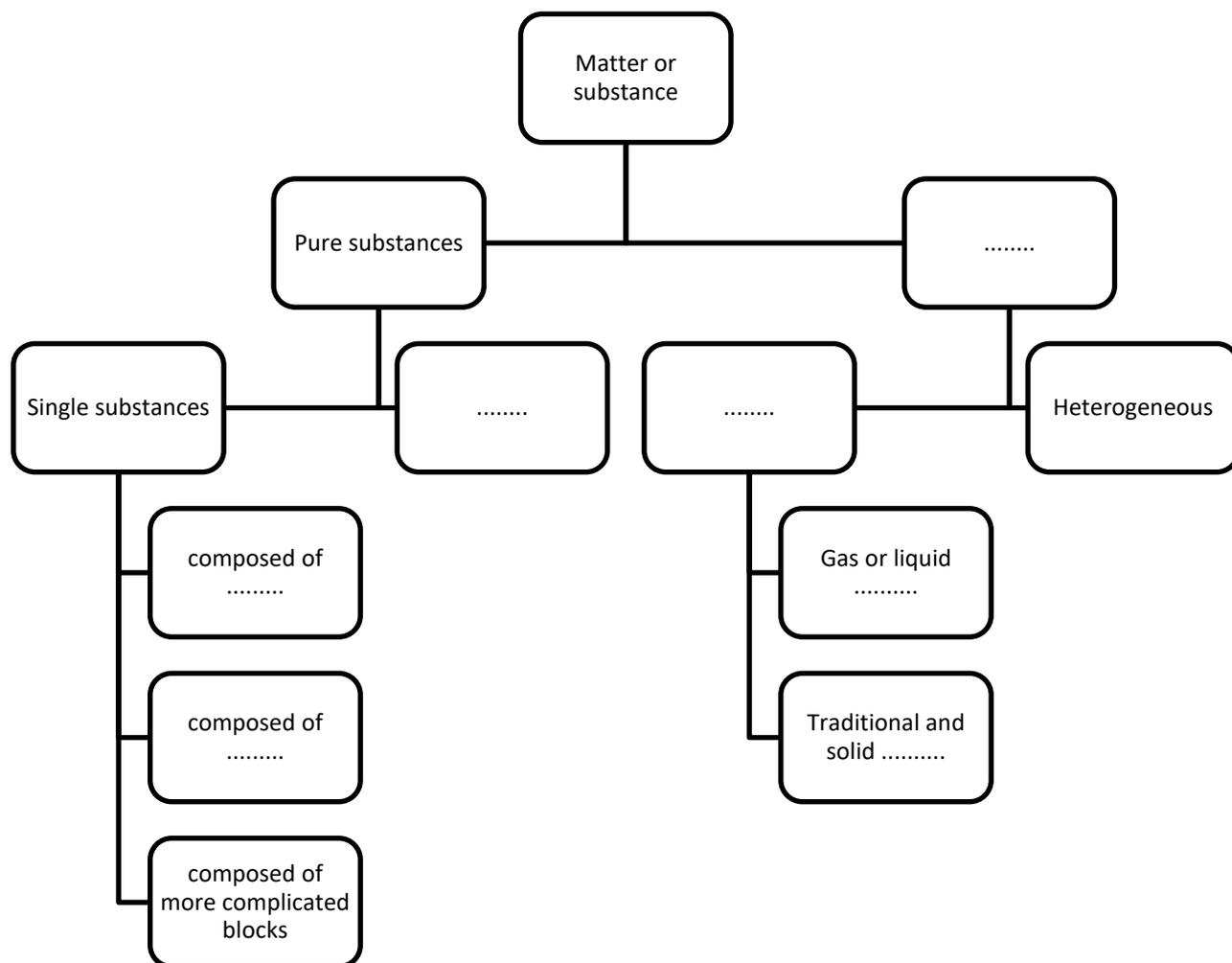
7. Complete the following sentences using modal verbs or their equivalents.

1. If chemist ... determine the crystal structure of a substance, he usually uses X-ray diffraction.
2. We ... discuss the data obtained.
3. Chemist ... employ analytical balances for measuring micro quantities of substances.
4. Chemist ... employ the thermocouple if he has to measure the temperature in the reactor.
5. Chemist ... use different glassware to carry out chemical analysis.
6. Graduated cylinders... be used to measure the volumes of liquids.
7. Gas-liquid chromatography ... be applied to separate and identify the components in mixtures of volatile liquids.

8. Look at these word families and define what parts of speech their members belong to.

Pure	purify	purification		
Impure	impurity	purity		
chemistry	chemical	chemist		
element	elementary	elemental		
atom	atomic	atomise	atomizer	
differ	different	difference	differentiate	differential
allotropy	allotrope	allotropic		
molecular	molecule	mole		
crystal	crystalline	crystallisation	crystallise	crystallised
structure	structural	structured		
compose	composition	composed		
mix	mixture	mixer	mixed	
contain	container	containment		

9. Sum up the categorisation of substances pictorially, complete the following diagram.



10. Work in pairs. Student A reads text A. Student B text B, then exchange the information to fill in the table given below and find out what facts are mentioned in the both of the texts.

	Text A	Text B
Definition of allotrope		
3 allotropes of carbon		
The date of discovering the fullerenes		
What scientists and when were awarded a Nobel prize for the discovery of the fullerenes		

The origin of the name (fullerenes)		
The most abundant fullerene		
Physical properties		
Chemical properties		
Structure		
Promising fields of application		

Text A

Solid carbon occurs in 3 forms. Different forms of a given element are called allotropes. The three allotropes of carbon are the familiar diamond and graphite forms plus a form that has only recently: been discovered called buckminsterfullerene. These elemental forms have very different properties due to their different structures. Diamond is the hardest natural substance known and is often used for industrial cutting tools. Diamonds are also valued as gem stones. Diamond is almost perfect insulator. Graphite, on the other hand, is rather soft material and a good conductor of heat and electricity.

Buckminsterfullerene (C_{60}) was named after Richard Buckminster Fuller, a noted architect who popularized the geodesic (huge) dome. Since buckminsterfullerenes have a similar shape to that sort of dome, the name was thought to be appropriate. As the discovery of the fullerene family came after buckminsterfullerene, the name was shorted to illustrate that the latter is the type of the former.

For the last decade, the chemical and physical properties of fullerenes have been a hot topic in the fields of research and development, and are likely to continue to be for a long time. Fullerenes have promising properties for medical use and for creation of heat resistant and superconductive materials, a special type of catalysts.

Text B

Fullerenes are a molecular form of pure carbon discovered in 1985. Harold Kroto, Robert Curl and Richard Smalley were awarded the 1996 Nobel Prize in

chemistry for their roles in the discovery of this class of compounds. The most abundant form produced is buckminsterfullerene (C_{60}), with 60 carbon atoms arranged in spherical structure. There are larger fullerenes containing from 70 to 500 carbon atoms. Fullerene cages are about 7-15 angstroms in diameter (1 Å = 10^{-10} m). In atomic terms, their sizes are enormous. But fullerenes are still small compared to many organic molecules. Chemically, they are quite stable, but not totally unreactive. Breaking the balls requires the temperatures of over 1000 °C (the exact number depends on which particular fullerene). At much lower temperature (a few hundred degrees C) fullerenes will sublime, which means vapor will form directly from solid.

Pure C_{60} is very interesting. Visually, it is quite different from both graphite and diamond — it is a yellow powder which turns pink when dissolved in certain solvents such as toluene. Fullerenes are the only known allotrope of carbon that can be dissolved in common solvents at room temperature. When exposed to strong ultraviolet light, the bulky balls polymerize forming bonds between adjacent balls. Electrically, it is an insulator. It shows electronegativity and forms compounds easily with alkali atoms.

11. Read text 3 again, divide it into logical parts, write out the main sentences from the each part. Rearrange sentences omitting unnecessary details to get a short summary of the text.

UNIT 4

SECTION 1

GRAMMAR: THE PASSIVE VOICE

Ingliz tilidagi fe'llarning majhul nisbatdagi formasi

Формы английского глагола в страдательном залоге:

BE + V3 (be + done)

	Simple	Progressive	Perfect
Present	Many substances <i>are oxidized</i> by oxygen	The substance <i>is being oxidized</i> by the oxygen evolving in the reaction	The substance <i>has been oxidized</i> already
Past	The substance <i>was oxidized</i> in the last experiment	The substance <i>was being oxidized</i> when we added some more reagent	The substance <i>had been oxidized</i> before the temperature was raised.
Future	The substance <i>will be oxidized</i> in a few minutes if exposed to the air	----	The substance <i>will have been oxidized</i> by the end of the experiment

Aniq va majhul nisbatlardagi gaplarning qiyosiy tahlili.

Сравнительный анализ предложений в страдательном и действительном залогах.

Ega -Подлежащее:

Kesim - Сказуемое:

To'ldiruvchi-Дополнение:

The rate of chemical reactions

is influenced

by many factors

Passive
Voice



influence

the rate of chemical
reactions

1. Transform the sentences in the active voice into the passive voice according to the model.

Model: We use this reaction for the laboratory preparation

of chlorine. — This reaction *is used* for the laboratory preparation of chlorine.

1. Our researchers carried out an experiment on comparing the redox behaviour of the substances obtained.
2. They repeated the experiment with several acids and alkalis.
3. We can show this information in the form of the following energy diagrams.
4. They work out an average value for the heat released per 1% of the fuel.
5. They have calculated the amount of heat absorbed by water.
6. They burnt some mass of the same fuel in each experiment.
7. We can use equations to calculate the volumes of gaseous reactants and the products.
8. We are investigating the properties of these substances in our laboratory.
9. The diagram represents, in schematic form, the products normally produced by the fuel combustion.
10. The iron displaces the copper of the compound.
11. A metal will displace another metal below it in the reactivity series (the reactivity series — metallarning kuchlanish qatori-ряд напряженности металлов).
12. We use this reaction for the laboratory preparation of chlorine.
13. We may change chemical energy into electrical in an electrical cell.
14. Teachers should encourage students to use the Internet as a resource.

2. Translate the following sentences into your mother tongue, paying attention to translating verbs in passive voice.

1. Petroleum and natural gas are hydrocarbons that are derived from previously living organisms.
2. Pt, Pd and Ni are used as catalysts in hydrogenation reactions.
3. The flow of directionally moving electrons is called an electric current.
4. A very simple battery may be constructed by simply placing a zinc strip in an aqueous solution of copper (II) sulphate.
5. In general, a solar battery is made up of «wafer» material: an electron donor wafer and an electron acceptor wafer.
6. Electrodes are dipped in a solution and electrical current is sent between them.
7. However, it is important to note this chemical equation is highly simplified.
8. Photosynthesis is a biochemical process by which the energy of light is converted in plants, algae, and certain bacteria into their food.
9. In plants carbon dioxide is taken in through the leaves, and water is taken in mainly through their roots.
10. A substance is reduced when it gains hydrogen atoms.
11. The book is well illustrated with graphical representations of the structure and forms of nanomaterials.
12. The purple MnO_4^- stain may be removed with oxalic acid.
13. In the process of photosynthesis glucose is produced by reaction of water and carbon dioxide, sunlight acts as the energy that is needed to run the reaction, in animals, this is exactly reversed in the process of respiration.
14. According to US scientists, a very significant increases in healthy lifespan can be provided by intervening in the ageing process.
15. Every reducing agent is linked, or coupled to conjugated oxidizing agent, and vice versa.
16. Oxidation states provide a compromise between powerful model of oxidation-reduction reactions which is based on the assumption that these compounds contain ions and our knowledge that the true charge on the ions in these compounds is not as large as this model predicts.

3. Translate into your mother tongue. What do the sentences of each group (from A to F) have in common? Analyze the peculiarities of translating English sentences in the passive voice into your mother tongue.

A

1. Many substances are oxidized in the open air.
2. This experiment will be made in the laboratory of organic chemistry.
3. A new compound was obtained in this experiment.
4. Pure water is never met in nature.
5. The article was published in the journal last year.
6. The research work of our department is widely published and recognized throughout the world.
7. The acidity of solutions is often expressed in terms of pH.

B

1. This book was written by a famous scientist.
2. The report will be made by one of the outstanding specialists in this field.
3. The lectures on nanochemistry are delivered by Professor M., a PhD.
4. The invention was made by research workers of our department.
5. Paper was invented by the Chinese in the first century AD.

C

1. They will be asked at the next lesson.
2. His article was severely criticised.
3. Our research team was given a rather complicated task.
4. She has been offered promotion to the principal researcher of the project.
5. The students are taught foreign languages.
6. They were told about the latest achievements in computer technology.
7. The students are being explained the principle on which a new experimental installation operates.

8. The problem of water pollution was attacked next.

D

1. The environmental issues are much written about on the Internet.
2. This article is often referred to.
3. Mendeleev's Periodic Table is spoken of as the greatest discovery in chemistry.
4. His report is much spoken about.
5. The new device was looked at with a great interest.

E

to answer — javob bermoq

to succeed } ergashmoq

to follow }

to attend — qatnashmoq

to affect } ta'sir qilmoq

to influence. }

to watch — kuzatmoq

to join — qo'shilmoq

1. The question will be answered later.
2. Hydrogen is followed by helium.
3. The conference was attended by many foreign scientists.
4. Molecules of metal are joined by oxygen atoms.
5. The rate of a chemical reaction is affected by many factors.
6. The solubility of chemical substances is influenced by temperature.
7. The discovery of the Periodic system was succeeded by the great achievements in the atomic structure.

F

to pay attention to — e'tibor qaratmoq - уделять внимание

to take account of — hisobga olmoq - учитывать

to make mention of — eslatib o'tmoq - упоминать

to take care of — qayg'urmoq - заботиться, принимать меры

to make reference to — ... ga havola qilmoq - ссылаться на

to take advantage of — foydalanmoq - учитывать, использовать

to take notice of — payqamoq - замечать

1. Account is taken of corrosion protection of the metallic constructions.
2. Special attention is paid to the purification of water.
3. Advantage is often taken of the effect of temperature on the rate of chemical reactions.
4. Care is to be taken to remove all the impurities.
5. The critical remarks have been taken notice of.
6. Specific references are made to the Internet resources.
7. Mention has been made of the utilization of industrial wastes.

G

1. At the refinery, the crude oil is processed into a variety of products including petrol, aviation fuel and plastics.
2. The equipment has been replaced since it became obsolete.
3. Special attention is being paid to the improvement of students' computer literacy.
4. Icon was referred to only to religious pictures, today it is used to name various small pictures we see on computer screen.
5. Life saving drug Penicillin was discovered by Alexander Fleming, a Scottish biologist and pharmacologist.
6. Connection of hardware (computer, monitor keyboard etc.) was followed by installation of the system software.
7. These data can be relied on.

4. Translate the following sentences into your mother tongue using a dictionary.

1. Atomic solids are held together by covalent bonding forces or London dispersion forces, depending on the nature of atoms.
2. A model is considered successful if it explains the known behaviour and predicts correctly the results of future experiments, but a model can never be proved absolutely true.

3. The shape of copper can easily be changed: it is both malleable (will form thin sheets) and ductile (can be pulled into a wire).
4. A compound is a distinct substance that is composed of atoms of two or more elements and always contains exactly the same relative masses of those elements.
5. The types of atoms and the number of each type of the atoms in a molecule of a given compound are conveniently expressed by a chemical formula.
6. Presently 112 different elements are known, 88 of which occur naturally, the rest have been made in laboratories.
7. Elements cannot be broken down into other substances by chemical means.
8. Emphasis is placed on the explanation of physical concepts, rather than on mathematical rigor.
9. An introduction to the present applications of ceramic powders is followed by a detailed account of the different chemical and physical techniques of powder preparation.
10. Computer simulations must be based on realistic and efficient models.
11. The strength or fatigue resistance of materials are related to the parameters of surface treatment.
12. In a solid the particles are held in fixed position.
13. The activation energy is the minimum amount of kinetic energy that must be given to the reactants before they will react.
14. The rate of a reaction can be defined either as the increase in concentration of one of the products per unit time, or as the decrease in concentration of one of the reactants per unit time.
15. When a single covalent bond is formed between two atoms of the same element, the electron pair will be shared equally between the two atoms, and the bond will be non-polar.
16. The redox reactions are covered fully in the next chapter.

SECTION 2

THE STRUCTURE OF ATOMS

1. Tuning in.

1. What do you know about the structure of the atom?

What main structural units do atoms contain?

2. Fill in the gaps in the table below.

Relative electrical charge	Electrons	Protons	Neutrons
	zero charge
Relative mass	very small relative mass		

3. What are the main concepts in the theory of the atomic structure?

4. Who laid the foundation of the modern science of the atom? Name the famous scientists who made a great contribution to development of the structure of atoms.

5. What can you say about the evolution of the atomic theory?

6. Have you ever heard of dualism of the electron? What is the modern concept of the electron?

2. Practice your pronunciation.

matter ['mætə]

compose [kəm'pəʊz]

tiny ['taini]

particle ['pɑ:tɪkl]

atom ['ætəm]

electron [i'lektɹən]

proton ['prəʊtən]

neutron [ˈnju:trɒn]
entirely [inˈtaɪəli]
indivisible [ɪndɪˈvɪzəbl]
convincing [kənˈvɪnsɪŋ]
evidence [ˈeɪvɪd(ə)ns]
physicist [ˈfɪzɪsɪst]
negative [ˈnegətɪv]
alfa [ˈælfə]
type [ˈtaɪp]
charge [tʃɑ:dʒ]
approximately [əˈprɒksɪmətli]
foil [ˈfɔɪl]
straight [ˈstreɪt]
angle [ˈæŋɡl]
reflect [rɪˈflekt]
backward [ˈbækwəd]
hydrogen [ˈhaɪdrədʒən]
positive [ˈpɒzətɪv]
magnitude [ˈmæɡnɪtju:d]
relatively [ˈrelətɪvli]
reason [ˈri:zn]
quantized [ˈkwɒntaɪzd], [ˈkwɑ:ntaɪzd]
level [ˈlevl]
emission [ɪˈmɪʃn]
fit [fɪt]
however [haʊˈevə]
apply [əˈplaɪ]
discard [dɪsˈkɑ:d]
although [ɔ:lˈðəʊ]
assume [əˈsjʊ:m]

wave[‘weiv]
mechanical [mi’ kænɪkl]
orbital [’ɔ:bitl]
precisely [pri’saisli]
path [’pɑ:θ]
allow [ə’lau]
arrangement [ə’reɪndʒmənt]
regularity [‘regjʊləreɪti]

3. Read the text.

Text 4

The Structure of Atoms

Matter is composed of tiny particles called atoms. The atom is a complex unit of various particles, the most important of which are electrons, protons and neutrons. The mass of the atom is concentrated almost entirely in the nucleus. The name «atom» comes from the Greek word meaning «indivisible». It was not until almost 1900 that convincing evidence became available proving that the atom is composed of the different particles. The English physicist named J. J. Thomson showed in the late 1890s that atoms of any element can be forced to emit tiny negative particles. He concluded that all types of atoms are made up of the negative particles, which now are called electrons. The negative charge of electrons must be balanced exactly by positive particles to provide the atom zero overall charge. In 1911 Ernest Rutherford carried out an experiment with alfa particles. Alfa particles are positively charged particles with a mass approximately 7500 times greater than that of an electron. In the experiment alfa particles were directed toward a thin foil. Although most of alfa particles passed straight through the foil, some were deflected at large angles, some were reflected backward. These results were explained by Rutherford in terms of the model of a nuclear atom, an atom with a dense centre of positive charge (the nucleus) around which tiny electrons moved in space that was otherwise empty. These positively charged particles were called protons.

A proton has the same charge as the electron, but its charge is positive. According to the model of hydrogen atom developed by Rutherford, hydrogen atom has a single proton at its center and one electron moving through the space of the atom at large distance from the nucleus. He reasoned that other atoms must be composed of many protons bound together somehow.

A great contribution to the development of the atom structure was made by Niels Bohr. He pictured the atom as a small positive nucleus with electrons around it. In the Bohr's atom model the hydrogen atom has quantized energy levels. The energy levels in the hydrogen atom were represented as certain allowed circular orbits. The model agreed with the hydrogen emission results and fit the hydrogen atom very well.

However, when this model was applied to atoms, other than hydrogen, it did not work. So, the Bohr model was discarded because it could be applied only to hydrogen. The further contribution to the development of the theory of atomic structure was made by French physicist Louis Victor de Broglie and physicist from Austria Werner Schrodinger. Although everyone had assumed the electron was a tiny particle, these scientists proved that it could be described as a wave. A new model of the hydrogen atom based on the idea of the wave nature of the electron was worked out by Schrodinger. In contrast to Bohr's model it applied equally well to other atoms. The model is called the wave mechanical model of the atom. In the wave mechanical model the electron states are described by orbitals. Orbitals are nothing like orbits.

We could not precisely describe the electron's path, but only predict the probabilities of finding the electron at given points in space around the nucleus. The wave mechanical model can be applied to all atoms in basically the same form. The wave mechanical model of the atom allows us to explain on the basis of electron arrangements regularity in the properties of elements.

4. Answer the following questions.

1. What is matter composed of?

2. Where is the mass of an atom concentrated?
3. What is the origin of the name «atom»?
4. Who obtained the convincing evidence that the atom is composed of different particles?
5. Which particle (proton, electron, neutron) was discovered first?
6. When and how protons were found?
7. Why did scientists propose existence of positive particles in the atom when the existence of the electron had been proved?
8. What model of the hydrogen atom was developed by Rutherford?
9. How was the atom pictured in the Bohr's model?
10. What contribution to the development of atomic structure was made by de Broglie and Schrodinger?
11. By whom was the wave mechanical model of the atom developed?
12. Why are orbitals nothing like orbits?
13. Is it possible to explain the regularity in the properties of elements? What makes you think so?

6. Say if the following sentences are true or false.

1. Atoms are defined as the imaginary units of matter.
2. The name «atom» comes from the Greek word meaning «indivisible».
3. Until the end of the 20th century atom was considered to be a «simple, solid, hard particle».
4. Electrons are the inner portion of the atom.
5. The neutron mass is approximately equal to that of the electron.
6. The positively charged atom of hydrogen is an alfa particle.
7. To the modern chemist, the atom is the smallest particle of an element.

8. Atoms of every elements differ from atoms of the other elements.
9. The application of the quantum theory changed our understanding of the electronic structure of the atoms.

7. *Make a plan of the text and retell the text using your plan.*

8. *Read the text below and render it.*

Due to the their minute size we shall never be able to see atoms in the traditional sense of the word «see», because they are smaller than the wave length of visible light. However, strong direct evidence to support the existence of atoms has been obtained since the invention of the scanning tunnel microscope in 1981.

The microscope uses a very fine probe* containing a tungsten tip to scan a solid surface. A small potential difference is applied between the probe and the surface, and, the minute changes in current are recorded when surface is uneven. A computer generated a contour map of the surface and the outlines of individual atoms can be seen.

Probe — burg'u - зонд (датчик, щуп).

UNIT 5

SECTION 1

GRAMMAR: FORMS OF THE PARTICIPLES AND THEIR FUNCTIONS

Forms of the participles

	Active	Passive
Indefinite Participle I	discussing	being discussed
Perfect Participle I	having discussed	having been discussed
Participle II	--	discussed

Functions of the participles

Participle I ning vazifalari (active) va uning tarjimasi:

→ aniqlovchi
muhokama qilinayotgan

~~→ aniqlovchi~~

discussing

↓
→ hol

nima qilayotib? muhokama qilayotib

having discussed

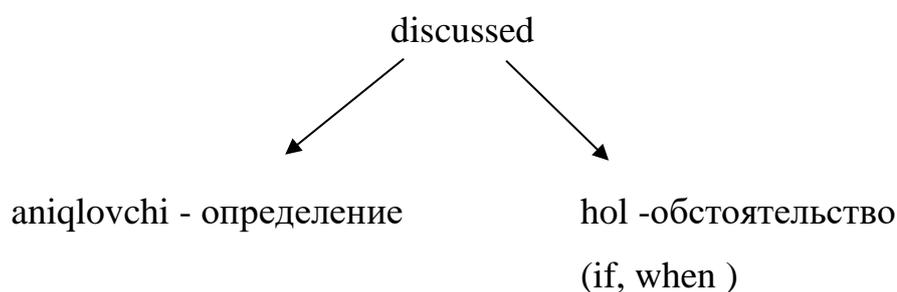
↓
→ hol

nima qilib? muhokama qilib

Perfect Participle Active aniqlovchi vazifasida ishlatilmaydi (не используется в функции определения).

Having been discussed for a long time, the <i>problem</i> was solved at last	Uzoq vaqt davomida muhokama qilinib, muammo nihoyat hal qilindi. После того как <i>вопрос</i> обсуждался в течение длительного времени, он наконец был решен.
Having been discussed in detail, the <i>plan</i> contained all the information necessary for its realization	Batafsil muhokama qilinib, rejada uni amalga oshirish uchun zarur bo'lgan barcha ma'lumotlar mavjud edi Так как <i>план</i> был подробно обсужден, он содержал всю информацию, необходимую для его выполнения.

Participle II gapda aniqlovchi va hol vazifasini bajarishi mumkin- может выполнять в предложении функции определения и обстоятельства:



muhokata qilinadigan- обсуждаемый

muhokata qilingan-обсужденный

muhokata qilinayotgan-обсуждающийся

muhokata qilganlar- обсуждавшийся

muhokata paytida

O‘tgan zamon ravishdoshi aniqlanmishdan keyin kelishi mumkin:

Причастие прошедшего времени может стоять после определяемого слова:

The question discussed = the discussed question.

1. Open the brackets using the correct form of the participles.

1. Water vapour (mix) with a gas is removed by bubbling the gas through the (concentrate) acid.
2. When (mix) with water (concentrated) sulphuric acid releases large amount of heat.
3. Oxidation and reduction were originally applied to reactions (involve) oxygen and oxides.
4. Redox reactions can involve atoms and ions (change) their charges.
5. The proportions of moles of reactants and products (involve) in a reaction are shown by the equation for the reaction.
6. The volumes (need) for complete reaction when solutions of reactants are mixed can be calculated (use) information (give) in equations.
7. Reactive metals are more stable in (oxidize) states.

2. Translate the sentences into your mother tongue. Point out the participles used; define their forms and their functions in the sentences.

- 1, Nearly all compounds derived from living organisms contain hydrogen in fats, carbohydrates and proteins.
2. In reality photosynthesis employs a very complex mechanism for adsorption and conversion of light into chemical energy, using chemical pathways with many important intermediates.
3. It is interesting to note that oxygen released during photosynthesis is not, in fact derived from the carbon dioxide, but rather from the water molecules which are consumed in the reaction.

4. Summarized in the table below, are examples of oxidizing agents and their uses.
5. The oxidation numbers of covalently bound elements are not real charges like the charges on ions, hence they may not be experimentally measured.
6. If heated the copper surface slowly turns black as the copper metal reduces oxygen in the atmosphere to form copper (II) oxide.
7. Free radicals causing heart disease, cancer and other diseases play important part in the ageing process.
8. Antioxidants damaging hydrogen peroxide remove a source of free radicals and could be a key to a long life.
9. The following three examples further illustrate the idea of oxidizing and reducing.

3. Point out the Participle II as an Attribute. Translate the sentences into your mother tongue.

1. The huge amounts of waste HCl gas that were produced caused appalling pollution of the atmosphere close to chemical works.
2. Products manufactured included refined petroleum oil and associated products, synthetic fibers and chemical intermediates (i. e. chemicals used to make other chemicals, e.g. drugs, adhesives).
3. The water used fitted all necessary requirements on the oxygen content.
4. The substance obtained acted as an oxidation agent in the reaction with hydrogen peroxide.
5. The opinions expressed differed widely on which of the methods was more reliable.
6. Initial tests showed that the liquid separated remained uncontaminated.
7. The treatment described increased corrosion resistance.
8. The gas evolved oxidized with release of heat.
9. The process developed combined low fuel consumption with simplicity.
10. The catalyst applied accelerated the rate of the reaction.
11. Surface treatment has led to the improved strength of materials without loss in workability, and to markedly enhanced fatigue properties.

12. Nanocrystal line materials exhibit remarkable structural, electrical, magnetic, and optical properties that can be exploited in a wide variety of structural and nonstructural applications ranging from flat panels to medical implants.

13. The research carried out by our laboratory on the novel materials is of a great practical significance.

4. Translate into your mother tongue. Analyze translation as an Attribute, Participle I and Participle II derived from certain verbs, point out any regularities you can find.

1. The thermal treatment of the synthesized compound followed by cooling to room temperature should be performed in the atmosphere of the inert gas.

2. Formation of the zinc layers on the steel surface thoroughly followed provides essential data on the porosity of the protective coating.

3. Purification of metal surface followed by formation of anticorrosive coating is carried out in stages.

4. The difference in temperature carefully followed in the experiment allows us to come to a definite conclusion.

5. The procedure followed in the given research is just the same as in the previous one.

6. The following requirement should be taken into the consideration in order to obtain practically reliable results.

7. Results referred to in the report concerning chemical resistance of the materials involved are of the great practical significance.

8. The kindling temperature of substances affected by a number of factors can vary in a wide range.

9. The particle size of the oxidizer affecting the burning rate of the propellant should be evaluated.

10. Factors greatly influencing our decision were represented in the feasibility study (feasibility study —техник-ekonomik asos- технико-экономическое обоснование).

12. The rate of chemical reaction influenced by temperature, was determined in a series of kinetic experiments.

11. The higher is the reactivity of solids influenced by many factors, the higher is the extent of their division, other things being equal.

5. Suggest the English equivalents for the following words combination.

1) qaynayotgan suv – qaynagan suv

кипящая вода - кипяченая вода;

sovutilayotgan suv – sovutilgan suv

охлаждающая жидкость- охлажденная жидкость;

test natijalarini tahlil qilayotgan talabalar – muhokama qilingan testlar

студенты, обсуждающие результаты теста - осужденные тесты;

ajralib chiqayotgan gaz- ajralib chiqqan gaz

выделяющийся газ - выделенный газ;

2) reaksiyaga kirishayotgan xom-ashyoning tarkibini aniqlab bo‘lib-ashyoning zichligini aniqlayotib;

определив состав продуктов реакции- определяя плотность вещества;

eritmani qizdirib bo‘lib – qizdirilayotgan eritma;

нагрев раствора - нагревная раствор;

suyuqlikni sovutib bo‘lib – suyuqlikni sovutayotib

охладив жидкость- охлаждающая жидкость;

kerakli mahsulotni olib bo‘lib – kerakli mahsulotni olayotib

получив требуемый продукт- получая требуемый продукт;

kimyoviy qonunlarni o‘rganayotib – kimyoviy qonunlarni o‘rganib bo‘lib

изучая законы химии- изучив основные законы химии;

6. Open the brackets and choose the correct form of the Perfect Participle (active or passive). Then translate the sentences into your mother tongue.

1. (Having calculated, having been calculated) the coefficients, they could write the equation of the chemical reaction.
2. (Having dissolved, having been dissolved), the substance was filtered, evaporated and dried.
3. (Having found, having been found) the necessary solvent, they purified the compound by recrystallization.
4. (Having synthesized, having been synthesized), the compound was cooled, weighed and analyzed.
5. (Having purified, having been purified) silica was used as an absorbent.
6. (Having removed, having been removed) impurities, they determined the composition and structure of the synthesized compound.
7. (Having used, having been used) volatile compounds, they modified chemical surface of the solids.
8. (Having applied, having been applied) the law of mass action we obtained the following equation.
9. (Having accepted, having been accepted) electrons, the ions reduced to the metallic form.

SECTION 2

THE PERIODIC LAW AND PERIODIC TABLE OF CHEMICAL ELEMENTS

1. Tuning in.

1. When and by whom was the Periodic Law discovered?
2. What does the Periodic Law state?
3. In what way were all the known elements arranged into the Periodic Table by D. Mendeleev?
4. What are called the horizontal rows in the Periodical Table?
5. What are called vertical columns in the Periodical Table?
6. Why is the Periodic Table widely used by chemists?

7. What are families of elements?
8. What can you say about relation between the Periodic Table and the structure of atoms?
9. Why has Periodic Table kept its value?
10. What can you say about the role of the Periodic Law in the development of science?
11. How many chemical elements are known today?
12. Are all periods of the Periodic Table completed?

2. Pronounce the following words:

through [ˈθru:]

atomic [əˈtɒmɪk]

weight [ˈweɪt]

description [dɪˈskrɪpʃn]

propose [prəˈpəʊz]

successful (sekˈsesf]

regularity [regjuˈlærəti]

octave [ˈɒktɪv]

function [fʌŋkt]

convinced [kənˈvɪnst]

contradict [kɒntrəˈdɪkt]

arrange [əˈreɪndʒ]

predict [prɪˈdɪkt]

reason [ri:zn]

reveal [riˈvi:l]

sense [sens]

existence [ɪgˈzɪst(ə)ns]

principal [ˈprɪnsəpl]

recur [riˈkɜ:]

outer [ˈaʊtə]

Text 5

The Periodical Law and the Periodical Table

Having carried out a thorough investigation of the relation between the atomic weights of elements and their chemical and physical properties, D. I. Mendeleev discovered the Periodic Law and developed the Periodic Table based on it in 1869.

The table of elements is a graphical description of the Periodic Law. The table of elements proposed by Mendeleev was not the first, but it was the most successful. Among earlier attempts to present regularities in the properties of elements mention could be made of the Law of octaves suggested by Englishman John Newlands. He noticed some kind of analogy between musical octaves (every next octave contains the same notes but with higher tone) and periodicity in the chemical properties of the elements.

It took the genius of D. I. Mendeleev to devise the first form of the Periodic Table that we would still recognize today. Mendeleev was ready to take a risk and assumed both that some of information such as atomic weight, might not be correct for all elements, and also that some elements still remained to be discovered. In the periodical law Mendeleev stated that the properties of elements are the periodical function of their atomic mass. Mendeleev was convinced that it is the mass of element that all other properties depend on. He arranged all the known elements from the lightest to the heaviest in a table composed of the eight columns. The elements with similar properties were put in the same columns, forming a «family» of elements. The Periodic Table as it was presented by Mendeleev was very much alike the present Periodic Table, but for inert gases. Having been discovered later, they were added to the periodic table as «zero» group. Mendeleev predicted existence of unknown and undiscovered at that time elements and left vacant places for them in the table. Reasoning from their supposed position in the Periodic Table he also predicted their properties and properties of their compounds.

On the basis of the Periodic system Mendeleev also corrected atomic weights of some elements.

All his predictions were successfully confirmed later. With the discovery of the Periodic Law chemistry was no more a descriptive science. The Periodic Law played a great role in the development of the atomic structure. The modern formulation of the Periodic Law states that the properties of elements are the periodic function of the nuclear charge of their atoms. New formulation of the Law does not contradict to the formulation given by Mendeleev.

The theory of atom structure accounts for the periodic change of the elements properties. Increase in positive charge of atomic nucleus periodically leads to recurrence of the similar structure of the outer level of atoms since the properties of elements depend basically on the outer level electrons, their change also represents the periodic function. The number of period corresponds to the number of energy levels.

The structure of atoms explains the existence of subgroups. In subgroups of each group the elements with similar structure of outer electron level are represented. The main subgroups include the elements, containing the number of electrons on the outer level which is equal to the number of group. The group label gives the total number of valence electrons for that group.

The wave mechanical model pictures the electrons in an atom as arranged in orbital with each orbital containing no more than two electrons. The same types of orbital recur as we move from one principal level to another. This means that atoms have particular valence — electron configurations recurring periodically. Thus groups of elements such as alkali metals showing similar chemical properties have the same type of valence — electron arrangement.

The Periodic Law which systematized the properties of chemical elements and their compounds made a great contribution to the development of the atomic structure.

3. Read the text thoroughly and answer the following questions.

1. What were underlying principles applied by Mendeleev in developing the Periodic Law?
2. Were there any attempts by other scientists to systemize the elements before Mendeleev developed the Periodic Law?
3. Was the Periodic Table presented by Mendeleev exactly the same as we know it today?
4. What new group was added to the system after discovery of inert gases?
5. What predictions were made by Mendeleev?
6. Why can we consider the experimental confirmation of Mendeleev's predictions as a triumph of the Periodic Law?
7. What is the modern formulation of the Periodic Law?
8. Why doesn't the modern formulation of the Periodic Law contradict to the formulation proposed by Mendeleev? What is the physical meaning of the Periodic Law according to the modern theory of atomic structure?
9. What information about the structure of an atom could be obtained from the Periodic table?
10. What factors according to the modern theory of atom structure are responsible for chemical properties?
11. How does the theory of atomic structure explain the Periodicity in the properties of elements?
12. Why is the Periodic Law considered as the greatest discovery in chemistry?

4. Match Uzbek-Russian words and word combinations, chemical terms in column A with their English equivalents in column B.

A		B
заряд ядра	yadro zaryadi	graphical
описательная наука	tavsiflovchi fan	description
формулировка	shakllantirish	atomic weight
противоречие	qarama-qarshilik	analogy

попытка	urinish	the Periodic Law
аналогия	analogiya	inert gases
атомный вес	atom massasi	later
повторение	takrorlash	outer shell level
раскрыть	ochish	electrons
периодический закон	davriy qonun	a nuclear charge
валентный электрон	valent elektron	atomic structure
инертные газы	inert gazlar	formulation
электроны внешнего	tashqi darajadagi elektronlar	existence
уровня		attempt
графическое	grafik tasvir	scientific validity
представление		reveal
позже	keyinroq	physical sense
расположение	joylashuv	descriptive science
атомная структура	atom tuzilishi	contradict
научная обоснованность	ilmiy asoslilik	subgroup
физический смысл	fizik mohiyat	reoccurrence
существование	mavjudlik	outer level
подгруппа	kichik guruh	electrons
		arrangement

5. Look through the text and find the participles, write them down, define their forms and their functions in the sentences.

6. Read the text again if necessary and state which of the following statements are true (T), false (F) or not mentioned (NM) in the text.

1. Although atoms exhibit a great variety of characteristics, certain elements can be grouped together because they have similarity in their properties.
2. Among those who attacked the Mendeleev's Periodic System was the German chemist Bunsen.
3. The existence of 3 elements predicted by Mendeleev was verified 15 years later.

4. Properties of the elements are a periodic function of the nuclear charge of their atoms.
5. The number of the period corresponds to the number of energy level.
6. The Periodic Law which systematized the properties of the elements and their compounds made a great contribution to the development of the atomic structure.
7. It is the number of protons and its arrangement that accounts for chemistry of an atom.

7. Match the words with similar meaning in column A and column B.

A	B
to propose	resemble
similar	to suggest
sense	because
property	to happen again
to be alike	to discover
since	therefore
to predict	same
to recur	to be grounded on
to reveal	meaning
thus	a way of organizing things
arrangement	to believe
to be convinced	characteristic
value	to contain
to be based on	importance
include	to forecast

8. Open the brackets and put the verb in the correct form (passive or active).

The last major changes to the periodic table (do) in the middle of 20century. Glenn Seaborg (give) the credit for it. Starting with his discovery of plutonium in

1940, he (discover) all trace uranic elements from 94 to 102. He (reconfigure) the Periodic table by placing the actinide series below lanthanide series.

In 1951, Seaborg (award) the Noble prize in chemistry for his work. Element 106 (name) seaborgium (Sg) in his honor. Of the periodic table, he has said that «the Periodic Table arguably the most important concept in chemistry, both in principle and in practice. It is the everyday support for students, it (suggest) new avenues of research to professionals, (provide) a succinct organization of the whole chemistry. It is a remarkable demonstration of the fact that the chemical elements (be, negative) a random cluster of entities but instead (display) trends and (lie) together in families. An awareness of the Periodic Table (be) essential to anyone who(wish) to disentangle the world and see how it (build) from fundamental building blocks of the chemistry, the chemical elements».

9. Look through the table regarding to Ag and answer the following questions.

Periodic table of the Elements (<http://chemistry.about.com/liorary/blad.htm/>)

Atomic Number	47
Symbol	Ag
Atomic weight	107,868
Discovery	Known since prehistoric time. Man learned to separate silver from lead as early as 3000 BC
Electron configuration	[kr]5s ¹ 4d ¹⁰
Word origin	Anglo-Saxon seafloor or sulfur, meaning «silver», and Latin argentum
Properties	The melting point of silver is 961,93 °C, boiling point is 2212 °C, specific gravity is 10,50 (20 °C), with a valence of 1 or 2. Pure silver has a brilliant white metallic luster. Silver is slightly harder than gold. It is very ductile and malleable, exceeded in these properties by gold and

	<p>palladium. Pure silver has the highest electrical and thermal conductivity of all metals.</p> <p>Silver is stable in pure air and water, although it tarnishes upon exposure to ozone, hydrogen sulfide, or air containing sulfur</p>
<p>Uses</p>	<p>The melting point of silver have many commercial uses. Sterling silver (92,5 % silver, with copper or other metals) is used for silverware and jewelry. Silver is used in photography, dental compounds, solder, brazing, electrical contacts, batteries, mirrors, and printed circuits. Freshly deposited silver is the best known reflector of visible light, but it rapidly tarnishes and loses its reflectance. Silver fulminate (Ag,C, N,O,) is a powerful explosive. Silver iodide is used in cloud seeding to produce rain. Silver chloride can be made transparent and is also used as a cement for glass. Silver nitrate or lunar caustic, is used extensively in photography. Although silver itself is not considered toxic, most of its salts are poisonous, due to the anions involved. Exposure to silver (metal and soluble compounds) should not exceed 0,01 mg/M³ (8 hours time-weighted average for a 40 hour week). Silver compounds</p> <p>can be absorbed into the circulatory system, with deposition of reduced silver in body tissues. This may result in argyria, which is characterized by a grayish pigmentation of the skin and mucous membranes. Silver is germicidal and may be used to kill many lower organisms without harm to higher organisms. Silver is used as coinage in many countries.</p>

Sources	<p>Silver occurs native and in ores including argentite (Ag₂S) and horn silver* (AgCl). Lead, lead-zinc, copper, copper-nickel and gold ores are other principal sources of silver. Commercial fine silver is at least 99,9 % pure. Commercial purities of 99,999+% are available</p> <p>Horn silver — минерал кераргирит</p>
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1. What is the Latin name of silver?
2. Since what time has silver been known to man?
3. What are melting and boiling points of Ag?
4. What can you say about its chemical properties?
5. What is the valence of Ag in its compounds?
6. What is the specific gravity of silver at the room temperature?
7. Is gold harder than silver?
8. What can you say about electrical and thermal conductivity of silver as compared to other metals?
9. What are the main fields of silver applications?
10. In what forms does silver occur in nature?

10. Choose any other element and fill in the same table as for Ag in the previous assignment. Prepare a short report based on the table. Be ready to answer questions related to the chosen element from your fellow-students.

11. Write the summary of text 5.

12. Translate the given sentences into English using the Participles.

1. Mendeleev o‘z davrida noma’lum bo‘lgan bir qancha elementlarning xossalarini bashorat qilgan va tavsiflagan.

1. Менделеев предсказал и описал свойства нескольких неизвестных в его время элементов.

2. Radiy va boshqa radioaktiv moddalarni o'rganish orqali olimlar inert gazlarni kashf etdilar.

2. Изучая радий и другие радиоактивные вещества, учёные открыли инертные газы.

3. Rossiya sharafiga atalgan ruteniy elementi (uning lotincha nomi Ruthenia) 1844-yilda kashf etilgan.

3. Элемент рутений, названный в честь России (латинское название которой Ruthenia), был открыт в 1844 году.

4. Mendeleev davriy qonun bo'yicha o'z ishini Rossiya kimyo jamiyatiga namoyish qilib, uni rus va nemis tillarida nashr ettirdi.

4. Представив работу по периодическому закону Русскому химическому обществу, Менделеев опубликовал её на русском и немецком языках.

5. Galliy Quyoshda topilgach, Yerda ham topildi.

5. После того как галлий был открыт на Солнце, он был обнаружен на Земле.

6. Atomning tuzilishi kashf etilgandan so'ng davriy qonunning fizik mohiyatini ochib berdi.

6. Когда структура атома была открыта, она раскрыла физический смысл периодического закона.

7. Xususiyatlari o'xshash elementlar bir guruhga kiradi.

7. Элементы, обладающие близкими свойствами, находятся в одной группе.

8. Mendeleev bir qancha ochilmagan elementlarning mavjudligini bashorat qilib, ularning taxminiy xossalarini tasvirlab bera oldi.

8. Предсказав существование нескольких неоткрытых элементов, Менделеев смог описать их предполагаемые свойства.

9. Inert gazlar kashf etilganda davriy sistemaning “nol” guruhini tashkil qilgan.

9. Когда инертные газы были открыты, они образовали <<нулевую >> группу Периодической системы.

10. Davriy sistemadan foydalanib, kimyogarlar turli guruhlarda mavjud elementlarning xossalari haqida muhim xulosalar chiqarishlari mumkin.

10. Используя Периодическую систему, химики могут делать важные заключения о свойствах элементов, представленных в разных группах.

UNIT 6

SECTION 1

GRAMMAR: THE ABSOLUTE PARTICLE CONSTRUCTION

1. Look at the following sentences, translate them into your mother tongue and try to formulate the rules of translating the English sentences into Uzbek-Russian

A. The Dependable Participle Construction

When *chemist* conducts a chemical reaction, he (*chemist*) takes into consideration the factors influencing its rate.

Conducting a chemical reaction, chemist takes into consideration the factors influencing its rate.

B. The Absolute Participle Construction

When active <i>molecules</i> collide, <i>rearrangement</i> of atoms in molecules can take place	Active <i>molecules</i> colliding, <i>rearrangement</i> of atoms in molecules can take place
As a <i>catalyst</i> was used, the reaction rate was increased	A <i>catalyst</i> (being) used, the reaction rate was increased
If the <i>temperature</i> rises, the average energy of molecules becomes higher	The <i>temperature</i> rising, the average energy of molecules becomes higher
<i>The Periodic System</i> of elements is one of the foundations of modern chemistry, and its <i>creator</i> is a great Russian chemist Mendelejev	<i>The Periodic System</i> of elements Is one of the foundations of modern chemistry, its <i>creator</i> being a great Russian chemist Mendelejev

2. Translate the sentences into your mother tongue.

1. The dictionaries having been brought, the students began to write a test-paper.

2. The professor delivering the lecture, the students were listening to him with great interest.
3. The student started the translation of the article, his friend helping him.
4. The gas is soluble in water, the solution having acidic properties.
5. The researchers left the laboratory, the experiment having been finished.
6. Science can be divided into pure and applied science, pure science dealing with theory only.
7. Scientists follow the scientific method, the first step being observation and measurement.
8. All of the evidence supporting the hypothesis, it becomes a new theory.
9. The temperature increasing, the solubility of oxygen in water drops.
10. The delocalized electrons moving through the structure, metals are good conductors of electricity.
11. Electromagnetic waves can travel through space or matter, the velocity of travel being related to its wavelength and frequency.
12. The energy level being full, extra electrons begin to fill the next available energy level.
13. The elements are arranged horizontally in periods, Elements in each period having electrons in the same outer shell.
14. The atmospheric pressure increasing, the boiling point of a liquid decreases.
15. Another approach having been employed, the results obtained become more reliable.
16. The temperature decreasing, the reaction proceeds slower.
17. The number of electrons increasing upon moving across a period, the number of protons in the nucleus also increases.

4. Point out the sentences with the Absolute Participle Construction. First translate them and then all other sentences left into Uzbek-Russian.

1. Ethanol in wine or beer may be oxidized by reaction with oxygen of the air if certain enzymes are present to catalyze the reaction, the wine or beer going sour due to formation of ethanolic (acetic) acid.
2. Oxides of all the elements in period 3 can be prepared by reaction with oxygen, oxide of chlorine and argon being exception.
8. Oxygen being very reactive, oxides of most elements can be obtained by direct methods.
4. Of the 3 halogens chlorine tends to be most reactive iodine the least, chlorine and hydrogen react explosively in sun light or when heated, iodine and hydrogen react together incompletely at high temperatures.
5. Chlorine and bromine are slightly soluble in water, in both cases, the solution formed has bleaching properties.
6. Clothing soaked by a spillage of the concentrated acid should be removed without delay, and if spilled on the skin the acid should be removed by swilling the skin with plenty of water.
7. The results of the experiment having been discussed, the research workers concentrated their efforts on theoretical interpretation of the unusual phenomenon observed.
8. Electrons having been discovered, chemists became convinced that redox reactions involved the transfer of electrons from one atom to another.
9. Catalysts being used, manufacturing process which is retarded by chemical reaction could be made economical.

5. Translate the sentences paying attention to the participles and their functions.

1. Great care must be taken while pouring water into the acid, since steam and acid spray can be formed.
2. Unreactive metals are more stable in reduced states.
3. Ionic bondin gis electrostatic attraction between oppositely charged ions.
4. Concentrated sulphuric acid is a weaker oxidizing agent than nitric acid, but a powerful dehydrating agent.

5. Cells that provide electricity using reducing agents like hydrocarbons are called «fuel cells».
6. An exothermal reaction being finished, there must be less heat energy in the new substances formed (products) than there was in the original substances (reactants).
7. In the experiment described above the value for heat released per 1 g of the fuel burned in each case was 0,5 %.
8. Having worked out an average value for the heat released per 1 g of fuel, they compared the results obtained.
9. Physical properties such as densities and melting temperatures of transition metals are higher, the chemical reactivity being generally lower than in groups I and II.
10. Hydrochloric acid being mixed with potassium manganite (VII) crystals, chlorine is obtained by oxidation of the HCl.
11. Chlorine is reduced by gain of hydrogen from H₂S, gaseous HCl being produced.
12. Being dipped in acid, the iron began to dissolve.
13. Some metal ions are too difficult to reduce using available reducing agent, and electrolysis is a more feasible method for their extraction.
14. The radioactivity of material containing a radioisotope gets less and less as time goes by.
15. Corroded metal often loses its strength and attractiveness, this process causing great economic loss.
16. Launching into space a vehicle that weighs millions of pounds requires unimaginable quantities of energy, all furnished by oxidation — reduction reactions.
17. In more recent time it has been realized that economic factors although important, are not the only ones to be taken into account when planning future.
18. The chemical industry's growing awareness of public concern about environment has also contributed to changes in practice.
19. Accumulated knowledge from various studies indicates that oxidation is probably a major cause of ageing.
20. Silica is inert and stable, that is it resists chemical changes under most conditions, however, it dissolves in bases when molten.

21. Water used by the chemical industry may be processed in various ways.
22. Nowadays efforts are made to limit pollution and to reverse damage caused in earlier times.
23. Workers in the chemical industry may be exposed to toxic materials causing professional diseases.
24. Oxides of metals can often be reduced in a variety of ways based on the use of different reactants.
25. Crystalline solids are made of particles arranged in regular patterns.
26. Some atoms gain one electron when they form negative ions, some two, a few atoms can gain 8 electrons, the ions called uninegative, dinegative and trinegative ions respectively.
27. But there are no ions formed by the gain more than 3 electrons.
28. In other words, faster motion of the particles (caused by heat energy) is needed to overcome the forces holding the particles together.
29. The atoms contained in molecules are not separated during physical change.
30. The Ionic theory says that electrolytes contain charged particles called ions.
31. A pair of electrons holding two atoms together is called a covalent bond.
32. Covalent structures can be drawn using lines for pair of electrons.
33. The greater number of electrons paired will result in an increased negative charge in the space between the nuclei, so the nuclei will be hold together more strongly.
34. Varieties of an element with atoms containing different number of neutrons are called isotopes of the element.
35. Approximately one-fifth of the iron and steel produced annually is used to replace rusted metal.
36. Silica [silicon (IV)] is one of the most abundant substances on the Earth, being a major constituent of sand, sandstone and many igneous rocks.
37. Being very active chemically a perfectly clean surface of aluminium covers itself in the air in a few seconds with a very thin protective coating of oxide.
38. Aluminium is manufactured by electrolysis of alumina dissolved in molten cryolite using carbon electrodes.

39. Conditions must be carefully controlled to get the desired results.

6. Translate the following sentences into English using the Absolute Participle Construction.

1. Harorat oshirilganda, mahsulot unumdorligi oshdi.

1. Когда температуру повысили, выход продукта увеличился.

2. Modda tozalangandan so'ng biz uni tajribamizda qo'llay oldik.

2. После того как вещество было очищено, мы смогли использовать его в нашем эксперименте.

3. Qo'shimcha tadqiqotlar o'tkazildi va reaksiya mexanizmi o'rnatildi.

3. Дополнительное исследование было проведено, и механизм реакции был установлен.

4. Moddaqizdirilganda parchalanishi sababli, haroratni diqqat bilan nazorat qilish kerak.

4. Так как вещество разлагается при нагревании, температурный режим следует тщательно контролировать.

5. Tadqiqot natijalari asosida maqola yozildi va hammualliflardan biri bo'limimiz xodimidir.

5. По результатам проведенного исследования была написана статья, причем одним из соавторов является рант нашей кафедры.

6. Bosim ko'tarilganda reaksiya tezligi ortadi.

6. Когда давление растет, скорость реакции увеличивается.

7. Natijalar muhokama qilingandan so‘ng, olimlar nazorat tajribasini o‘tkazishga qaror qilishdi.

7. После того как результаты были обсуждены, ученые решили провести контрольный эксперимент.

8. Issiqlik bilan ishlov berish amalga oshirilganda, rentgenologik tahlil yordamida hosil bo‘lgan moddaning tuzilishini tekshirdik.

8. Когда температурная обработка была проведена, мы исследовали структуру полученного вещества с помощью рентгеновского анализа.

9. Agar harorat 300 ° C ga ko'tarilsa, bug‘lanish tezligi keskin oshadi.

9. Если температуру повысить до 300 °C, скорость испарения резко возрастает.

10. Modda tozalanganligi sababli, biz uni reaktiv sifatida ishlatdik.

10. Так как вещество было очищено, мы использовали его в качестве реагента.

SECTION 2

FACTORS THAT DETERMINE THE RATE

OF CHEMICAL REACTIONS

1. Tuning in.

1. How would you define chemical reactions?

2. What types of chemical reactions do you know?

3. What classifications of chemical reactions are you familiar with?

4. Look at the following charts. What are the classifications (A, B) suggested in the chart based on?

A

Chemical reactions						
Homogeneous			Heterogeneous			
Iconic reactions in solutions	Gas + gas	Mixing liquids	Solid + solid	Solid + gas	Solid + liquid	Unmixing liquids

B

Chemical reactions			
Redox reactions	Iconic reactions in solutions	Polymer reactions	Catalytic reactions

5. What other types of reactions do you know?
6. What are the main factors that influence the reactions rate?
7. What molecules are called active?

2. Practice your pronunciation.

determine [di'tɜ:mɪn]

determination [di,tɜ:mi'neɪʃn]

temperature {'tempri,tʃə]

concentration [,kɒnsn'treɪʃn]

instantaneously[,ɪnstən'teɪniəsli]

collide [kə'laid]

collision [kə'liʒn]

violent ['vaiələnt]

activation [ækti'veɪʃn]

average ['æv(ə)rɪdʒ]

special ['speʃl]

reactants [ri'æktənts]

manufacture [,mænʃʊ' fæktʃə]

application [æpli'keɪʃn]]
sulphuric acid ['sʌlfjʊrɪk 'æsɪd]]
ammonia [ə'məʊniə]
catalyst ['kætəlist]
accumulation [ə,kju:mjə'leɪʃn]
pathway['pɑ:θ,wei]

Text 6

Factors That Determine the Rate of Chemical Reactions

Chemical reactions are processes in which groups of atoms are reorganized. There are numerous factors that determine the rate of a reaction. First of all the rate of a chemical reaction depends on the chemical nature of substances involved in the reaction, the temperature, and the concentration of the reacting substances.

Besides that the rate of a reaction is influenced by many other factors such as physical state of the reagents and products of the reaction, radiation (UY — light, laser light etc.), presence of other substances etc. The influence of the temperature and concentration could be explained from the kinetic molecular point of view. Collision between particles (molecules, ions) of the starting substances is the crucial condition for a reaction to take place. The particles must come close enough to each other so that the atoms of the one particle can be subjected to the electrical field creating by the atoms of the other particle. Only under those circumstances electron transfer and rearrangements of the atoms leading to formation of the reaction products can occur.

That is why the rate of a chemical reaction is proportional to the number of collisions between the molecules of the reacting substances. In turn the number of collisions increases with the increase of concentration of each of the reactants. In other words, the concentrations of reacting substances increasing, more reaction events take place.

The kinetic molecular theory of gases and liquids allows us to count the number of collisions between the particles of reacting substances under certain conditions. According to the calculations, the number of collisions under normal conditions is so high, that all the reactions should proceed in no time. Indeed, reactions between ions in solutions proceed almost instantaneously. On the other hand, there are numerous reactions that are extremely slow at normal conditions.

The contradiction can be overcome if we take into the consideration that not all collisions possess enough energy to weaken or break chemical bonds. A minimum energy called the activation energy (E_a) is needed for reaction to occur. If a given molecule possesses an energy greater than (E_a), collision can result in a reaction. The molecules having energy less than E_a , their collision will not lead to chemical interaction. The molecules will bounce apart unchanged. The molecules possessing the additional energy are called active molecules.

The temperature rising, the motion of the molecules speeds up. At higher temperature the average collision being more energetic, this makes it more likely that a given collision will be accompanied by a chemical interaction. Activation energy of different reactions changes in a wide range. The value of E_a is influenced by the nature of the reacting substances. The E_a of ionic reactions being negligibly small, the rate of this type of reactions is very high. In contrast the reaction of ammonia synthesis from H₂ and N₂, is so slow at ordinary temperature, it is practically impossible to notice it.

We can use special substances called catalysts to accelerate a reaction without changing the temperature and the reactant concentration. A catalyst is a substance that speeds up a reaction and is not consumed during a reaction. A catalyst provides a new pathway for the reaction with lower activation energy.

Because of the lower activation energy the more collisions will have enough energy to allow reaction. This in turn leads to a faster reaction. There are numerous reactions which cannot be used in practice without catalysts. Manufacture of sulphuric acid, ammonia, nitric acid involves the application of catalysts.

Catalysts, called enzymes, play important part in biological systems. Enzymes are simple and complicated proteins. Our body contain 30 000 of different enzymes, each of which being an effective catalyst of the certain vital processes. For example, enzyme (called carbonic anhydrase) speeding up the reaction between carbon dioxide and water helps to prevent an excess accumulation of carbon dioxide in our blood. Specific enzymes are used in the digestion of food.

3. Look though the text and find sentences with the Absolute Participate Construction translate them into your mother tongue.

4. Read the text thoroughly and answer the following question.

1. What main factors influence the reaction rate?
2. Why does the reaction rate depend on the concentration of reacting substance?
3. What can you say about the influence of temperature on the reaction rate?
4. What is the activation energy of chemical reaction?
5. What is the necessary condition for the chemical interaction to take place?
6. Why was the concept of activation energy introduced?
7. What is the role of catalysts in manufacturing processes?
8. What can you say about the role of catalysts in the biological systems?

5. Match the Uzbek-Russian words or word combinations, chemical terms in A with their English equivalents in B.

A		B
энергия активации	faollashtirish energiyasi	instantaneously
ЭНЗИМ	ferment	blood
накопление	to‘planishi	lead to
с точки зрения	nuqtai nazaridan	sulphuric acid
реагирующие вещества	reaktivlar	collision
КРОВЬ	qon	catalyst

определять		aniqlash		a new reaction pathway
свою очередь		o'z navbati		kinetic molecular theory
серная кислота		sulfat kislota		under normal conditions
новый	механизм	yangi	reaksiya	close enough
реакции		mexanizmi		reaction rate
ион		ion		ammonia
катализатор		katalizator		accelerate
средний		o'rtacha		reacting substances
при	нормальных	normal sharoitda		average
условиях				theory
аммиак		ammiak		accumulation
соударения		to'qnashuvlar		enzyme
мгновенно		darhol		from the point of view
скорость реакции		reaksiya tezligi		(of)
молекулярно-		molekulyar kinetik		determine
кинетическая		nazariya		in turn
теория				ion
ускорять		tezlashtirmoq		activation energy
приводить к		olib borish		
достаточно близко		yetarlicha yaqin		

6. Look at the word families, what part of speech each of the family member belong to.

react	reactive	reagent	reactant	reaction
apply	applicant	application	applied	
concentration		concentrated	concentrate	
produce	product	production	productive	
ion	ionization	ionic	ionize	ionizer

catalyst	catalysis	catalyze	catalytic	
form	formation	formal	formally	
radiate	radiation	radiant	radioactive	
determine	determination	determined	determinism	
instantaneous	instantaneously	instant	instantly	
lead (to)	leader	leading	leadership	
depend (on)	dependence	dependent		
solve	solution	solute	solvent	dissolve
involve	involving	involved	involvement	
special	specialise	specialist	speciality	specially

7. Match the words with the similar meaning in columns A and B.

A	B
1) instantaneously	a) account for
2) explain	b) reorganize
3) speed up	c) particular
4) rearrange	d) reagent
5) reactant	e) have
6) consume	f) use
7) manufacture	g) supply
8) excess	h) in no time
9) enzyme	i) production
10) provide	j) accelerate
11) lead to	k) result in
12) possess	l) ferment
13) special	m) more than is necessary

8. Write the plan of the text. Render the text using the plan.

9. Translate the text into English.

Kimyoviy reaksiya tezligi haqidagi savolni ko'rib chiqishda bir jinsli sistemada kechadigan reaksiyalar bilan geterogen sistemada kechadigan reaksiyalarni farqlash kerak. Bir hil sistemada sodir bo'ladigan reaksiyalar ushbu tizimning butun hajmida sodir bo'ladi.

Gomogen sistemadagi reaksiyalar tezligi deganda reaksiyaga kiradigan yoki reaksiya jarayonida sistemaning birlik hajmiga vaqt birligida hosil bo'ladigan moddaning miqdori tushuniladi. Kimyoviy reaksiyalardan amaliyotda foydalanilganda berilgan reaksiyaning qanchalik tez borishini bilish zarur.

Kimyoviy reaksiyalar tezligini o'rganuvchi kimyo bo'limiga kimyoviy kinetika deyiladi. Reaksiya tezligiga ta'sir qiluvchi eng muhim omillar - bu reaktivlarning tabiati, ularning konsentratsiyasi, harorati va katalizatorlarning mavjudligi.

Kimyoviy reaksiya reaksiyaga kirishuvchi zarrachalarning bir vaqtning o'zida to'qnashuvi natijasida sodir bo'ladi va uchta reaksiyaga kirishuvchi zarrachalarning to'qnashuvi juda kam uchraydi.

При рассмотрении вопроса о скорости химической реакции необходимо различать реакции, протекающие в гомогенной системе, и реакции, протекающие в гетерогенной системе. Реакции, протекающие в гомогенной системе, идут во всем объеме этой системы.

Скоростью реакций в гомогенной системе называется количество вещества, вступающего в реакцию или образующегося в ходе реакции за единицу времени в единице объема системы. При использовании химических реакций на практике, важно знать, с какой скоростью будет протекать данная реакция.

Раздел химии, изучающий скорость химических реакций, называется химической кинетикой. К важнейшим факторам, влияющим на скорость реакции, относятся природа реагирующих веществ, их концентрация, температура, присутствие катализаторов.

Химическая реакция происходит в результате одновременного столкновения реагирующих частиц, причем столкновение трех реагирующих частиц происходит очень редко.

10. Write the summary of text 6.

UNIT 7

SECTION 1

GRAMMAR: THE GERUND

Gerundi- harakatni bildiruvchi fe'lining shaxssiz formasi

Герундий – неличная форма глагола, выражающая действие.

Forms of Gerund

Form	Active	Passive
non-perfect	discussing	being discussed
perfect	having discussed	having been discussed

1. Translate the sentences into your mother tongue, paying attention to the form of the gerund.

1. She likes asking questions.
2. He does not like being asked.
3. I remember having asked the questions.
4. I remember having been asked about it.

1. Translate the sentences into your mother tongue.

1. There are several approaches one can take in answering the question.
2. The only reliable way of verifying hypothesis is to perform experiments.
3. A compound can be usually broken down by heating or by the application of an electric current.
4. There are other schemes for classifying reactions.
5. The body adapts to living at high elevations by producing additional hemoglobin.
6. In writing the equation for a chemical reaction, we put the reactants on the left and the products on the right side of the equation.

7. Going from the liquid to the gaseous state involves a much greater change than going from the solid to the liquid.
8. Changing weather conditions cause the atmospheric pressure to vary.
9. Molecular bonding and structure play the central role in determining the course of chemical reactions.
10. The method of induction is the process of reasoning from particular facts or ideas to a general rule or law.
11. Molten common salt can be decomposed by passing an electric current through it.
12. There are many reasons for studying chemistry.
13. In the late 18-th century Joseph Priestly prepared oxygen by concentrating the sun's rays through a lens on mercuric oxide.
14. The graduated cylinder is commonly used in chemical laboratories for measuring the volume of liquids.

4. Translate the sentences into your mother tongue.

1. I knew nothing of his having made the report.
2. Her taking part in the discussion surprised us greatly.
3. I heard of your friend's going abroad.
4. Their approving his suggestion was not unexpected.
5. There is no excuse for her talking to you like that.
6. I know of his having finished the experiment.
7. They insisted on our adopting the new plan.

5. Identify the sentences with gerund phrase.

1. They knew of his having published the results of his last research.
2. The atoms of radium were shown by experiment to be giving off alpha particles.
3. Having been heated the solution lost its colour.
4. Mankind is interested in atomic energy being used only for peaceful purposes.

5. His having asked such a question showed that he did not understand the explanation.

6. There are two curves in this figure, one of them showing the dependence of the drop in the weight from the temperature.

6. Gerundi va ravishdosh o‘rtasidagi farqni ko‘rsatuvchi belgilani o‘qing.

Прочитайте о признаках, на основании которых можно отличить герундий от причастия.

Gerundi va ravishdoshni taqqoslash

Gerundini quyidagi omillarga asosan ravishdoshdan farqkash mumkin..

1. Gapdagi vazifasiga ko‘ra (Gerundi ega va to‘ldiruvchi vazifasida kelishi mumkin.):

Learning a foreign language helps us to know better our native one.

2. Aniqlovchi yoki hol vazifasida kelgan gerund oldidagi predlogga qarab.

Hol vazifasida kelgan ravishdoshdan oldin *when, while* bog‘lovchilari kelishi mumkin.

Gerundi - Герундий	Ravishdosh -Причастие
Aniqlovchi	
There are two ways of carrying out the reaction	The man carrying out the research is a qualified specialist in the field
Hol	
After watching the experiment, students took part in its discussion. Before carrying out the experiment, he spent a lot of time on the purification of the solvents.	When watching the experiment students were very attentive. While carrying out the experiments you should pay attention to the safety measures.

3. Gerundi oldidan egalik olmoshi yoki bosh va egalik kelishigidagi otning mavjudligi:

Our taking part in the conference is very important. Excuse my interrupting you.

We insisted on the problem being solved immediately.

7. Translate the sentences below, indicate whether the –ing form is a participle or a gerund..

1. The student went on studying the properties of that new substance.
2. A long time ago people noticed the attracting ability of the magnet.
3. Working at his new device, the designer carried out an important research.
4. The teacher objected to our translating such an easy text with a dictionary.
5. Having experimented with electricity and magnetism, Gilbert wrote a book on magnetism.
6. Three criteria should be regarded in distinguishing between chemical and physical changes.
7. Being treated with certain chemicals wood can be used for some purposes instead of metal.
8. We heard of that experiment having been made last week.

8. Choose the correct of the translation of –ing form

Выберите правильный перевод –ing формы.

1. In the organic laboratory carrying out a reaction is only a small part of the chemist's work.

A) проводящий; B) проводя; B) проведение.

2. Experiments showing the changes in materials are of practical importance.

A) показывая; B) показывающие; B) показание.

3. To compare the data obtained by our tests is the only means of solving the problem in question.

A) решить; B) решающий; B) решение.

4. Heating a body we place it in contact with another body at a higher temperature.

A) нагревающееся; B) нагревая; B) для нагревания.

5. When discussing this question at the last seminar we did not know about these results.

A) при обсуждении ; B) обсуждение; B) обсуждаемый.

6. The method developed at our laboratory is aimed at defecting micro cracks in metals.

A) обнаружение; B) обнаруженный; B) обнаруживая.

10. Translate the sentences and identify in which the word “measuring” is a gerund.

1. Thermometers are used for measuring temperature.

2. Measuring temperatures we usually use thermometers.

3. The measurement of temperatures is effected by means of thermometers.

4. There are several ways of measuring the temperature.

5. The main temperature measuring instruments include the thermometers and the thermocouples.

11. Read the text and identify the usage of participle and the gerund, make a plan and narrate the text.

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Acids and Alkalis in Our Everyday Lives

In our daily lives we come across many compounds which are acids and alkalis. Citric acid is responsible for sour taste in lemons and oranges. Acetic acid is commonly known as vinegar that we use in cooking. All forms of soaps contain sodium hydroxide which is an alkali.

When you chop an onion, you break open some of the onion's cells. This releases enzymes which act on one of the flavoring components of onions, allicin. Allicin is a compound containing sulphur. This volatile irritant «fumes» up from the onion and irritates your eyes. The stinging sensation is because of the sulphuric acid produced when allicin dissolves in the water of your eyes. Our stomachs have hydrochloric acid which is needed for breaking down ingested food. Our stomach lining is thick and is immune to the effects of hydrochloric acid, but occasionally this acid spills into the esophagus.

The lining of the esophagus is not as thick as the stomach lining. So when the stomach acid touches esophagus, we get a burning sensation. When you have stomach burns, you take a medicine called antacid. Antacid is a chemical that has aluminum hydroxide. This alkali neutralizes the excess acid in your stomach. Baking powder is actually sodium bicarbonate and is alkaline. On heating, it degenerates and produced carbon dioxide. This is the reason why sodium bicarbonate is used in bakery products; on heating the carbon dioxide is released. This makes the cake rise. It is also the same soda that is in most of the soft drinks.

Esophagus — qizilo 'ngach, нууцевод.

SECTION 2

THE CHEMICAL EQUILIBRIUM

1. Tuning in.

1. Do all reactions proceed to the full completion? Can you give any examples of such reactions?
2. What reactions are called reversible?
3. Production of what important chemicals is based on using reversible chemical reactions?
4. How can you define the state of the equilibrium for a chemical reaction?
5. What is the graphical designation of the reversible reactions?

6. Why are chemists interested in determining the factors that influence the position of the equilibrium?
7. What factors are used in practice (for example in the production of ammonia from hydrogen and nitrogen) to shift the position of the equilibrium in the favour of the desired product?
8. What principle determining the effect of concentration, pressure or temperature on chemical reactions do chemists apply in their work?

2. Pronounce the following words.

equilibrium [i:kwi'libriəm]

balance ['bæləns]

essentially [i'senʃli]

completion [kəm'pli:ʃn]

convert [ken'vɜ:t]

completely [kəm'pli:tli]

consume [ken'sju:m]

reversible [ri'vɜ:səbl]

forward ['fɔ:wəd]

reverse [ri'vɜ:s]

proceed [prə'si:d]

dynamic [dai'næmik]

concentration [kɒnsn'treiʃn]

indefinitely [in'defənətli]

arrow ['ærəʊ]

eventually [i'ventʃuəli]

Norwegian [nɔ:wi:dʒ(ə)n]

essential [i'senʃl]

extensive [ik'stensiv]

position [pə'ziʃn]

reduce [ri'dju:s]

Text 7

The Chemical Equilibrium

Equilibrium is a situation in which there is a balance between several different influences or aspects of a situation so that none is more important or powerful than another. Chemists define equilibrium as the exact balancing of two processes, one of which is the opposite of the other.

Many reactions proceed essentially to completion. For such reactions we can assume that reactants are converted to products until limiting reactant is completely consumed. On the other hand, there are many chemical reactions that don't reach the completion. Such chemical reactions are called reversible, the products and reagents always can be found in the reactional mixture. The situation when the forward reaction and the reverse reaction proceed with the same rate is the situation of dynamic equilibrium. Chemical equilibrium is a dynamic situation where the concentration of reactants and products remain the same indefinitely, as long as the conditions are not changed:



Reversible reactions can occur in either direction. We usually indicate this fact by using double arrows. Molecules react by colliding with one another, and the more collisions, the faster the reaction. As the concentrations of the reactants decrease, the forward reaction slows down. Increasing the concentration of the reaction products speeds up the reverse reaction. Eventually, the concentrations reach the level at which the rate of the forward reaction equals the rate of the reverse reaction.

The concept of the chemical equilibrium was developed on the basis of observing many chemical reactions. In 1864 two Norwegian chemists Cato Maximilian Goldberger and Peter Waage, proposed the law of chemical equilibrium (or the law of mass action). For the reaction given above the law of mass action is represented as following:

$$K = \frac{[C]^c \cdot [D]^d}{[A]^a \cdot [B]^b}$$

The square brackets indicate the concentrations of the chemical species at equilibrium (in units of mol/L), and K is a constant called equilibrium constant. The equilibrium expression is a special ratio of the concentrations of the products to the concentrations of the reactants. Each concentration is raised to a power corresponding to its coefficient in the balanced equation.

The equilibrium condition could always be described by this special ratio, called the equilibrium expression.

Each set of equilibrium concentrations is called an equilibrium position. Distinguishing between the equilibrium constant and the equilibrium positions for a given reaction system is essential. There is only one equilibrium constant for a particular system at a particular temperature, but there is an infinite number of equilibrium positions.

Chemists are interested in changing the position of a chemical equilibrium in favour of the desired product as much as possible. In developing synthesis of ammonia extensive studies were carried out to determine how the equilibrium concentration of ammonia depended on the conditions of temperature and pressure. The effects of changes in concentration, pressure and temperature on a system at equilibrium can be determined by using Le Chatelier's principle. It states that when a change is imposed on a system at equilibrium, the position of the equilibrium shifts in a direction that tends to reduce the effect of that change.

3. Find the English equivalents in the text.

динамическое равновесие	dinamik muvozanat
точное уравновешивание	aniq muvozanatlash
реагенты превращаются	reagentlar ... ga aylanadi
обратимые реакции	qaytariladigan reaksiyalar
реакционная смесь	reaksiya aralashmasi

прямая и обратная реакция	to'g'ri va teskari reaksiya
с той же самой скоростью	bir xil tezlikda
равновесные концентрации	muvozanatli konsentratsiyalar
неопределенно долго	cheksiz muddatga
в том и другом направлении	har ikki yo'nalishda
двойные стрелки	ikki tomonlama o'qlar
в конечном итоге	oxir-oqibatda
достигать уровня	darajaga yetishi
закон химического равновесия	kimyoviy muvozanat qonuni
закон действующих масс	amaldagi massalar qonun
для реакции, приведенной выше	yuqorida o'tkazilgan reaksiya uchun
квадратные скобки	kvadrat qavslar
константа равновесия	muvozanat konstantasi
состояние равновесия	muvozanat holati
для отдельной системы	alohida tizim uchun
принцип Ле Шателье	Le Chatelier tamoyili
два норвежских химика	ikki norvegiyalik kimyogar
в пользу требуемого продукта	kerakli mahsulot foydasiga
синтез аммиака	ammiak sintezi
при равновесии	muvozanat holatida
положение равновесия	muvozanat holati
сдвигается в сторону	yon tomonga siljiydi
уменьшить действие	harakatni kamaytirish

4. Read the text thoroughly and answer the following questions.

1. What definition of equilibrium is given in the text?
2. What is the peculiarity of chemical equilibrium?
3. Why is the state of equilibrium reached in the course of a reversible reaction?
4. What law states the ratio between the reagents and products of a chemical reaction at the equilibrium?

5. What scientists did state the law?
6. How did they come to the discovery of the law?
7. What factors does the position of the equilibrium depend on?
8. What is the constant of equilibrium?
9. What does the principle of Le Chatelier state?

5. Choose one word from the box for the each group of the words.

equilibrium	ratio	system	studies	concentration	product
reaction	reach	law	be interested in		

- | | |
|---|--|
| <p>1) reverse ...
reversible ...
forward...</p> <p>2) dynamic ...
... constant
a system at...</p> <p>3)... the completion
... the level
... the destination</p> <p>A) each ...
equilibrium ...
... of the products</p> <p>5) propose the ...
... of mass action
.. of gravity</p> | <p>6) extensive ...
environmental ...
scientific ...</p> <p>7) special ...
... of the products and reagents
... of the initial and final
concentration</p> <p>8) desired
... of the reaction
concentration of the ...</p> <p>9) a particular...
... at equilibrium
... of elements</p> <p>10) ... chemistry
... changing the rate v
... determining the equilibrium
constant</p> |
|---|--|

6. Match synonyms in columns A and B.

A

B

- | | |
|-----------------|--|
| 1) equilibrium | a) reagents |
| 2) reach | b) balance |
| 3) convert | c) occur |
| 4) reactants | d) transform |
| 5) particular | e) relationship |
| 6) proceed | f) achieve |
| 7) consume | g) suppose |
| 8) essential | h) blend |
| 9) assume | i) use smth (reagents, energy) up |
| 10) conduct | j) specific |
| 11) reduce | k) carry out |
| 12) study | l) research |
| 13) carry out | m) entirely |
| 14) distinguish | n) extremely important |
| 15) mixture | o) move smth from one place to another |
| 16) ratio | p) find out |
| 17) completely | q) perform |
| 18) shift | r) see the difference between two things |
| 19) determine | s) decrease |

7. Match the words with opposite meaning in columns A and B.

A	B
reversible	reverse
complete	unbalanced
forward	definitely
dynamic	undependable
synthesis	unequal
remain	products
indefinitely	variable
dependable	incomplete

reactants	analysis
eventually	unnecessary
equal	static
constant	extract the root
raise to a power	irreversible
balanced	at the beginning
essential	important
desired	impossible
possible	change
unimportant	undesired

8. Translate into English.

Barcha kimyoviy reaksiyalar ikki guruhga bo‘linishi mumkin: qaytarilmas va qaytariladigan reaksiyalar. Qaytarilmas reaksiyalar reaksiyaga kirishuvchi moddalardan birining to‘liq iste‘mol qilinmaguniga qadar davom etadi. Qaytariladigan reaksiyalar oxirigacha ketmaydi. Qaytariladigan reaksiya bilan reaksiyaga kiradigan moddalarning hech biri to‘liq iste‘mol qilinmaydi. Bu farq, qaytarilmas reaksiya bir yo‘nalishda davom etishi va teskari reaksiya ham to‘g‘ri, ham teskari yo‘nalishda davom etishi mumkinligi bilan bog‘liq. Kimyoviy muvozanat dinamik deb ataladi. To‘g‘ri va teskari reaksiyalarning tezligi muvozanat bilan bir xil, shuning uchun tizimda o‘zgarishlar sezilmaydi. Tezlik muvozanati tenglamasi muvozanat sharoitida reaksiyaga jalb qilingan barcha moddalarning konsentratsiyasi bir-biri bilan bog‘liqligini ko‘rsatadi. Moddalarning har qanday konsentratsiyasining o‘zgarishi boshqa barcha moddalar konsentratsiyasining o‘zgarishiga olib keladi.

Все химические реакции можно разделить на две группы: необратимые и обратимые реакции. Необратимые реакции протекают до конца до полного израсходования одного из реагирующих веществ. Обратимые реакции не идут до конца. При обратимой реакции ни одно из реагирующих веществ не

расходуется полностью. Это различие связано с тем, что необратимая реакция может протекать в одном направлении, а обратимая реакция может протекать как в прямом, так и в обратном направлении. Химическое равновесие называют динамическим. При равновесии скорости прямой и обратной реакций одинаковы, вследствие чего изменений в системе не заметно. Уравнение константы равновесия показывает, что в условиях равновесия концентрации всех веществ, участвующих в реакции, связаны между собой. Изменение концентрации любого из веществ влечет изменение концентрации всех остальных веществ.

CHEMISTRY QUIZ

1. Which type of change occurs when the size, shape, appearance or volume of a substance is changed without changing its composition?

- A) chemical
- B) physical
- C) nuclear

2. When nuclear change takes place, which is true:

- A) energy is destroyed
- B) energy is released
- C) energy is changed

3. Dissolving salt in water is example of what type of the change:

- A) physical
- B) nuclear
- C) chemical

4. Which state of matter undergoes the same amount of expansion for a given increase in temperature:

- A) Solid
- B) liquid
- C) gas

5. Which temperaturescale is an absolute scale, where zero point is the lowest possible temperature?

- A) Kelvin
- B) Celsius
- C) Fahrenheit

6. The formation of water from oxygen and hydrogen is an example of... change.

- A) chemical
- B) physical
- C) nuclear

7. An element is determined by the number of...

- A) electrons
- B) protons
- C) neutrons

8. What subatomic particles carry a negative charge?

- A) Protons
- B) Electrons
- C) Neutrons

9. Choose the correct answer. According to the atomic theory electrons are usually:

- a) found in the atomic nucleus;
- b) out the nucleus, yet very near it because they are attached to the protons;
- c) out the nucleus and then far from it;
- d) most of an atom's volume is its electron cloud either in the nucleus or around it;
- e) electrons are readily found anywhere in an atom.

10. Which particles have approximately the same size and masses:

- a) neutrons and electrons;
- b) protons and electrons;
- c) electrons and protons.

11. Which two particles would be attracted to each other:

- a) proton and electron;
- b) electron and neutron;
- c) neutron and proton.

12. The atomic number of an atom is the number of:

- a) protons;
- b) electrons;
- c) neutrons.

13. Changing the numbers of neutrons of an atom changes its:

- a) isotope;
- b) element;
- c) ion charge.

14. When you change the number of electrons of an atom you produce a different:

- a) isotope;
- b) ion;
- c) element;
- d) atomic mass.

15. Y is the chemical symbol for which element:

- A) Ytterbium
- B) Yttrium

16. What element is named in honour of Russia?

- a) Radium
- b) Rubidium
- c) Ruthenium
- d) Rhenium

APPENDICES

APPENDIX A. WORDS TO BE REMEMBERED

Unit 1.

acid — kislota -кислота	pressure —bosim- давление
advantage —ustunlik- преимущество	property —xususiyat- свойства
ancient — qadimiy- древний	relation —munosabat,aloqa
approach — yondashuv- подход	отношение, связь
characteristic — 1.xos; 2. Xususiyat	require — talab qilmoq-требовать
1) характеристика; 2) характерный	research — tadqiqot- исследование
chemistry — kimyo- химия	regularity — doimiylik
composition —tarkib- состав	закономерность
deal with — shug'ullanmoq;	science —ilm- наука
o'rganmoq- иметь дело,	structure —tuzilish- структура
рассматривать	successfully —muvaffaqiyatli-
determine —aniqlamoq- определять	успешно
discovery — kashfiyot- открытие	synthesize — sintezlash-
equal — teng- равный, одинаковый	синтезировать
measurement — o'lchov- измерение	type —tur- тип
observation — kuzatuv- наблюдение	volume —sig'im- объём
participle — частица	undergo —boshdan kechirmoq-
phenomenon — явление	подвергаться

Unit 2

allow — ruxsat bermoq-позволять	breakthrough — muhim kashfiyot-
attempt —urinish- попытка	прорыв
available — mavjud-доступный,	change — o'zgarish -изменение,
имеющийся в наличии	превращение
benefit —foйда- выгода	concept —tushuncha- понятие,
	компетенция

conservation —himoya qilish-
сохранение
detailed — batafsil-подробный
development —yuksalish- развитие,
разработка
effective — samarali- эффективный
efficiently — samarali -эффективно
expand — kengaymoq- расширять
(ся)
explanation —tushuntirish-
объяснение
experience —tajriba- опыт
experiment — tajriba- опыт,
эксперимент
explosive —portlovchi- взрывчатое
вещество
fertilizer —o'g'it- удобрение
findings — результаты
hypothesis —gipoteza- гипотеза

innumerable — son-sanoqsiz
бесчисленные
in terms of —asosida- исходя из
interpretation — izoh-объяснение,
интерпретация
knowledge —bilim- знание
law —qonun- закон
level — sath-уровень
mass —og'irlik- масса
material —material- материал
nature — tabiat-природа
natural — tabiiy-природный
profit —foyda- прибыль
remain —qolmoq- оставаться,
сохраняться
reasonable —maqul-обоснованный
scientific —ilmiy- научный
theory — qarash,nazariya-теория
the same — aynan- тот же самый
total — umumiy- общий, полный

Unit 3

although — ...ga qaramay- хотя
affinity —yaqinlik- сродство,
сходство
allotropy —allotroplik- аллотропия
bind — bog'lash- связывать
breathe —nafas olish- дышать
carbon —uglerod- углерод

cause — sabab-причина, вызывать
classify — tasniflash-
классифицировать
combination —birikma- сочетание
compound —birikm- соединение
define — aniqlash-определять
definite — aniq- определенный

diamond — olmos- алмаз
differ in — farq qilmoq-отличаться
(чем-либо)
entirely — butunlay-полностью
element — element- элемент
elementary — boshlang'ich
элементарный
exist — mavjud bo'lish-
существовать
for example — misol uchun-
например
graphite — grafit- графит
heterogeneous — turlicha-
гетерогенный
homogeneous — bir turdan-
гомогенный
however — biroq- однако
hydrogen — vodorot-водород
impurity — aralashma- примесь

mixture — qorishma-смесь
metal — metal- металл
modification — o'zgarish-
модификация
occur — sodir bo'lmoq- встречаться
optoelectronics — optoelektronika-
оптоэлектроника
phosphor — fosfor- фосфор
promising — istiqbolli-
перспективный
property — xususiyat- свойство
proportion — nisbat, mutanosiblik-
пропорция, соотношение
rapidly — tez- быстро
solution — qorishma-раствор
variable — o'zgaruvchan-
изменчивый, переменный
virtually — haqiqiy- фактически,
практически

Unit 4

angle — burchak- угол
backward — orqaga - назад
allow — ruxsat bermoq-позволять,
разрешать
charge — quvvatlamоq-заряд
compose — tashkil topmoq- состоять
из
apply — qo'llamoq применять,
прикладывать

approximately -tahminan—
приблизительно
assume — taxmin qilish- допускать,
предполагать
arrangement — joylashuv-
расположение
convince — ko'ndirmoq- убеждать
discard — uloqtirmoq-отбрасывать
electron — electron- электрон

emission — emissiya-излучение,
испускание
evidence — dalil-свидетельство,
доказательство
fit — mos kelish- соответствовать,
подходить
foil — folga- фольга
hydrogen — vodorod- водород
indivisible — неделимый
level — уровень
magnitude — ko‘lam- величина
mechanical — mexanik-
механический
negative — salbiy-отрицательный

neutron — neytron- нейтрон
orbital — fazoviy- орбиталь
path — yo‘l- путь
particle — zarra- частица
physicist — fizik- физик
positive — ijobiy- положительный
precisely — aniq- точно
reason — sabab- причина
reflect — aks ettirish- отражать
regularity — muntazamlik-
закономерность
straight — to‘g‘ri - прямой
wave — to‘lqin - волна

Unit 5

alkali — щелочь
(to) be alike — o‘xshash bo‘lmoq
быть похожим
(to) be based on — ...ga asoslanmoq-
быть основанным на
(to) be equal to ...ga teng bo‘lmoq—
равняться
(to) be responsible for — javobgar
bo‘lmoq - отвечать за., объяснять
carry out — amalga oshirmoq-
выполнять
contradict — zid bo‘lish-
противоречить, несогласовываться

description — tasvir- описание
develop – rivojlanish- разрабатывать,
развивать
depend on (upon) —... ga bog‘liq
bo‘lmoq- зависеть от
explain — tushuntirish - объяснять
existence — mavjudlik-
существование
function — funksiya- функция
heavy — og‘ir- тяжелый
increase — o‘shish - увеличиваться
notice — sezish - замечать
nuclear — yadroviy - ядерный

mass —og'irlik - масса
modern —zamonaviy - современный
outer particular —tashqi zarra -
внешний
physical — fizik - физический
predict — bashorat qilmoq -
предсказывать
propose — taklif qilish - предлагать
(the) same — aynan - тот же самый

sense —mohiyat - смысл
similar — o'xshash - похожий
successfully — muvaffaqiyatli- с
успехом
suppose —taxmin qilish - полагать
such —shunday- такой
systematize — tizimlash-
систематизировать
valence —valentlik- валентность

Unit 6

accumulation — to'planish-
накопление
activation —faollashish-активация
ammonia — ammiak-аммиак
application —qo'llash применение
catalyst —katalizator- катализатор
collide —to'qnashish-соударяться
collision —to'qnashuv- соударение,
столкновение
concentration — jamlanish-
концентрация
determine — aniqlash-определять

determination — aniqlamoq-
определение
instantaneously — мгновению
manufacture — ishlab chiqarish-
производить
pathway — yo'l - путь
reactant — reagent- реагент
special — maxsus- специальный,
особенный
sulphuric acid — sulfat kislota-
серная кислота
temperature — harorat- температура
violent —kuchli - бурный

Unit 7

arrow — yo'nalish belgisi- стрелка
balance — muvozanat- равновесие

completely — to'liq - полностью
completion — tugatishзавершение

consume — iste'mol qilmoq

потреблять

convert — aylantirmoq- превращать

dynamic — dinamik- динамический

essential — ahamiyatli-

существенный

eventually — oxirida- в конечном

итоге

extensive — keng- обширный

forward (reaction) — tekis- прямая

(реакция)

indefinitely — noaniq-

неопределенно

position — holat- положение

proceed — davom etmoq- проходить

reduce — kamaytirmoq, pasaytirmoq-

понижать, восстанавливать

reverse (reaction) — zid- обратная

(реакция)

reversible — o'giriluvchi- обратимый

**APPENDIX B. THE MOST COMMONLY USED SUFFIXES
AND PREFIXES WITH DIFFERENT PARTS OF SPEECH**

Suffixes

Noun

-age language
-er worker, boiler
-or inventor
-ant assistant
-ent student
-ist scientist
-ian mathematician
-ance significance
-ence difference
-ion discussion
-ation consideration
-ity ability
-ment development
-ship relationship
-ure pressure
-ing understanding
-hood neighborhood
-th growth

Adjective

-al natural
-ic atomic
-ant important
-ent different
-ive active
-ful fruitful
-less colourless
-ous numerous
-able movable
-ish greenish

Verb.

-ate precipitate
-en strengthen
-ize crystallize
-fy modify

GLOSSARY

absolute zero - Absolute zero is 0K. It is the lowest possible temperature. Theoretically, at absolute zero, atoms stop moving.

accuracy - Accuracy is a measure of how close a measured value is to its true value. For example, if an object is exactly a meter long and you measure it as 1.1 meters long, that is more accurate than if you measured it at 1.5 meters long.

acid - There are several ways to define an acid, but they include any chemical that gives off protons or H^+ in water. Acids have a pH less than 7. They turn the pH indicator phenolphthalein colorless and turn litmus paper red.

acid anhydride - An acid anhydride is an oxide that forms an acid when it is reacted with water. For example, when SO_3 is added to water, it becomes sulfuric acid, H_2SO_4 .

actual yield - The actual yield is the amount of product you actually obtain from a chemical reaction, as in the amount you can measure or weigh as opposed to a calculated value.

addition reaction - An addition reaction is a chemical reaction in which atoms add to a carbon-carbon multiple bond.

alcohol - An alcohol is any organic molecule that has an -OH group.

aldehyde - An aldehyde is any organic molecule that has a -COH group.

alkali metal - An alkali metal is a metal in Group I of the periodic table. Examples of alkali metals include lithium, sodium, and potassium.

alkaline earth metal - An alkaline earth metal is an element belonging to Group II of the periodic table. Examples of alkaline earth metals are magnesium and calcium.

alkane - An alkane is an organic molecule that only contains single carbon-carbon bonds.

alkene - An alkene is an organic molecule that contains at least one $C=C$ or carbon-carbon double bond.

alkyne - An alkyne is an organic molecule that contains at least one carbon-carbon triple bond.

allotrope - Allotropes are different forms of a phase of an element. For example, diamond and graphite are allotropes of carbon.

alpha particle - An alpha particle is another name for a helium nucleus, which contains two protons and two neutrons. It's called an alpha particle in reference to radioactive (alpha) decay.

amine - An amine is an organic molecule in which one or more of the hydrogen atoms in ammonia have been replaced by an organic group. An example of an amine is methylamine.

base - A base is a compound that produces OH^- ions or electrons in water or that accepts protons. An example of a common base is sodium hydroxide, NaOH.

beta particle - A beta particle is an electron, although the term is used when the electron is emitted in radioactive decay.

binary compound - A binary compound is one made up of two elements.

binding energy - Binding energy is the energy that holds protons and neutrons together in the atomic nucleus.

bond energy - Bond energy is the amount of energy required to break one mole of chemical bonds.

bond length - Bond length is the average distance between the nuclei of two atoms that share a bond.

buffer - A liquid that resists change in pH when an acid or base is added. A buffer consists of a weak acid and its conjugate base. An example of a buffer is acetic acid and sodium acetate.

calorimetry - Calorimetry is the study of heat flow. Calorimetry may be used to find the heat of reaction of two compounds or the heat of combustion of a compound, for example.

carboxylic acid - A carboxylic acid is an organic molecule containing a $-\text{COOH}$ group. An example of a carboxylic acid is acetic acid.

catalyst - A catalyst is a substance that lowers the activation energy of a reaction or speeds it up without being consumed by the reaction. Enzymes are proteins that act as catalysts for biochemical reactions.

cathode - A cathode is the electrode which gains electrons or is reduced. In other words, it is where reduction occurs in an electrochemical cell.

chemical equation - A chemical equation is a description of a chemical reaction, including what reacts, what is produced, and which direction(s) the reaction proceeds.

chemical property - A chemical property is a property that can only be observed when a chemical change occurs. Flammability is an example of a chemical property, since you can't measure how flammable a substance is without igniting it (making/breaking chemical bonds).

covalent bond - A covalent bond is a chemical bond formed when two atoms share two electrons.

critical mass - Critical mass is the minimum quantity of radioactive material needed to cause a nuclear chain reaction.

critical point - The critical point is the endpoint of the liquid-vapor line in a phase diagram, past which a supercritical liquid forms. At the critical point, the liquid and vapor phases become indistinguishable from one another.

crystal - A crystal is an ordered, repeating three-dimensional pattern of ions, atoms, or molecules. Most crystals are ionic solids, although other forms of crystals exist.

delocalization - Delocalization is when electrons become free to move all over a molecule, such as when double bonds occur on adjacent atoms in a molecule.

denature - There are two common meanings for this in chemistry. First, it can refer to any process used to make ethanol unfit for consumption (denatured alcohol). Second, denaturing can mean breaking down the three-dimensional structure of a molecule, such as a protein is denatured when exposed to heat.

diffusion - Diffusion is the movement of particles from an area of higher concentration to one of lower concentration.

dilution - Dilution is when a solvent is added to a solution, making it less concentrated.

dissociation - Dissociation is when a chemical reaction breaks a compound into two or more parts. For example, NaCl dissociates into Na^+ and Cl^- in water.

double displacement reaction - A double displacement or double replacement reaction is when cations of two compounds switch places.

effusion - Effusion is when a gas moves through an opening into a low-pressure container (e.g., is drawn by a vacuum). Effusion occurs more quickly than diffusion because additional molecules aren't in the way.

electrolysis - Electrolysis is using electricity to break the bonds in a compound to break it apart.

electrolyte - An electrolyte is an ionic compound that dissolves in water to produce ions, which can conduct electricity. Strong electrolytes completely dissociate in water, while weak electrolytes only partially dissociate or break apart in water.

enantiomers - Enantiomers are molecules that are non superimposable mirror images of each other.

endothermic - Endothermic describes a process that absorbs heat. Endothermic reactions feel cold.

endpoint - The endpoint is when a titration is stopped, typically because an indicator has changed color. The endpoint need not be the same as the equivalence point of a titration.

energy level - An energy level is a possible value of energy that an electron can have in an atom.

enthalpy - Enthalpy is a measure of the amount of energy in a system.

entropy - Entropy is a measure of the disorder or randomness in a system.

enzyme - An enzyme is a protein that acts as a catalyst in a biochemical reaction.

equilibrium - Equilibrium occurs in reversible reactions when the forward rate of the reaction is the same as the reverse rate of the reaction.

equivalence point - The equivalence point is when the solution in a titration is completely neutralized. It is not the same as the endpoint of a titration because the indicator may not change colors precisely when the solution is neutral.

ester - An ester is an organic molecule with a R-CO-OR' function group.

excess reagent - Excess reagent is what you get when there is leftover reagent in a chemical reaction.

excited state - An excited state is a higher energy state for an electron of an atom, ion, or molecule, compared with the energy of its ground state.

exothermic - Exothermic describes a process that gives off heat.

family - A family is a group of elements sharing similar properties. It is not necessarily the same thing as an element group. For example, the chalcogens or oxygen family consists of some different elements from the nonmetal group.

Kelvin - Kelvin is a unit of temperature. A Kelvin is equal in size to a degree Celsius, although Kelvin starts from absolute zero. Add 273.15 to a Celsius temperature to get the Kelvin value. Kelvin is *not* reported with a ° symbol. For example, you would simply write 300K not 300°K.

ketone - A ketone is a molecule that contains a R-CO-R' functional group. An example of a common ketone is acetone (dimethyl ketone).

kinetic energy - Kinetic energy is energy of motion. The more an object moves, the more kinetic energy it has.

lanthanide contraction - The lanthanide contraction refers to the trend in which lanthanide atoms become smaller as you move left to right across the periodic table, even though they increase in atomic number.

lattice energy - Lattice energy is the amount of energy released when one mole of a crystal forms from its gaseous ions.

law of conservation of energy - The law of conservation of energy states the energy of the universe may change form, but its amount remains unchanged.

ligand - A ligand is a molecule or ion stuck to the central atom in a complex. Examples of common ligands include water, carbon monoxide, and ammonia.

mass - Mass is the amount of matter in a substance. It is commonly reported in units of grams.

mole - Avogadro's number (6.02×10^{23}) of *anything*.

node - A node is a location in an orbital with no probability of containing an electron.

nucleon - A nucleon is a particle in the nucleus of an atom (proton or neutron).

oxidation number The oxidation number is the apparent charge on an atom. For example, the oxidation number of an oxygen atom is -2.

period - A period is a row (left to right) of the periodic table.

precision - Precision is how repeatable a measurement is. More precise measurements are reported with more significant figures.

pressure - Pressure is force per area.

product - A product is something made as a result of a chemical reaction.

quantum theory - Quantum theory is the description of energy levels and the predictions about the behavior of atoms at specific energy levels.

radioactivity - Radioactivity occurs when the atomic nucleus is unstable and breaks apart, releasing energy or radiation.

Raoult's Law - Raoult's Law states that the vapor pressure of a solution is directly proportional to the mole fraction of solvent.

rate determining step - The rate determining step is the slowest step in any chemical reaction.

rate law - A rate law is a mathematical expression relating the speed of a chemical reaction as a function of concentration.

redox reaction - A redox reaction is a chemical reaction that involves oxidation and reduction.

resonance structure - Resonance structures are the set of Lewis structures that can be drawn for a molecule when it has delocalized electrons.

reversible reaction - A reversible reaction is a chemical reaction which can go both ways: reactants make products and products make reactants.

RMS velocity - The RMS or root mean square velocity is the square root of the average of the squares of individual velocities of gas particles, which is a way of describing the average speed of gas particles.

salt - An ionic compound formed from reacting an acid and a base.

solute - The solute is the substance that gets dissolved in a solvent. Usually, it refers to a solid that is dissolved in a liquid. If you are mixing two liquids, the solute is the one that is present in a smaller amount.

solvent - This is the liquid that dissolves a solute in solution. Technically, you can dissolve gases into liquids or into other gases, too. When making a solution where both substances are in the same phase (e.g., liquid-liquid), the solvent is the largest component of the solution.

STP - STP means standard temperature and pressure, which is 273K and 1 atmosphere.

strong acid - A strong acid is an acid that completely dissociates in water. An example of a strong acid is hydrochloric acid, HCl, which dissociates into H^+ and Cl^- in water.

strong nuclear force - The strong nuclear force is the force that holds the protons and neutrons in an atomic nucleus together.

sublimation - Sublimation is when a solid changes directly into a gas. At atmospheric pressure, dry ice or solid carbon dioxide goes directly into carbon dioxide vapor, never becoming liquid carbon dioxide.

synthesis - Synthesis is making a larger molecule from two or more atoms or smaller molecules.

system - A system includes everything you are evaluating in a situation.

temperature - Temperature is a measure of the average kinetic energy of particles.

theoretical yield - Theoretical yield is the amount of product which would result if a chemical reaction proceeded perfectly, to completion, with no loss.

thermodynamics - Thermodynamics is the study of energy.

titration - Titration is a procedure in which the concentration of an acid or base is determined by measuring how much base or acid is required to neutralize it.

triple point - The triple point is the temperature and pressure at which the solid, liquid, and vapor phases of a substance exist in equilibrium.

unit cell - A unit cell is the simplest repeating structure of a crystal.

unsaturated - There are two common meanings for unsaturated in chemistry. The first refers to a chemical solution that does not contain all of the solute that can be dissolved in it. Unsaturated also refers to an organic compound which contains one or more double or triple carbon-carbon bonds.

unshared electron pair - An unshared electron pair or lone pair refers to two electrons that aren't participating in chemical bonding.

valence electron - The valence electrons are the atom's outermost electrons.

volatile - Volatile refers to a substance that has a high vapor pressure.

VSEPR - VSEPR stands for Valence Shell Electron Pair Repulsion. This is a theory used that predicts molecular shapes based on the assumption that electrons stay as far as possible from each other.

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Essential English for Biology students

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