ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ БІЛІМ ЖӘНЕ ҒЫЛЫМ МИНИСТРЛІГІ
С. ТОРАЙҒЫРОВ АТЫНДАҒЫ ПАВЛОДАР МЕМЛЕКЕТТІК УНИВЕРСИТЕТІ

КӘСІБИ БАҒЫТТАЛҒАН ШЕТЕЛ ТІЛІ

(ағылшын тілі)

Кереку баспасы

Павлодар

Қазақстан Республикасының Білім және ғылым министрлігі

С. Торайғыров атындағы Павлодар мемлекеттік университеті

Гуманитарлық-педагогикалық факультеті

«Шет тілдер» кафедрасы

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Кереку
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С. Торайғыров атындағы Павлодар мемлекеттік университетінің оқу-әдістемелік кеңесімен баспаға ұсынылды

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Оқу-әдістемелік құралында түпнұсқалық мәтіндер, лексикалық және грамматикалық жаттығулар, диалог сөзді дамытуға арналған жаттығулар берілген.

Ұсынылып отырған оқу-әдістемелік құралы 5В060600 «Химия», 5В072000 «Бейорганикалық заттардың химиялық технологиясы», 5В072100 «Органикалық заттардың химиялық технологиясы» бакалавриат мамандықтары бойынша мемлекеттік тілде күндізгі және сырттай оқитын екінші курс студенттеріне арналған.

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Кіріспе

Ұсынылып отырған оқу-әдістемелік құралы 5В060600 «Химия», 5В072000 «Бейорганикалық заттардың химиялық технологиясы», 5В072100 «Органикалық заттардың химиялық технологиясы» бакалавриат мамандықтары бойынша мемлекеттік тілде күндізгі және сырттай оқитын екінші курс студенттеріне арналған және сондай ақ магистранттар, ағылшын тілін өздігінен оқитын оқырмандар да бұл оқу-әдістімелік құралын үйрету курстарында оқу кезінде қажеттеріне қарай пайдалана алады.

Кәсіби-бағытталған шетел тілін оқытудын мақсаты студенттердің коммуникативтік біліктілігін қалыптастыру. Бұл оқу құралы студенттердің ағылшын тілінің лексикалық, грамматикалық құбылыстары мен заңдылықтарын коммуникативтік әрекеті ретінде қолдана білуіне көмек етеді.

Әдістемелік құралда лексикалық және грамматикалық жаттығулар, түпнұскалық мәтіндер, диалог сөзді дамытуға арналған жаттығулар берілген.

1 Lexico-grammatical Exercises

Ex.1 Translate the words into Kazakh. Explain the meaning of the prefixes

- more than one; many; much: **poly**atomic.
- more than usual; excessive; abnormal: **poly**dipsia.
- polymer; polymeric: **poly**ethylene.

- **polyatomic**, polychromatic,
- **semi**conductor, **semi**metal;
- **multi**acid , **multi**component , **multi**phase, **multi**valence;
- **macro**molecule, **macro**porous;
- **infra**sonic, **trans**onic, **super**sonic, **hyper**sonic, **ultra**sonic;
- **un**load, **un**saturated, **un**stable;
- **non**metal, **non**-gradable, **non**-polar;
- **in**soluble , **im**miscible, **ir**reversible;
- **dis**charge, **dis**connected , **dis**continuity, **dis**sociation;
- **mis**alignment , **mis**calculate, **mis**matching;
- **pre**blending, **pre**mix, **pre**set;
- **pseudo**acid, **pseudo**elasticity;
- **inter**action, **inter**calibration, **inter**crystalline, **inter**depend;
- **counter**flow, **counter**argument;
- **trans**figure, **trans**lucent;
- **re**absorption, **re**-oxidize;
- **co**-combustion , **co**crystallization;
- **sub**miniature, **sub**alkaline, **sub**class.

Ex.2 Write new words using the appropriate suffixes

a) blend, heat, hydrate;	-ify, -ize,
b) crystallize, ferment , laminate	-ness, -ity
c) acid, carbon, crystal	-ation
d) brittle, hard, malleable	-ible, -less
e) reverse, wash, colour	-er, -or

Ex.3 Translate the sentences into Kazakh. Pay attention to the subjects

There was nickel in the alloy.
There are no oxides in this phase.

This is the descriptive-geometric representation.
That was what we concluded.
As for inorganic salts, these were purified by recrystallization.
Afterburning was tested extensively in an altitude chamber.
To model an interaction means to calculate the location of a molecule in a receptor.
Mendeleev's interests were wide.
This problem is not devoid of interest.
We have suggested a mechanism of the reaction. The mechanism is described in the following section.
The speed of the polymerization runs parallel with the susceptibility to hydrolysis.

Ex.4 Translate the sentences into Kazakh. Pay attention to the predicates and conjunctions.

Chlorides are salts.
The mixture is explosive.
The reaction was over.
The task proved impossible.
The article presents a new method.
Lasers offer possibilities in the field of precise measurements.
They made the mixture boil.
We let the solution stand for several hours.
This effect gave the first idea about the mechanism.
The substance dissolves in water.
The evaporating dish cracked.
Flat-bottomed flasks stand without support.
You should stand a flask under the burette.
We assume that the gas does not react at this temperature.
It may be argued that the forces result from another source.
Flasks stand on the shelf.
The burette leaks.
The compound doesn't absorb light.
A pipette is here.
The solution is boiling.
Flakes are aggregating.
We have carried out the calculation.
The operator has finished the process.
The process has been going too long.
We have been studying the problem.
The process had been going for an hour when explosion happened.

We add the standard solution. The indicator changes its colour.
Calcium is washed out of the soil by rainwater.
Diamond and quartz may be thought of as highly ordered polymers.
The water moderator was adopted for reasons of expediency.
This property has been utilized in numerous applications.
The reaction is quite slow, but the catalyst accelerates it.
The catalyst accelerates the reaction, though it is quite slow.
The reactor was loaded carefully, and the process began.
After the reactor was loaded carefully, the process began.

They ran out of platinum and had to look for some other refractory material.

Because they had ran out of platinum, they had to look for some other refractory material.

We have developed this approach, and (we) find it reasonably valid.
We have developed this approach, which we find reasonably valid.

Ex.5 Match the words with their definitions

a) **solution**	a tall cup without a handle, usually made of plastic
b) **element**	a powder that is turned red by acid and blue by alkali
c) **patent**	a liquid which a substance has been dissolved into
d) **beaker**	a legal right that a person or company receives to make or sell a particular product so that others cannot copy it
e) **electron**	a change which happens when two substances are put together
f) **litmus**	a simple substance which cannot be reduced to smaller chemical parts
g) **reaction**	the smallest unit that an element can be divided into
h) **atom**	an extremely small piece of an atom with a negative electrical charge
i) **isotope**	a part of an atom with a positive electrical charge
j) **proton**	a form of an atom that has a different atomic weight from other forms of the same atom but the same chemical structure

Ex. 6 Fill in the gaps using the words below

test tubes, research, pollution, environment, science, reaction, health, gloves, mask, cookery, goggles.

Chemistry is a ____ (1) that is useful in many different industries.

Chemical ________ (2) is very important for improving human conditions but most people have a negative image of chemistry because of the _________ (3) that is generated by this industry.

Fortunately, nowadays, the chemical industry takes better care of the _______ (4) although it still sometimes pollutes it.

Chemists know that experiments must be done in _______ (5) for safety reasons because mixing different chemicals under certain conditions will cause a chemical _______ (6) to occur.

Some substances can be hazardous to ________ (7) and cause injury or even cancer.

You must wear _________ (8) to protect your eyes if you handle chemicals.

Additionally, it's a good idea to put on ________ (9) to protect your hands.

In some cases, you must wear a ________ (10) to avoid inhaling dangerous substances.

In a way, chemistry is like ______ (11) because you mix and heat various ingredients according to a recipe.

Ex.7 Put the nouns into the correct column according to whether they are used with make or do

Expressions with make and do

decisions		a job	a mistake		an experiment
	sense	a discovery		nothing	
a favour		tests	a difference		progress

make+ noun	do+noun

Ex.8 Choose the correct options to complete the description of a scientist's work.

"I work as a scientist in a laboratory. Obviously, we all dream of (1) making/doing a big discovery some day, but the reality is that most scientists (2) make/do a job that is pretty mundane at times. Part of that job involves coming up with a theory, and then (3) making/doing an experiment that allows you to test it. It's important to (4) make/do the right decisions when you're devising that experiment, because if you (5) make/ do even a small mistake, it could (6) make/ do a big difference to the results and invalidate them. Once an experiment's up and running, you can be really busy and (7) make/do quick progress, but sometimes it's question of waiting for results, and you sit around (8) making/ doing nothing for hours. When that happens, I sometimes ask a colleague to (9) make/do me a favour and keep an eye on things while I work from home.

As for how I came to be a scientist, I always got good results when I (10) made/did science tests at school, and whereas a lot of my classmates had problems with maths, it always just seemed to (11) make/ do sense to me. So studying science at college just seemed a natural choice."

Ex. 9 Complete the sentences

1 The kind of industry which produces medicines – P_____________;
2 A chemical found in diamonds and coal – C__________;
3 The gas we breathe out is C______;
4 Mixing chemicals may cause a chemical R____________;
5 A natural or chemical material used by farmers to help grow crops – F_______;
6 Plants A_________ water through their roots and sunlight through their leaves;
7 A household chemical product used to disinfect – B_______;
8 Another word for poisonous – T__________;
9 A way of describing a material with particular physical characteristics – S_____;
10 The release of a gas – E________;
11 The chemicals derived from petrol and gas – P______________;
12 An abbreviation for the gases which have now been removed from aerosols to protect the ozone layer C________;
13 A nuclear accident may cause C________ of the surrounding area.
14 the opposite of synthetic – O___________;
15 The different types of synthetic material which can be moulded and shaped to make many products – P________;
16 Chemicals used to kill unwanted insects – P_________;
17 A form of energy from nuclear power which is dangerous to humans and animals – R____________;
18 The chemicals added to food are called food A_________;

Ex.10 Read the passage and work out what the numbered words mean.

Many of us are exposed to a range of toxic substances in our daily lives. According to Professor Jack Ng of the University of Queensland: " We are seldom exposed only to a single contaminant in the environment – but more often than not to a cocktail of chemical mixtures. Exposure can take place at a contaminated site or via the food chain. Examples include mixtures of petroleum **hydrocarbons**[1], metals and **metalloids**[2] in mining and pesticides on or in the food we consume.

Dr Ng cautions that health risk assessment of chemical mixtures can be complex and it is often very expensive to get sufficient evidence-based data for proper evaluation. He asserts that the notion that a single exposure to a chemical mixture automatically places a person into a higher risk category is an **urban myth**[3] that has no foundation. He states that: "The facts about toxicity remain the same for either a single chemical or a mixture of chemicals: it is a **dosage**[4] that makes them poisonous." When assessing the toxicity of a substance, it is important to have a good understanding of how the different contaminants in the mix may interact both with one another and inside any creature which absorbs them. Sometimes these reactions can make a substance more, or, less toxic. Professor Ng said the cost of analysing all the possible interactions and effects of any **compound**[5] mixture would be immense.

Ex.10.1 Match the numbered words with their definitions.

a) a commonly told story not based on fact	
b) a mixture of carbon and hydrogen	
c) a chemical that combines two or more elements	
d) the amount of medicine you should take	
e) something that can act like a metal	

Ex.10.2 Fill in the gaps using the words below

Natural remedies, capsule, bacteria, medical staff, pure, absorb, side effects, dosage, compounds, alternative, protein, blood, infection

Ancient cultures made medicines from plants and animals. Modern scientists are studying the _________ [1] found in the _______ [2] of crocodiles They believe it may help to fight ______ [3]. The field of medical science is taking an interest in phytochemicals (i.e. chemical _________ [4] found naturally in plants). Scientists have already been able to show the health benefits of drinking green tea. Those who provide funding for medical research are now more supportive of ________ [5] therapies. As a result, scientists are studying how antioxidants may help with Alzheimer's disease. They are attempting to find the exact _______ [6] (i.e. without any harmful ____________ [7].

Researchers have discovered that when phytochemicals are in a _________ [8] state, the body cannot _______ [9] absorb them easily. They are using nanotechnology to make a ________ [10] that will slowly release the medicine.

Hospitals around the world are having problems with ________ [11] which cannot be treated with antibiotics. _______ [12] are now using ________ [13] such as tea tree oil.

Ex.10.3 Answer the questions

a) Do you think there is enough control of the use of chemicals in our society? (Why? / Why not?)

b) Do you think we are too dependent on chemicals nowadays? (Why? / Why not?)

c) Have chemicals improved our life or made it more dangerous?

d) Who do you think should be responsible for chemical spills which damage our environment?

e) How will our attitude to chemicals change in the future?

Ex.11 Fill in the table

	chemical name	elements present	chemical formula	translation
1	sodium chloride	sodium and chlorine	NaCl	хлорид натрия
2	potassium oxide			
3	magnesium bromide			
4	sodium fluoride			
5	aluminum iodide			
6	calcium sulfide			
7	lithium phosphide			
8	strontium chloride			
9	barium nitride			
10	aluminum oxide			
11				темір оксиді

Ex.12 Write chemical formulas

Examples of neutralisation reactions. Acids reacting with metal hydroxide bases

a) Sulfuric acid + sodium hydroxide ⟶sodium sulfate + water;

$\underline{H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + H_2O}$

b) Nitric acid + potassium hydroxide ⟶potassium nitrate + water;

____

c) Sodium hydroxide + nitric acid ⟶sodium nitrate + water;

____

d) Hydrochloric acid + magnesium hydroxide ⟶magnesium chloride + water;

____

e) Potassium hydroxide + acetic acid ⟶potassium acetate + water.

____

Ex.13 Fill in the gaps

Acids reacting with metal oxide bases

a) Sodium oxide + nitric acid ⟶sodium nitrate + **water;**

$Na_2O + 2HNO_3 \longrightarrow 2NaNO_3 +$ ______

b) Hydrochloric acid + calcium oxide ⟶**calcium chloride** + water;

$2HCl + CaO \longrightarrow$ _______ $+ H_2O$

c) **Potassium oxide** + phosphoric acid ⟶potassium phosphate + water;

_______ $+ 2H_3PO_4 \longrightarrow 2K_3PO_4 + 3H_2O$

d) Aluminum oxide + hydrochloric acid ⟶**aluminum chloride** + water;

$Al_2O_3 + 6HCl \longrightarrow$ _______ $+ 3H_2O$

e) Barium oxide + **hydrochloric acid** ⟶barium chloride + water.

$BaO +$ _______ $\longrightarrow BaCl_2 + 2H_2O$

Ex.14 Rewrite the sentence so that it contains the word in capitals.

I'm sure you know the difference between a solid and a gas (MUST)

You <u>**must**</u> know the difference between a solid and a gas.

a) I'm sure you know the difference between a solid and a gas	MUST
b) If a substance does not contain hydrogen, then we are sure that it isn't an acid	CAN'T
c) If we put some litmus paper in a solution and it turns red, then we are sure that the solution is an acid.	MUST
d) If we add a substance to a red-cabbage solution and it stays red, then we are sure that the solution isn't an alkali	CAN'T
e) If we add a substance to a red-cabbage solution and it turns green, then the substance is sure to be an alkali	MUST
f) If we put some litmus paper in a solution and it turns red, then we are sure that the solution isn't an alkali	CAN'T
g) If it's not an acid, or an alkali, then it's sure to be neutral.	MUST
h) If we use a universal indicator to check a substance,	CAN'T

and it turns purple, then we are sure that the substance isn't an acid.

Ex.15 Choose the correct option, A, B or C, to complete the sentence

a) Alexander Fleming is usually described as the scientist who discovered penicillin in 1928, but in fact at least two other scientists had noticed its antibiotic effect ____ he did.

b) The antibiotic effects of penicillin _____ had been recorded in France by a Costa Rican scientist.

c) Fleming conducted experiments with penicillin, but _____ decided that it would not work as an antibiotic in humans.

d) Luckily, other scientists continued with the research and were _____ making progress when the Second World War began in 1939.

e) However, at that point they had not _______ treated any patients.

f) A few years ______. in 1942, Bumstead and Hess became the first doctors in the world to save a patient using penicillin.

g) At this point, Dorothy Hodgkin had ______described the chemical structure of penicillin, so it was now possible for penicillin to be produced in large quantities.

h) Penicillin is __________ used to treat many infections.

i) However, ____________ in the 1940s, the first cases of resistance to the drug had been reported.

j) Because bacteria can change, they grow resistant to antibiotics, and scientists have not ____ found a solution to this problem.

a)	A	after	B	before	C	already
b)	A	already	B	later	C	still
c)	A	after	B	later	C	just
d)	A	after	B	afterwards	C	still
e)	A	yet	B	just	C	still
f)	A	after	B	later	C	yet
g)	A	just	B	still	C	yet
h)	A	still	B	yet	C	already
i)	A	yet	B	still	C	already
j)	A	later	B	yet	C	already

Ex.16 Study the table:

passive			
present simple	The experiments	**are**	conducted
present continuous	The experiments	**are being**	conducted
past simple	The experiments	**were**	conducted
past continuous	The experiments	**were being**	conducted
present perfect simple	The experiments	**have been**	conducted
past perfect simple	The experiments	**had been**	conducted
future simple	The experiments	**will be**	conducted
future perfect simple	The experiments	**will have been**	conducted
infinitive	The experiments	**have to be**	conducted
modals	The experiments	**may be**	conducted

Ex.17 Make up your own sentences using all tenses above
put some litmus paper in a solution;
add a substance to a red-cabbage solution;
use a universal indicator to check a substance;
conducte experiments with penicillin;
treat many infections;
describe the chemical structure of penicillin.

Ex.18 Read about the scientific discovery that was made due to chance and complete the sentences.

Alexander Fleming's most famous discovery happened entirely by accident. One day he was cleaning the culture dishes in his lab when he saw mould growing on one of the plates. There weren't any germs growing around the mould, so Fleming decided to grow more of it for experiments. He discovered that the mould acted against bacterial infections. However, Fleming's initial publication about his discovery was largely ignored by the medical community so he abandoned his research in 1932. It wasn't until 1935, when the researchers Florey and Chain saw Fleming's research papers, that the drug, penicillin, was developed.

a) If Fleming hadn't been cleaning the culture dishes, he _______ mould growing on one of the plates.

b) Fleming wouldn't have grown more of the mould if there _______ growing around it.

c) If his initial publication hadn't been received so poorly by the medical community, he ______________ in 1932.

d) Penicillin might not have been developed if Florey and Chain ________.

Ex.19 Make your own sentences, using Type 3 conditional sentences, as in the examples above

Ex.20 Rewrite the sentences in the passive

a) I confirm the reservation________________________________
b) We will deliver the goods immediately______________________
c) We arranged a meeting___________________________________
d) You can cancel the contract within five business days.__________
e) They execute all orders carefully. ___________________________
f) You have made a mistake. ________________________________
g) We are processing your order.______________________________
h) Jane had booked a light.___________________________________
i) He has not answered our letter. _____________________________
j) She did not sign the contract.________________________________

Ex.21 Complete the sentences

a) If your conditions are competitive, we (place) _______ an order.

b) If I had more time, I (do) ________ a course in business English.

c) If we had known more about their culture, negotiating (be) _____ easier.

d) If you (customize) ______ your CV, your chances of getting a job will be better.

e) We (cancel) ______ our order if you don't deliver the goods by Friday.

f) If Brittany (speak) ______ better English, she would apply for a job abroad.

g) If you (tell) _____ me about the problem, I would have helped you.

h) I (let) _______ you know if I weren't satisfied.

i) If you execute the order carelessly, they (place / not) ____ another order with you in the future.

j) If I were you, I (worry / not) ______ about the presentation.

Ex.22 Complete the sentences with the correct form.

a) We must (inform, to inform, informing) you that your payment is overdue.

b) We have (doing, done, to do) overtime.

c) Do you mind (open, to open, opening) the window?

d) Catherine managed (acquiring, to acquire, acquried) an important customer.

e) We look forward to (to hear, heard, hearing) from you soon.

f) Jane is busy (to write, writing, written) invitations for our company's anniversary celebration.

g) Could you let me (finished, finishing, finish) my sentence?

h) It is hard (pleasing, pleased, to please) certain customers.

i) Let me begin by (tell, told, telling) you something about our company's history.

j) We risk (lose, lost, losing) a lot of money.

Ex.23 Complete the sentences with the correct participle.

a) Thank you for your interested/interesting offer.

b) We hereby send you the signing/signed contract.

c) Thank you for your letter dating/dated 30 March 2016.

d) Enclosed/ enclosing please find our order.

e) Being/ been responsible for the project, I put all my energy into it.

f) Do you know the man talking/talked to Tom?

g) We hereby return the damaging/damaged items.

h) The goods were more expensive than expecting/expected.

i) Tidying/tidied up my desk, I found Mister Thompson's business card.

j) Worked\Working abroad, she hardly ever sees her family.

2 Basic Texts

Text 1 The Origins of Today's "Central Science"

Ex.1 Explain the meaning of the terms "elixir of life", "philosopher's stone

Ex. 2 Read the text and translate it using a dictionary

The word "alchemy" brings to mind a cauldron – full of images: witches hovering over a boiling brew, or perhaps sorcerers in smoky labs or cluttered libraries. Despite these connotations of the mythic and mystical, alchemical practice played an important role in the evolution of modern science.

Historically, alchemy refers to both the investigation of nature and an early philosophical and spiritual discipline that combined chemistry with metal work. Alchemy also encompassed physics, medicine, astrology, mysticism, spiritualism, and art. The goals of alchemy were:

- to find the "elixir of life" (it was thought that this magical elixir would bring wealth, health, and immortality);
- to find or make a substance called the "philosopher's stone," which when heated and combined with "base" (nonprecious metals such as copper and iron) would turn it into gold, thought to be the highest and purest form of matter; and
- to discover the relationship of humans to the cosmos and use that understanding to improve the human spirit.

Alchemy began as a quest to know the world around us – its composition as well as our own.

That quest for knowledge required an understanding of chemical processes, and while alchemy itself would not survive the Enlightenment, the quest continues today in chemistry.

To understand the ever-evolving field of chemistry, which is sometimes called "the central science" because it connects natural sciences like physics, geology, and biology, it's critical to grasp its beginnings.

Alchemists contributed to an incredible diversity of what would later be recognized as chemical industries: basic metallurgy, metalworking, the production of inks, dyes, paints, and cosmetics, leather-tanning, and the preparation of extracts and liquors. It was a fourth-century Indian alchemist who first described the process of zinc production by distillation, a 17th-century German alchemist who isolated phosphorus, and another German alchemist of the same period who developed a porcelain material that broke China's centuries-old monopoly on one of the world's most valuable commodities. These contributions proved valuable to the societies in which alchemists lived and to the advancement of civilization.

But alchemists often made no distinction between purely chemical questions and the more mystical aspects of their craft. They lacked a common language for their concepts and processes. They borrowed the terms and symbols of biblical and pagan mythology, astrology, and other spiritual arenas, making even the simplest formula read like a magic spell or ritual. And although there were commonly used techniques, alchemists shared no standardized, established scientific practice.

Ex.3 Find the definition of the words and word combinations.

1 bring to mind	a) the period in the 18th century in Europe when many people began to emphasize the importance of science and reason, rather than religion and tradition
2 sorcerer	b) to include a lot of things, ideas, places
3 encompass	c) the study of the positions and movements of stars and planets to say how they might influence people's lives
4 quest for	d) to be one of the causes of an event or a situation
5 the Enlightenment	e) in stories, a man who has magical powers and who uses them to harm other people
6 evolve	f) an attempt to get something or do something difficult
7 contribute to	g) relating to religious beliefs that do not belong to any of the main religions of the world
8 pagan	h) a magic instruction
9 craft	i) to develop or make something develop
10 spell	j) an activity in which you make something using a lot of skill, especially with your hands
11 astrology	k) to make you remember something
12 distinction	l) a difference between two similar things

Ex.4 Translate them into Kazakh.

Ex.5 Give synonyms from the text to the following words:

useful, progress, develop, goods

Ex. 6 Match the words and make up your own sentences with the following word combinations:

play	a contribution to
make	for knowledge
bring	to
refer	an important role in
make	distinction
quest	to mind
make	a substance

? Test Yourself

Ex.7 Answer the following questions

a) What did alchemy include?

b) What did alchemy aim?

c) Why was it important to find the "elixir of life"?

d) Why is chemistry called "the central science"?

e) What contribution did alchemy make to the progress of civilization? Give some examples!

f) Why couldn't alchemists distinguish between purely chemical questions and mystical aspects?

Ex.8 Retell the text and give your opinion!

Text 2 Roots in the ancient world

Ex.1 Fill in the gaps using the given words

the Common Era (CE), immortality, evolved, BCE [ˌbi:si:'i:] (before the Common Era), established, influence, the philosopher's stone, purification, track down, medieval, translated

The origins of alchemy are difficult to ______ (1). In the East, in India and China, alchemy started sometime before ________ (2) with meditation and medicine designed to purify the spirit and body and to thereby achieve _______ (3). In the West, alchemy probably ______ (4) from Egyptian metallurgy as far back as the fourth millennium _____ (5). The ideas of Aristotle (384–322 BCE), who proposed that all matter was composed of the four "elements" – earth, air, fire, and water – began to ________ (6) alchemical practices when his student Alexander the Great (356–323 BCE) ________ (7) Alexandria as a center of learning. Alexander is said by some to have discovered the Greek god Hermes's famous Emerald Tablet, reputed to contain the secret of________ (8), and to have built the Library of Alexandria specifically to house alchemical texts.

Islamic Arabs took over Alexandria in the seventh century CE, and as the center of learning shifted to Damascus and the newly founded Baghdad, alchemical texts were _____ (9) from Greek to Arabic. An eminent figure at that time was Jabir ibn Hayyan (721–815, who became a royal alchemist in Baghdad. Jabir's writings were the first to mention such important compounds as corrosive sublimate (mercuric chloride), red oxide of mercury (mercuric oxide), and silver nitrate. Like Aristotle, Jabir believed metals grew in the Earth, adding to Aristotelian theory the notion that metals were differentiated by how much mercury and sulfur they contained. Making gold thus required the ________ (10) of these ingredients. Scholars in the West first learned about alchemy in roughly the 12th and 13th centuries as they copied and translated Arabic texts into Latin. ______ (11) science was still dominated by the ideas of Aristotle.

Text 3 What Is Chemistry?

Chemistry is a physical science, and it is the study of the properties of and interactions between matter and energy. In other words, chemistry is a way to study the properties, characteristics, and physical and chemical changes of matter.

Matter is pretty important because it's anything that has mass and takes up space – basically, all of the "stuff" that makes up our world! Chemists study atoms, which are the basic building blocks of matter, as well interactions between atoms.

They also study subatomic particles, which are smaller than atoms, and these include things like protons, neutrons, and electrons. Since everything on Earth is made of matter, and matter is made of atoms, you can see how this creates the overlap between chemistry and other sciences. You can't have "stuff" to study if you don't have "stuff" in the first place. In other words, matter really matters!

Chemistry Has a Rich History

Your understanding of chemistry may be shiny and new, but chemistry itself has been around for a very long time. Basic chemistry dates back to ancient times and is described as originating from alchemists who were very thorough scientists. They ran experiments and recorded their results, which is a key component of good science.

Modern chemistry dates back to the 17th century, and credited as one of the founders of this scientific field is Robert Boyle. Boyle is one of the developers of the scientific method, which is an organized set of steps to gain knowledge and answer questions. Boyle believed in rigorous, tested experimentation and was a strong advocate of proving scientific theories before calling them "truths".

Though not always considered a formal science, chemistry has been performed throughout human history. People have been fermenting food and drink for centuries. Extracting metal from ores is another form of "natural" chemistry, as is making glass, soap, and extracting plant components for medicinal purposes. Archaeologists find pottery at their dig sites, and both the pots and the glazes used to protect them come from knowledge of chemistry as well.

Branches of Chemistry

As you can see, chemistry exists whether we define it or not. And because an understanding of chemistry is so vital in so many other scientific fields, there are several different branches of chemistry that exist. In fact, chemistry is often studied so that scientists can better understand their own field.

Analytical chemistry is a field that is just what it sounds like: the analysis of matter. Analytical chemists try to gain information and knowledge about the properties, composition, and structure of different materials and substances in order to better understand them.

Applied chemistry is a neat field because it is the application of chemistry for practical purposes. You know all those different shampoos at the store? Some are for colored hair, some for dry/damaged hair, and others are for thin hair. Applied chemistry is specifically used to solve problems - in this case, chemistry is used to have different effects on different hair types.

Chemistry deals with the properties of matter, and the transformation and interactions of matter and energy. Central to chemistry is the interaction of one substance with another, such as in a chemical reaction, where a substance or substances are transformed into another. Chemistry primarily studies atoms and collections of atoms such as molecules, crystals or metals that make up ordinary matter. According to modern chemistry it is the structure of matter at the atomic scale that determines the nature of a material.

Chemistry has many specialized areas that overlap with other sciences, such as physics, biology or geology. Historically, the science of chemistry is a recent development but has its roots in alchemy which has been practiced for millennia throughout the world. The word chemistry is directly derived from the word alchemy.

Ex. 1 Match the definitions with the areas of chemistry

A) The study of how matter behaves on a molecular and atomic level and how chemical reactions occur. Based on their analyses, chemists may develop new theories, such as how complex structures are formed. They often work closely with materials scientists to research and develop potential uses for new materials.	**biochemistry**
B) The science of obtaining, processing, and communicating information about the composition and structure of matter. In other words, it is the art and science of determining what matter is and how much of it exists.	**physical chemistry**
C) The study of the structure, properties, composition, reactions, and preparation of carbon-containing compounds, which include not only hydrocarbons but also compounds with any number of other elements, including hydrogen (most compounds contain at least one carbon–hydrogen bond), nitrogen, oxygen, halogens, phosphorus, silicon, and sulfur. This branch of chemistry was originally limited to compounds produced by living organisms but has been broadened to include human-made substances such as plastics. The range of application of organic compounds is enormous and also includes, but is not limited to, pharmaceuticals, petrochemicals, food, explosives, paints, and cosmetics.	**inorganic chemistry**
D) The study of the structure, composition, and chemical reactions of substances in living systems. It emerged as a separate discipline when scientists combined biology with organic, inorganic, and physical chemistry and began to study how living things obtain energy from food, the chemical basis of heredity, what fundamental changes occur in disease, and related issues. It includes the sciences of molecular biology, immunochemistry, and neurochemistry, as well as bioinorganic, bioorganic, and biophysical chemistry	**organic chemistry**
E) Chemists study large, complex molecules that are built up from many smaller (sometimes	**analytical chemistry**

thereby remain competitive in the market. They also discover new marketable products which brings more revenue to their companies.

For instance, chemists in the cosmetics industry use their knowledge of chemistry to research and develop new fragrances, skin treatment solution, dyes, and other formulations that the company can market. Research and development chemists usually have PhD in chemistry fields; however, there are still numerous opportunities for BS or MS degree holders to work in the research and development department as technicians performing researches under the supervision of the chemist.

Quality Control Chemist: Quality control chemists in the industry help to check that the quality of their company's products is up to the desired standard before they are released into the market.

Production Chemist: Production chemists are responsible for translating the new products developed by the research chemists into something that can be mass produced by a manufacturing process. In performing their job, production chemists work closely with plant engineers in coming up with the right design of plant equipment to use for better productivity and costs. Production chemists supervise production and make sure production process complies with environmental protection policies. They also check quality control.

Food Chemist: In the food processing industry, food chemists use their knowledge of chemistry to create foods with desirable qualities, such as better taste, longer shelf life, improved nutrition, healthy and safe to consume.

Chemical Sales Career: Chemists can pursue sales careers in the chemical industry. Chemical manufacturing companies need people with chemistry background to sell their products directly to target customers. Chemists are able to work with customers and to determine the type of products that would best enable the customer to realize their goal.

This job involves one-on-one dealings with customers and so requires a great degree of interpersonal relationship skills.

Chemical Marketing Career: Chemists can also be involved in the marketing of chemical products. In addition to their chemistry background, chemists who wish to pursue a career in marketing will need to take some training in marketing. As a marketing professional, you will be involved in all processes that adequately publicize and compel target customers to buy your products. The job entails identifying and understanding your target customers and designing effective marketing strategies to reach and make them buy from you. It also involves studying sales and trends to predict the future.

repeating) units. They study how the smaller building blocks (monomers) combine, and create useful materials with specific characteristics by manipulating the molecular structure of the monomers/polymers used, the composition of the monomer/polymer combinations, and applying chemical and processing techniques that can, to a large extent, affect the properties of the final product. Chemists are unique within the chemistry community because their understanding of the relationship between structure and property spans from the molecular scale to the macroscopic scale.	
F) The study is concerned with the properties and behavior of inorganic compounds, which include metals, minerals, and organometallic compounds. While organic chemistry is defined as the study of carbon-containing compounds and it is the study of the remaining subset of compounds other than organic compounds, there is overlap between the two fields (such as organometallic compounds, which usually contain a metal or metalloid bonded directly to carbon).	**polymer chemistry**

Text 4 Careers in Chemistry

There are lots of career options for someone with a degree in chemistry. In fact, a chemist can work almost in all industries and government agencies. This is because chemistry covers every aspect of life.

Careers in chemistry can be grouped into four categories: careers in industrial chemistry, academics, government, and careers in related fields.

Careers in Industrial Chemistry

The chemical, petrochemical, pharmaceutical, food processing, breweries, and other industries are areas where most chemists usually seek for employment after completing their studies. There are wide varieties of careers for chemists there, including working in the business side of the firm, such as sales and customer support departments. Here are some of them.

Research and Development Chemist: Research and development chemists help their companies to research and discover ways to improve on their products so as to provide more and better value for the customer and

Technical Service Career: The technical service professional's job involves helping customers to solve problems relating to the workability of the product and troubleshooting for customers with problems, questions or challenges. It also involves generating new applications for the products and creating instructional manuals to guide customers on how to use the products.

Chemistry Careers in Schools

Schools offer the second largest places after the industries where graduates of chemistry can work. Chemistry teachers are needed to impart chemistry knowledge to students in high school, college or university.

High School Teacher: All high schools need chemistry teachers to teach the subject. To teach in a public school you will also be required to have an additional qualification in education. Private schools may not however demand education qualification; with a B.S. degree in chemistry you can be hired directly.

Undergraduate College or University Teacher: To be faculty member in a primarily undergraduate institution, you will almost need a PhD in chemistry. Your work will include to teach classes and labs, and to direct students' research projects.

Teacher at Research Universities: You will need to have PhD and some years of post-doctoral experience may be required to be faculty in research universities, which offer BS, MS, and PhD degree programs. You will be involved in teaching undergraduate and graduate courses, and directing research projects for groups of undergraduate and graduate students.

Careers in Support Positions: With background in chemistry, you can work in a number of support positions that require technical background in colleges and universities. These job positions include lab technician and staff scientist, safety officer, and stockroom manager.
The lab technician and staff scientist operates research equipment and performs support duties for teaching and research. The safety officer is responsible for handling and disposing of harmful waste, and to ensure that all safety guidelines, including EPA are enforced. The storeroom manager is responsible for ordering and maintaining inventories of chemicals and supplies to support the schools research and teaching programs.

Chemistry Careers in Government

A variety of job opportunities are available for graduates of chemistry in all levels of government – federal, state, and local government. For instance, the federal government runs national research laboratories across the country, which employs BS, MS and PhD graduates, including those with chemistry degrees, to research on a wide range of issues.

Other places that chemistry graduates can find employment with government are in government's regulatory agencies, such as the ATF, EPA, FBI, and FDA. These agencies employ chemists to carry out research and analysis so as to be able to effectively perform their role.

Also, chemists can build careers in forensic science and work with local, state, or national forensic science laboratories. This is because forensic science is based mainly on analytical chemistry and biochemistry.

Careers in Related Fields

Graduates of chemistry can also build career in non-core chemistry fields based on their training, which makes them suitable for such jobs. Some of these areas include:

Biotechnology: Chemistry and biochemistry graduates are qualified to pursue further training and career in biotechnology if they so desired.

Toxicology: This is an area interested chemists can get further training and build a career. Toxicologists study toxic substances to find out how they produce their effects and so create solutions for dealing with them. Some industries, including manufacturers of therapeutic drugs, cosmetics, food additives, and agriculture chemicals are often required by federal laws to perform thorough testing on their products before they are released into the market.

These industries therefore are compelled to employ toxicologists to perform the required tests and confirmation of the safety of their products.

Environmental Science: This is an area open to chemistry graduates to make a career. This is because chemistry is central to the study of the environment. As environmental scientists, you can work in the industries, with government, not-for-profit organizations, and in the colleges.

Dietary Science: With chemistry background, you can build a career in dietary science after taking some courses to properly integrate you into the profession. Dietary science is the study of how what we eat affects our health and wellbeing.

Career in the Medical Professions: If you are interested in pursuing medical careers such as being a medical doctor, pharmacist, dentist, veterinarian, and nursing, your degree in chemistry can qualify you to be admitted into the training program for the particular course.

Medical Laboratory: Chemistry background can enable you to work as laboratory technician in medical offices and hospitals. Medical lab technicians analyze patient samples for doctors to be able to effectively diagnose diseases. They may also be required to prepare drugs and other materials used in treating patients.

Technical Writing: If you have writing skill and are interested in combining it with your chemical training, technical or scientific writing is a good career path you can take. There are opportunities for technical writers to work for trade magazines and technical journals. You can also work as a writer in the industries to produce product manuals and other informational materials that enable the company to inform its customers about its products in the way that they will understand. A course in English and/or Journalism would help to achieve success in this profession.

Scientific Libraries: With a background in chemistry and some training in library science, you can work in science libraries. If you did a graduate study in library science, you could work as research librarian with government libraries and university research libraries. You could also work with large companies as a research librarian.

Museums: A background in chemistry combined with training in information technology can qualify you to work in museums. Your work may involve researching and producing materials for exhibits, making presentations, and procuring materials for the museum.

Patent Agency: A degree in chemistry can enable you to work as a patent agent with the federal government. The job involves analyzing patent applications to confirm if they are actually novel and worthy to be awarded a patent. The analytical skill which you gain from studying chemistry makes you suitable for the job.

Patent Law: You can become a patent lawyer after your chemistry degree by going to law school. The job of patent lawyers include helping scientists to prepare patents that are legally enforceable; helping their clients or employers to ensure that their patents rights are not infringed on; and going after those who infringe on their clients or employers patents.

Ex.1 Translate into Kazakh the words given below

- BS, MS, ATF, EPA, FBI, and FDA;
- to seek for employment after completing their studies;
- to bring revenue;
- to remain competitive;
- to be responsible for;
- to impart chemistry knowledge to;
- to require technical background;
- to perform support duties for;
- to carry out research;

- to build careers in forensic science;
- to make a career;
- to pursue further training;
- to perform thorough testing on;
- to gain analytical skills;
- to make suitable for the job;
- to infringe on patents, rights;
- career options;
- BS or MS degree holders;
- under the supervision;

? Test Yourself

Ex.2 Answer the following questions

a) Where can graduates with chemistry background work?

b) What job opportunities are available for graduates of chemistry in Kazakhstan?

c) What does "Chemistry in Related Fields" mean?

d) What profession would you like to choose?

Ex.3 Read the dialogue and make up a dialogue about your future profession.

Talking About Your Job

Jack: Hi Peter. Can you tell me a little bit about your current job?

Peter: Certainly. What would you like to know?

Jack: First of all, what do you work as?

Peter: I work as a computer technician at Schuller's and Co.

Jack: What do your responsibilities include?

Peter: I'm responsible for systems administration and in-house programming.

Jack: What sort of problems do you deal with on a day-to-do basis?

Peter: Oh, there are always lots of small system glitches. I also provide information on a need-to-know basis for employees.

Jack: What else does your job involve?

Peter: Well, as I said, for part of my job I have to develop in-house programs for special company tasks.

Jack: Do you have to produce any reports?

Peter: No, I just have to make sure that everything is in good working order.

Jack: Do you ever attend meetings?

Peter: Yes, I attend organizational meetings at the end of the month.

Jack: Thanks for all the information, Peter. It sounds like you have an interesting job.

Peter: Yes, it's very interesting, but stressful, too!

Key Vocabulary
day-to-day – күндегі, күнбе-күнгі, күн сайынғы, күндегі;
glitch – қате;
good working order – жарамдылық;
in-house– ішкі;
organizational meeting – ұйымдастыру жиналысы;
stressful – есеңгіреген;
to be responsible for – жауапты болу;
to develop– дамыту;
to involve – тартып алу;
to pay bills– салық төлеу;
to produce reports – баяндама жасау;

Ex.4 Prepare a one-minute speech for school-leavers to advertise your future profession

Text 5 History of the Periodic Table

In 1863, the English chemist John Newlands noticed that if the known elements were placed in order of their atomic weight, and then put into rows of seven, there were strong similarities between elements in the same vertical column.

This pattern became known as Newlands' law of octaves. It was useful for some of the elements, but unfortunately Newlands' pattern broke down when he tried to include the transition elements.

In 1896, the Russian chemist Dimitri Mendeleev produced his periodic table elements with similar properties occurred periodically and were placed in vertical columns called groups.

Like Newlands, Mendeleev arranged the elements in order of increasing atomic weight, but unlike Newlands he did not stick strictly to this order. He left gaps for elements that had yet to be discovered, such as germanium and gallium, and made detailed predictions about the physical and chemical properties these elements would have.

Eventually, when these elements were discovered and their properties analysed, scientists confirmed Mendeleev's predictions. His table went from being an interesting curiosity to a useful tool for understanding how a particular element would behave.

By leaving gaps and swapping the order of the elements, Mendeleev had actually arranged the elements in order of increasing atomic number (or the number of protons in the nucleus of an atom), even though protons themselves were not discovered until much later.

In fact, electrons, protons and neutrons were all discovered in the early 20^{th} century.

Text 6 Atoms and the Periodic Table

Today, scientists consider the periodic table an important summary of the structure of atoms. The periodic table can be used to source the boiling point or density of elements. A detailed periodic table can be used to find the names, symbols, relative atomic masses and atomic number of any element.

In the periodic table, elements are arranged in order of increasing atomic number. It is called a periodic table because elements with similar properties occur at regular intervals or 'periodically'. The elements are placed in horizontal rows, called periods, and elements with similar properties appear in the same vertical column. These vertical columns are called group 1 of the periodic table include lithium, sodium and potassium. All the elements in group 1 of the periodic table share similar properties: they are all metals expect H (hydrogen) and they all consist of atoms that have just one electron in their outer shell. When these metals react they form ions which have a 1 + charge. Elements in the same period have the same number of shells of electrons.

All the isotopes of an element have the same number of electrons and protons. All the isotopes of an element appear in the same place on the periodic table.

? Test Yourself

1 Why do scientists have to re-evaluate existing models?

2 How are the elements arranged in the modern periodic table?

3What are the horizontal rows and vertical columns in the periodic table called?

Text 7 Discovery and Assignment of Elements with Atomic Numbers 113, 115, 117 and 118

IUPAC announces the verification of the discoveries of four new chemical elements: The 7th period of the periodic table of elements is complete.

The fourth IUPAC/IUPAP Joint Working Party (JWP) on the priority of claims to the discovery of new elements has reviewed the relevant literature for elements 113, 115, 117, and 118 and has determined that the claims for discovery of these elements have been fulfilled, in accordance with the criteria for the discovery of elements of the IUPAP/IUPAC Transfermium Working Group (TWG) 1991 discovery criteria. These elements complete the 7th row of the periodic table of the elements, and the discoverers from Japan, Russia and the USA will now be invited to suggest permanent names and symbols.

"A particular difficulty in establishing these new elements is that they decay into hitherto unknown isotopes of slightly lighter elements that also need to be unequivocally identified" commented JWP chair Professor Paul J. Karol, "but in the future we hope to improve methods that can directly measure the atomic number, Z".

"The chemistry community is eager to see its most cherished table finally being completed down to the seventh row. IUPAC has now initiated the process of formalizing names and symbols for these elements temporarily named as ununtrium, (Uut or element 113), ununpentium (Uup, element 115), ununseptium (Uus, element 117), and ununoctium (Uuo, element 118)" said Professor Jan Reedijk, President of the Inorganic Chemistry Division of IUPAC.

The proposed names and symbols will be checked by the Inorganic Chemistry Division of IUPAC for consistency, translatability into other languages, possible prior historic use for other cases, etc. New elements can be named after a mythological concept, a mineral, a place or country, a property or a scientist. After Divisional acceptance, the names and two-letter symbols will be presented for public review for five months, before the highest body of IUPAC, the Council, will make a final decision on the names of these new chemical elements and their two-letter symbols and their introduction into the Periodic Table of the Elements.

"As the global organization that provides objective scientific expertise and develops the essential tools for the application and communication of chemical knowledge for the benefit of humankind, the International Union of Pure and Applied Chemistry is pleased and honored to make this announcement concerning elements 113, 115, 117, and 118 and the completion of the seventh row of the periodic table of the elements," said IUPAC President Dr. Mark C. Cesa, adding that, "we are excited about these new elements, and we thank the dedicated scientists who discovered them for their painstaking work, as well the members of the IUPAC/IUPAP Joint Working Party for completing their essential and critically important task."

Ex.1 Listen to the interview with Dr Ben Pilgrim, University of Cambridge http://www.thenakedscientists.com/HTML/articles/chemistry/

Four new elements discovered

Most school science labs have a periodic table on the wall but until now, there Periodic Table have been a few missing elements towards the bottom. Ben Pilgrim explained to Kat Arney why everyone is suddenly very excited about this historic table...

Ben Yes, there's been a very exciting week for chemistry. So IUPAC, announced that four elements (elements number 113, 115, 117 and 118) have been discovered. Now these haven't all been discovered in the last few days - that would be quite a coincidence. It's actually been about 10 or 15 years since scientists first started gathering evidence to suggest that these elements did exist. So there have been gaps in the periodic table; they've been predicted to be there for a long time, but it's all about the scientists getting enough data to be able to be sure that these elements are actually there.

Kat The periodic table - a lot of people have heard of it, a lot of people probably recognise it. What exactly is it as a way of categorising elements? How did they know that there were these gaps in there?

Ben So, elements are placed in a periodic table depending on the number of protons, which are a particle found in the nucleus of every atom, and there's basically, you know, the first element hydrogen has one proton, the second element helium has two, and so on. The number of protons defines what element you have and, it so happens these numbers I said earlier, they are the number of protons that we hadn't found yet but, you know, they should be there because it should be possible to have one with that particular number.

Kat So how do you go about discovering a new element - I assume you don't find it down the back of the sofa?

Ben Yes, I mean the problem is that there's about 90 elements on the earth, sort of naturally occurring, we find them around. They might be bound up with other things but they will always be there, they're stable. An oxygen will always be an oxygen, a gold will always be a gold. The trouble with these elements is they're radioactive, they're unstable. They fall apart after a very short amount to time - sometimes fractions of a second, and so the scientists actually have to make them and they do this by firing two lighter elements at each other. So, for example, they fire a calcium atom at an atom of americium. Calcium has a number of 20 and americium has a number of 95 and that adds together to make 115. Part of the difficulty is that these new ones we make, they are unstable, they fall apart, so how do we know we've made them?

Chris They hand around for something in the region of about a microsecond through to a couple of seconds, don't they. I mean someone was saying that one of these new elements, they'd only ever made 90 atoms ever.

Ben Yes. One of the ones I found out that 117 apparently 15 atoms have been observed, so...

Chris As many as that.

Ben You don't want to...

Kat Don't spend them all at once.

Ben But, imagine if you had a video, for example, of a game of snooker and someone had, by some computer wizardry, removed the cue ball from the piece of videotape that you might be able to think about where the cue ball was based on what the other balls were moving and how they were moving around the table, and that's a bit like what they have to do here. They have to kind of use what these heavy atoms decay into, and then kind of reconstruct and then assume what they had before.

Chris Can I just ask you the really simple question though which is - why are we doing this?

Ben Well I think it's very exciting because there's something that's referred to as the 'island of stability'. So, as we get heavier and heavier, the atoms are becoming less stable but, it's been hypothesised by a number of people that, once we get a little bit higher up we might actually get back into some stable elements again, some stable atoms and these may have new properties that, you know, haven't been seen before. So that's very exciting.

Kat And, of course, the big question is - what are we going to call them, because numbers aren't cool? We need like brilliant names. What's the...

Chris Ununtrium and ununpentium and ununseptium. Is that not sexy enough?

Kat Come on, no!

Ben Those names are a little dull, so they can be called after a number of things. A number are called after countries or places or after famous scientists.

Chris There was a petition this week to call one after Lemmy from Motorhead.

Ben Yes, this would be one of the heaviest of the heavy metals. Unfortunately, I think it has to be a scientist, according to the rules. There are certainly some British scientists - Humphry Davy, Michael Faraday that don't have elements named after them. Even perhaps one of our most famous scientist overall, Isaac Newton, doesn't have an element. But because the research groups - 113 was discovered by a Japanese group, the others by a collaboration between Russian scientists and American scientists, I think we might maybe see a reference to Japan in one of them, one based on the name of Moscow I've heard, and so I think that's perhaps slightly more likely.

Kat Well, I think we shall have to see.

Төменгіде берілген сөздер мен сөз тіркестерді аударып, жадыңызда сақтаңыз

Joint Working Party (JWP), the International Union of Pure and Applied Chemistry, to fulfill the claims for discovery, Transfermium Working Group (TWG),

Text 8 History and Uses of Chemical Elements

Ex.1 Read about 5 chemical elements and fill in the table below

	O	H	N	C	Pb	???
the name						
atomic number						
description						
properties						
uses						
health effects						
environmental effects						

Ex.2 Tell about the chemical elements with atomic numbers 99, 101,13,16,19, 20, 25, 26.

Text 8.1 Oxygen

Oxygen had been produced by several chemists prior to its discovery in 1774, but they failed to recognize it as a distinct element. Joseph Priestley and Carl Wilhelm Scheele both independently discovered oxygen, but Priestly is usually given credit for the discovery. They were both able to produce oxygen by heating mercuric oxide (HgO). Priestley called the gas produced in his experiments "dephlogisticated air" and Scheele called his "fire air". The name oxygen was created by Antoine Lavoisier who incorrectly believed that oxygen was necessary to form all acids.

Oxygen is the third most abundant element in the universe and makes up nearly 21% of the earth's atmosphere. Oxygen accounts for nearly half of the mass of the earth's crust, two thirds of the mass of the human body and nine tenths of the mass of water. Large amounts of oxygen can be extracted from liquefied air through a process known as fractional distillation. Oxygen can also be produced through the electrolysis of water or by heating potassium chlorate ($KClO_3$).

Oxygen is a highly reactive element and is capable of combining with most other elements. It is required by most living organisms and for most forms of combustion. Impurities in molten pig iron are burned away with streams of high pressure oxygen to produce steel. Oxygen can also be combined with acetylene (C_2H_2) to produce an extremely hot flame used for welding. Liquid oxygen, when combined with liquid hydrogen, makes an excellent rocket fuel. Ozone (O_3) forms a thin, protective layer around the earth that shields the surface from the sun's ultraviolet radiation. Oxygen is also a component of hundreds of thousands of organic compounds.

Gaseous chemical element, symbol: O, atomic number: 8 and atomic weight 15,9994. It's of great interest because it's the essential element in the respiratory processes of most of the living cells and in combustion processes. It's the most abundant element in The Earth's crust. Nearly one fifth (in volume) of the air is oxygen. Non-combined gaseous oxygen normally exists in form of diatomic molecules, O_2, but it also exists in triatomic form, O_3, named ozone.

In normal conditions oxygen is a colourless, odourless and insipid gas; it condensates in a light blue liquid. Oxygen is part of a small group of gasses literally paramagnetic, and it's the most paramagnetic of all. Liquid oxygen is also slightly paramagnetic.

Oxygen is reactive and will form oxides with all other elements except helium, neon, argon and krypton. It is moderately soluble in water (30 cm^3 per 1 liter of water dissolve) at 20 Celsius.

Applications. Oxygen can be separated from air by fractionated liquefaction and distillation. The main applications of oxygen in order of importance are: 1) melting, refining and manufacture of steel and other metals; 2) manufacture of chemicals by controlled oxidation; 3) rocket propulsion; 4) medical and biological life support; 5) mining, production and manufacture of stone and glass products.

An emergency supply of oxygen automatically becomes available for the passenger in an aircraft when the pressure drop suddently. This oxygen is stored not as an oxygen gas but as the chemical sodium chlorate.

Oxygen in the environment

The crust of earth is composed mainly of silicon-oxygen minerals, and many other elements are there as their oxides.

Oxygen gas makes up a fifth of the atmosphere, amounting to more than a million billion tonnes. The oxygen in the Earth's atmosphere comes from the photosynthesis of plants, and has built up in a long time as they utilised the abundant supply of carbon dioxide in the early atmosphere and released oxygen.

Oxygen is fairly soluble in water, which makes life in rivers, lakes and oceans possible. The water in rivers and lakes needs to have a regular supply of oxygen, for when this gets depleted the water will no longer support fish and other aquatic species.

Nearly every chemical, apart from the inert gasses, bind with oxygen to form compounds. Water, H2O, and silica, SiO2, main component of the sand, are among the more abundant binary oxygen compounds. Among the compounds which contain more than two elements, the most abundant are the silicates, that form most of the rocks and soils. Other compounds which are abundant in nature are calcium carbonate (limestone and marble), calcium sulphate (gypsum), aluminum oxide (bauxite) and various iron oxides, that are used as source of the metal.

Health effects of oxygen

Oxygen is essential for all forms of life since it is a constituent of DNA and almost all other biologically important compounds. Is it even more drammatically essential, in that animals must have minute by minute supply of the gas in order to survive. Oxygen in the lungs is picked up by the iron atom at the center of hemoglobin in the blood and thereby transported to where it is needed.

Every human being needs oxygen to breathe, but as in so many cases too much is not good. If one is exposed to large amounts of oxygen for a long time, lung damage can occur. Breathing 50-100% oxygen at normal pressure over a prolonged period causes lung damage. Those people, who work with frequent or potentially high exposures to pure oxygen, should take lung function tests before beginning employment and after that. Oxygen is usually stored under very low temperatures and therefore one should wear special clothes to prevent the freezing of body tissues.

Environmental effects of oxygen

Highly concentrated sources of oxygen promote rapid combustion and therefore are fire and explosion hazards in the presence of fuels.

The fire that killed the Apollo 1 crew on a test launchpad spread so rapidly because the pure oxygen atmosphere was at normal atmospheric pressure instead of the one third pressure that would be used during an actual launch.

Key vocabulary

distinct recognizably different in nature from something else of a similar type

given credit for the discovery - praise that is given to someone for something they have done

oxide ['ɔksaɪd] ; окисел

impurity қоспа, араласқан

molten iron = molten pig iron шойын

welding ['weldɪŋ] пісіру, дәнекерлеу

potassium [pə'tasēəm] the chemical element of atomic number 19, a soft, silvery-white reactive metal of the alkali metal group.

combustion [kəm'bʌsʧ(ə)n] жану

abundant кең таралған

odourless ['əudələs] иіссіз

insipid [ɪn'sɪpɪd] тұщы

soluble ['sɔljəbl] ерігіш

liquefaction [ˌlɪkwɪ'fækʃ(ə)n] сұйылту

rocket propulsion зымыран қозғалысы

aquatic [ə'kwætɪk] су

limestone ['laɪmstəun] әктас

marble ['mɑːbl] мәрмәр

gypsum ['ʤɪpsəm] гипс

bauxite ['bɔːksaɪt] боксит, алюминий кені

DNA deoxyribonucleic acid ДНҚ, дезоксирибонуклеин қышқылы

tissue ['tɪʃuː] тін, материя

hazard ['hæzəd]қауіптілік

launchpad сөре алаңы

Text 8.2 Hydrogen

Hydrogen is the first element in the periodic table. In normal conditions it's a colourless, odourless and insipid gas, formed by diatomic molecules, H_2. The hydrogen atom, symbol H, is formed by a nucleus with one unit of positive charge and one electron. Its atomic number is 1 and its atomic weight 1,00797 g/mol. It's one of the main compounds of water and of all organic matter, and it's widely spread not only in The Earth but also in the entire Universe. There are three hydrogen isotopes: protium, mass 1, found in more than 99,985% of the natural element; deuterium, mass 2, found in nature in 0.015% approximately, and tritium, mass 3, which appears in small quantities in nature, but can be artificially produced by various nuclear reactions.

Uses: The most important use of hydrogen is the ammonia synthesis. The use of hydrogen is extending quickly in fuel refinement, like the breaking down by hydrogen (hydrocracking), and in sulphur elimination. Huge quantities of hydrogen are consumed in the catalytic hydrogenation of unsaturated vegetable oils to obtain solid fat. Hydrogenation is used in the manufacture of organic chemical products. Huge quantities of hydrogen are used as rocket fuels, in combination with oxygen or fluor, and as a rocket propellent propelled by nuclear energy.

Hydrogen can be burned in internal combustion engines. Hydrogen fuel cells are being looked into as a way to provide power and research is being conducted on hydrogen as a possible major future fuel. For instance it can be converted to and from electricity from bio-fuels, from and into natural gas and diesel fuel, theoretically with no emissions of either CO2 or toxic chemicals.

Properties: Common hydrogen has a molecular weight of 2,01594 g. As a gas it has a density of 0.071 g/l at 0ºC and 1 atm. Its relative density, compared with that of the air, is 0.0695. Hydrogen is the most flammable of all the known substances. Hydrogen is slightly more soluble in organic solvents than in water. Many metals absorb hydrogen. Hydrogen absorption by steel can result in brittle steel, which leads to fails in the chemical process equipment.

At normal temperature hydrogen is a not very reactive substance, unless it has been activated somehow; for instance, by an appropriate catalyser. At high temperatures it's highly reactive.

Although in general it's diatomic, molecular hydrogen dissociates into free atoms at high temperatures. Atomic hydrogen is a powerful reductive agent, even at ambient temperature. It reacts with the oxides and chlorides of many metals, like silver, copper, lead, bismuth and mercury, to produce free metals. It reduces some salts to their metallic state, like nitrates, nitrites and sodium and potassium cyanide. It reacts with a number of elements, metals and non-metals, to produce hydrides, like NAH, KH, H_2S and PH_3. Atomic hydrogen produces hydrogen peroxide, H_2O_2, with oxygen.

Atomic hydrogen reacts with organic compounds to form a complex mixture of products; with etilene, C_2H_4, for instance, the products are ethane, C_2H_6, and butane, C_4H_{10}. The heat released when the hydrogen atoms recombine to form the hydrogen molecules is used to obtain high temperatures in atomic hydrogen welding.

Hydrogen reacts with oxygen to form water and this reaction is extraordinarily slow at ambient temperature; but if it's accelerated by a catalyser, like platinum, or an electric spark, it's made with explosive violence.

Health effects of hydrogen

Effects of exposure to hydrogen: Fire: Extremely flammable. Many reactions may cause fire or explosion. Explosion: Gas/air mixtures are explosive. Routes of exposure: The substance can be absorbed into the body by inhalation. Inhalation: High concentrations of this gas can cause an oxygen-deficient environment. Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting and depression of all the senses. The skin of a victim may have a blue color. Under some circumstances, death may occur. Hydrogen is not expected to cause mutagenicity, embryotoxicity, teratogenicity or reproductive toxicity. Pre-existing respiratory conditions may be aggravated by overexposure to hydrogen. Inhalation risk: On loss of containment, a harmful concentration of this gas in the air will be reached very quickly.

Physical dangers: The gas mixes well with air, explosive mixtures are easily formed. The gas is lighter than air.

Chemical dangers: Heating may cause violent combustion or explosion. Reacts violently with air, oxygen, halogens and strong oxidants causing fire and explosion hazard. Metal catalysts, such as platinum and nickel, greatly enhance these reactions.

High concentrations in the air cause a deficiency of oxygen with the risk of unconsciousness or death. Check oxygen content before entering area. No odor warning if toxic concentrations are present. Measure hydrogen concentrations with suitable gas detector (a normal flammable gas detector is not suited for the purpose).

First aid: Fire: Shut off supply; if not possible and no risk to surroundings, let the fire burn itself out; in other cases extinguish with water spray, powder, carbon dioxide. Explosion: In case of fire: keep cylinder cool by spraying with water. Combat fire from a sheltered position. Inhalation: Fresh air, rest. Artificial respiration may be needed. Refer for medical attention. Skin: Refer for medical attention.

Environmental effects of hydrogen

Hydrogen in the environment: Hydrogen forms 0.15 % of the earth's crust, it is the major constituent of water. 0.5 ppm of hydrogen H_2 and varial proportions as water vapour are present in the atmosphere. Hydrogen is also a major component of biomass, consituing the 14% by weight.

Environmental stability: hydrogen occurs naturally in the atmosphere. The gas will be dissipated rapidly in well-ventilated areas.

Effect on plants or animals: Any effect on animals would be related to oxygen deficient environments. No adverse effect is anticipated to occur to plant life, except for frost produced in the presence of rapidly expanding gases.

Effect on aquatic life: No evidence is currently available on the effect of hydrogen on aquatic life.

Scientists had been producing hydrogen for years before it was recognized as an element. Written records indicate that Robert Boyle produced hydrogen gas as early as 1671 while experimenting with iron and acids. Hydrogen was first recognized as a distinct element by Henry Cavendish in 1766.

Composed of a single proton and a single electron, hydrogen is the simplest and most abundant element in the universe. It is estimated that 90% of the visible universe is composed of hydrogen.

Hydrogen is the raw fuel that most stars 'burn' to produce energy. The same process, known as fusion, is being studied as a possible power source for use on earth. The sun's supply of hydrogen is expected to last another 5 billion years.

Hydrogen is a commercially important element. Large amounts of hydrogen are combined with nitrogen from the air to produce ammonia (NH_3) through a process called the Haber process. Hydrogen is also added to fats and oils, such as peanut oil, through a process called hydrogenation. Liquid hydrogen is used in the study of superconductors and, when combined with liquid oxygen, makes an excellent rocket fuel.

Hydrogen combines with other elements to form numerous compounds. Some of the common ones are: water (H_2O), ammonia (NH_3), methane (CH_4), table sugar ($C_{12}H_{22}O_{11}$), hydrogen peroxide (H_2O_2) and hydrochloric acid (HCl).

Hydrogen has three common isotopes. The simplest isotope, called protium, is just ordinary hydrogen. The second, a stable isotope called deuterium, was discovered in 1932. The third isotope, tritium, was discovered in 1934.

Key vocabulary

solvent ['sɔlvənt] еріткіш

brittle ['brɪtl] сынғыш

dizziness ['dɪzɪnəs] бас айналу

drowsiness ['drauzɪnəs] қалғу, мүлгу

nausea ['nɔ:sɪə], ['nɔ:zɪə] жүрек айнушылық

vomiting ['vɔmɪtɪŋ] құсық, лоқсу, құсу

distinct [dɪ'stɪŋkt] жеке

Haber process an industrial process for producing ammonia from nitrogen and hydrogen, using an iron catalyst at high temperature and pressure (named after Fritz Haber (1868 - 1934) and Carl Bosch (1874 - 1940), German chemists).

Text 8.3 Nitrogen

Nitrogen is a common normally colourless, odourless, tasteless and mostly diatomic non-metal gas. It has five electrons in its outer shell, so it is trivalent in most compounds.

Applications. The greatest single commercial use of nitrogen is as a component in the manufacture of ammonia, subsequently used as fertilizer and to produce nitric acid.

Liquid nitrogen (often referred to as LN2) is used as a refrigerant for freezing and transporting food products.

Nitric acid salts include some important compounds, for example potassium nitrate, nitric acid, and ammonium nitrate. Nitrated organic compounds, such as nitro-glycerine and trinitrotoluene, are often explosives.

Nitrogen in the environment. Nitrogen constitutes 78 percent of Earth's atmosphere and is a constituent of all living tissues. Nitrogen is an essential element for life, because it is a constituent of DNA and, as such, is part of the genetic code.

Nitrogen molecules occur mainly in air. In water and soils nitrogen can be found in nitrates and nitrites. All of these substances are a part of the nitrogen cycle, and there are all interconnected.

Humans have changed natural nitrate and nitrite proportions radically, mainly due to the application of nitrate-containing manures. Nitrogen is emitted extensively by industrial companies, increasing the nitrate and nitrite supplies in soil and water as a consequence of reactions that take place in the nitrogen cycle. Nitrate concentrations in drinking water will greatly increase due to this.

Health effects of nitrogen. Nitrates and nitrites are known to cause several health effects. These are the most common effects:

- Reactions with haemoglobin in blood, causing the oxygen carrying capacity of the blood to decrease (nitrite);
- Decreased functioning of the thyroid gland (nitrate);
- Vitamin A shortages (nitrate);
- Fashioning of nitro amines, which are known as one of the most common causes of cancer (nitrates and nitrites).

But from a metabolic point of view, nitric oxide (NO) is much more important than nitrogen alone. In 1987, Salvador Moncada discovered that this was a vital body messenger for relaxing muscles, and today we know that it is involved in the cardiovascular system, the immune system, the central nervous system and the peripheral nervous system. The enzyme that produces nitric oxide, called nitric oxide synthesis, is abundant in the brain.

Environmental effects of nitrogen

Humans have radically changed natural supplies of nitrates and nitrites. The main cause of the addition of nitrates and nitrites is the extensive use of fertilizers. Combustion processes can also enhance the nitrate and nitrite supplies, due to the emission of nitrogen oxides that can be converted to nitrates and nitrites in the environment.

Nitrates and nitrites also form during chemical production and they are used as food conservers. This causes groundwater and surface water nitrogen concentration, and nitrogen in food to increase greatly.

The addition of nitrogen bonds in the environment has various effects. Firstly, it can change the composition of species due to susceptibility of certain organisms to the consequences of nitrogen compounds. Secondly, mainly nitrite may cause various health effects in humans and animals. Food that is rich in nitrogen compounds can cause the oxygen transport of the blood to decrease, which can have serious consequences for cattle.

High nitrogen uptake can cause problems in the thyroid gland and it can lead to vitamin A shortages. In the animal stomach and intestines nitrates can form nitroamines; dangerously carcinogenic compounds.

Key vocabulary

ammonia [ə'məunıə] аммиак
manure [mə'njuə] тыңайтқыш
emit [ı'mıt] шығару
susceptibility [səˌseptə'bılətı] сезінушілік

Text 8.4 Carbon

Carbon, the sixth most abundant element in the universe, has been known since ancient times. Carbon is most commonly obtained from coal deposits, although it usually must be processed into a form suitable for commercial use. Three naturally occurring allotropes of carbon are known to exist: amorphous, graphite and diamond.

Amorphous carbon is formed when a material containing carbon is burned without enough oxygen for it to burn completely. This black soot, also known as lampblack, gas black, channel black or carbon black, is used to make inks, paints and rubber products. It can also be pressed into shapes and is used to form the cores of most dry cell batteries, among other things.

Graphite, one of the softest materials known, is a form of carbon that is primarily used as a lubricant. Although it does occur naturally, most commercial graphite is produced by treating petroleum coke, a black tar residue remaining after the refinement of crude oil, in an oxygen-free oven. Naturally occurring graphite occurs in two forms, alpha and beta. These two forms have identical physical properties but different crystal structures. All artificially produced graphite is of the alpha type. In addition to its use as a lubricant, graphite, in a form known as coke, is used in large amounts in the production of steel. Coke is made by heating soft coal in an oven without allowing oxygen to mix with it. Although commonly called lead, the black material used in pencils is actually graphite.

Diamond, the third naturally occurring form of carbon, is one of the hardest substances known. Although naturally occurring diamond is typically used for jewelry, most commercial quality diamonds are artificially produced. These small diamonds are made by squeezing graphite under high temperatures and pressures for several days or weeks and are primarily used to make things like diamond tipped saw blades. Although they posses very different physical properties, graphite and diamond differ only in their crystal structure.

A fourth allotrope of carbon, known as white carbon, was produced in 1969. It is a transparent material that can split a single beam of light into two beams, a property known as birefringence. Very little is known about this form of carbon.

Large molecules consisting only of carbon, known as buckminsterfullerenes, or buckyballs, have recently been discovered and are currently the subject of much scientific interest. A single buckyball consists of 60 or 70 carbon atoms (C60 or C70) linked together in a structure that looks like a soccer ball. They can trap other atoms within their framework, appear to be capable of withstanding great pressures and have magnetic and superconductive properties.

Carbon-14, a radioactive isotope of carbon with a half-life of 5,730 years, is used to find the age of formerly living things through a process known as radiocarbon dating. The theory behind carbon dating is fairly simple. Scientists know that a small amount of naturally occurring carbon is carbon-14. Although carbon-14 decays into nitrogen-14 through beta decay, the amount of carbon-14 in the environment remains constant because new carbon-14 is always being created in the upper atmosphere by cosmic rays. Living things tend to ingest materials that contain carbon, so the percentage of carbon-14 within living things is the same as the percentage of carbon-14 in the environment. Once an organism dies, it no longer ingests much of anything. The carbon-14 within that organism is no longer replaced and the percentage of carbon-14 begins to decrease as it decays. By measuring the percentage of carbon-14 in the remains of an organism, and by assuming that the natural abundance of carbon-14 has remained constant over time, scientists can estimate when that organism died. For example, if the concentration of carbon-14 in the remains of an organism is half of the natural concentration of carbon-14, a scientist would estimate that the organism died about 5,730 years ago, the half-life of carbon-14.

There are nearly ten million known carbon compounds and an entire branch of chemistry, known as organic chemistry, is devoted to their study. Many carbon compounds are essential for life as we know it. Some of the most common carbon compounds are: carbon dioxide (CO_2), carbon monoxide (CO), carbon disulfide (CS_2), chloroform ($CHCl_3$), carbon tetrachloride (CCl_4), methane (CH_4), ethylene (C_2H_4), acetylene (C_2H_2), benzene (C_6H_6), ethyl alcohol (C_2H_5OH) and acetic acid (CH_3COOH).

Key vocabulary

bluish көгілдірлеу
lustrous ['lʌstrəs] жалтыр, жылтыр
malleable ['mælɪəbl] созымды, қақталатын
ductile ['dʌktaɪl] созымды, қақталатын
resistant to corrosion тот баспайтын
tarnish ['tɑːnɪʃ] күңгірттену, қараңғылану, жалтыры кету
lead [led] қорғасын
alloy ['ælɔɪ] коспа
pewter ['pjuːtə] қалайы мен қорғасының қорытпасы

Text 8.5 Lead

Lead is a bluish-white lustrous metal. It is very soft, highly malleable, ductile, and a relatively poor conductor of electricity. It is very resistant to corrosion but tarnishes upon exposure to air. Lead isotopes are the end products of each of the three series of naturally occurring radioactive elements.

Applications. Lead pipes bearing the insignia of Roman emperors, used as drains from the baths, are still in service. Alloys include pewter and solder. Tetraethyl lead ($PbEt_4$) is still used in some grades of petrol (gasoline) but is being phased out on environmental grounds.

Lead is a major constituent of the lead-acid battery used extensively in car batteries. It is used as a coloring element in ceramic glazes, as projectiles, in some candles to threat the wick. It is the traditional base metal for organ pipes, and it is used as electrodes in the process of electrolysis. One of its major uses is in the glass of computer and television screens, where it shields the viewer from radiation. Other uses are in sheeting, cables, solders, lead crystal glassware, ammunitions, bearings and as weight in sport equipment.

Lead in the environment. Native lead is rare in nature. Currently lead is usually found in ore with zinc, silver and copper and it is extracted together with these metals. The main lead mineral in Galena (PbS) and there are also deposits of cerrussite and anglesite which are mined. Galena is mined in Australia, which produces 19% of the world's new lead, followed by the USA, China, Peru' and Canada. Some is also mined in Mexico and West Germany. World production of new lead is 6 million tonnes a year, and workable reserves total are estimated 85 million tonnes, which is less than 15 year's supply.

Lead occurs naturally in the environment. However, most lead concentrations that are found in the environment are a result of human activities. Due to the application of lead in gasoline an unnatural lead-cycle has consisted. In car engines lead is burned, so that lead salts (chlorines, bromines, oxides) will originate.

These lead salts enter the environment through the exhausts of cars. The larger particles will drop to the ground immediately and pollute soils or surface waters, the smaller particles will travel long distances through air and remain in the atmosphere. Part of this lead will fall back on earth when it is raining. This lead-cycle caused by human production is much more extended than the natural lead-cycle. It has caused lead pollution to be a worldwide issue.

Health effects of lead. Lead is a soft metal that has known many applications over the years. It has been used widely since 5000 BC for application in metal products, cables and pipelines, but also in paints and pesticides. Lead is one out of four metals that have the most damaging effects on human health. It can enter the human body through uptake of food (65%), water (20%) and air (15%).

Foods such as fruit, vegetables, meats, grains, seafood, soft drinks and wine may contain significant amounts of lead. Cigarette smoke also contains small amounts of lead.

Lead can enter (drinking) water through corrosion of pipes. This is more likely to happen when the water is slightly acidic. That is why public water treatment systems are now required to carry out pH-adjustments in water that will serve drinking purposes.

For as far as we know, lead fulfils no essential function in the human body, it can merely do harm after uptake from food, air or water.

Lead can cause several unwanted effects, such as:

- disruption of the biosynthesis of haemoglobin and anaemia;
- a rise in blood pressure;

- kidney damage;
- miscarriages and subtle abortions;
- disruption of nervous systems;
- brain damage;
- diminished learning abilities of children;
- behavioural disruptions of children, such as aggression, impulsive behavior and hyperactivity.

Lead can enter a foetus through the placenta of the mother. Because of this it can cause serious damage to the nervous system and the brains of unborn children.

Environmental effects of lead. Not only leaded gasoline causes lead concentrations in the environment to rise. Other human activities, such as fuel combustion, industrial processes and solid waste combustion, also contribute.

Lead can end up in water and soils through corrosion of leaded pipelines in a water transporting system and through corrosion of leaded paints. It cannot be broken down; it can only converted to other forms.

Lead accumulates in the bodies of water organisms and soil organisms. These will experience health effects from lead poisoning. Health effects on shellfish can take place even when only very small concentrations of lead are present. Body functions of phytoplankton can be disturbed when lead interferes. Phytoplankton is an important source of oxygen production in seas and many larger sea-animals eat it. That is why we now begin to wonder whether lead pollution can influence global balances.

Soil functions are disturbed by lead intervention, especially near highways and farmlands, where extreme concentrations may be present. Soil organisms than suffer from lead poisoning, too.

Lead is a particularly dangerous chemical, as it can accumulate in individual organisms, but also in entire food chains.

Key vocabulary
conductor өткізгіш
lead қорғасын
resistant to corrosion тот баспайтын
foetus ұрық
lustrous ['lʌstrəs] жалтыр, жылтыр

Text 9 Matter and Properties of Matter

Matter can be described and identified by physical and chemical properties. Physical (chemicals, properties, substances, textures) have to do with appearance. You can observe many physical properties with your senses and by measuring the length, (width, density, height, property), height, mass and density of a substance. (Chemical, Matter, Described, Physical) properties include color, shape, smell, texture, taste and size. The state of matter (whether it's a solid,(water, molecule, liquid, atom), or gas) and the (time, temperature, design, cylinder) at which the substance boils, melts or freezes are also physical properties. Magnetic properties are physical properties as well.

(Chemical, Physical, Substance, Gaseous) properties, on the other hand, have more to do with the atomic or molecular composition of matter. Chemical properties deal with how substances react with other (properties, physicals, degrees, substances) such as water, air or fire.

A physical change has occurred when a substance changes color, size, shape, temperature or state. A (temperature, physical, chemical, color) change has occurred when a substance has changed into something new or (similar, different, familiar, original) so that the original substance is gone. Digestion and combustion are examples of chemical changes. A chemical change takes place in a (battery, bulb, change, switch) to produce electricity when you turn on a flashlight.

Chemical changes are sometimes represented by a chemical formula:

$2H2 + O2 = 2H2O$

This formula states that two hydrogen gas molecules react with one oxygen gas molecule to produce two molecules of water.

Text 10 Properties of Solids, Liquids, and Gases

A solid has a definite (mass, texture, volume) and a (3D, irregular, definite) shape. The particles in a solid are . Particles in a solid move by . solids soften before melting. The particles in this type of solid are not arranged in regular pattern. Amorphous solids have a distinct melting point. Crystalline solids have a .

Liquids have no of their own. A liquid takes the shape of its container. Without a container liquids spread into a wide, shallow puddle. The of a liquid does not change. is a term used to describe a liquids resistance to flow. Some liquids flow easier than others because the particles in liquids with are spread further apart.

Gases can change very easily. The determines the volume and shape of a gas. The movement of gas particles could be described as .

Text 11 Chemical Reactions and Atoms

Symbols

Each element has its own unique symbol that is recognised all over the world.

Each symbol consists of one or two letters and is much easier to read and write the full name.

In some cases the symbol for an element is simply the first letter of the element's name. This letter must be a capital letter: the element iodine is represented by the symbol I.

Occasionally, an element may take its symbol from its former Latin name. When this happens, the first letter is a capital and the second letter, if there is one, is lower case: the element mercury is represented by the symbol Hg. This comes from the Latin name for mercury, which was hydrargyrum, or **liquid silver**.

Several elements have names that start with the same letter. When this happens, the first letter of the element's name is used, together with another letter from the name. The first letter is a capital and the second letter is lower case: the element magnesium is represented by the symbol Mg.

Chemical Formulae

Compounds consist of two or more different types of atom that have been chemically combined.

A compound can be represented using a chemical formula that shows the type and ratio of the atoms that are joined together in the compound.

Ammonia has the chemical formula NH_3. This shows that in ammonia, nitrogen and hydrogen atoms are joined together in the ratio of one nitrogen atom to three hydrogen atoms.

You should take care when writing out the symbols for chemicals compounds as some of them are very similar to elements. For example:

The element carbon has the symbol C

The element oxygen has the symbol O

The element cobalt has the symbol Co

The formula CO shows that a carbon atom and an oxygen atom have been chemically combined in a 1:1 ratio. This is the formula of the compound carbon monoxide.

The symbol Co represents the element cobalt. Notice how the second letter of the symbol is written in lower case. If it wasn't, it would be a completely different substance.

The formula CO_2 shows that carbon and oxygen atoms have been chemically combined in a 1:2 ratio. This is the formula of the compound carbon dioxide.

Chemical reactions

Atoms can join together by:

Covalent bonding – sharing pairs of electrons.

Ionic bonding – giving and taking electrons.

Compounds formed from metals and non-metals consist of ions. These compounds are held together by strong ionic bonds. Compounds formed from non-metals often consist of molecules. The atoms are held together by strong covalent bonds.

Word and Symbol Equations

Symbol equations can be used to describe what happens during a chemical reaction.

When magnesium burns in air the magnesium metal reacts with the non-metal atoms in oxygen molecules to form the ionic compound magnesium oxide. The reaction can be shown in a word equation:

Magnesium + Oxygen → Magnesium Oxide

or by the symbol equation:

$2Mg + O_2 \longrightarrow 2MgO$

Atoms are not created or destroyed during a chemical reaction: the atoms are just rearranged.

This means that the total mass of the reactants is the same as the total mass of the products.

Ionic Compounds

Ionic compounds are formed when a metal reacts with a non-metal. When metal atoms react they lose negatively charged electrons to become positively charged ions (or **cations**). When non-metal atoms react they gain negatively charged electrons to become negatively charged ions (or **anions**).

Build Your Understanding

There is no overall charge on ionic compounds so you can use the charge on the ions to work out the formula of the ionic compound.

Metal Ions	**Non-metal Ions**
Sodium, Na+	Bromide, Br-
Pottasium, K+	Chloride, Cl-

The compound sodium contains sodium, Na+, and chloride, Cl-, ions. For every one sodium ion one chloride ion is required. The overall formula for the compound is NaCl.

? Test Yourself

1 How can atoms join together?

2 Give the name of the elements with the symbols Na and Cr.

3 A water molecule has the formula H_2O.

Explain what this formula tells us.

4 Sodium nitrate has the formula $NaNO_3$.

Explain what this formula tells us.

Stretch Yourself

Give the formula for the following compounds:

potassium chloride.

sodium bromide.

Watch the video

http://go.mail.ru/search_video?tsg=l&q=chemistry+in+everyday+life

Give more examples

Chemical compounds have been employed for a number of useful purposes in our daily life, for example sugar is used to sweeten tea, soaps are used for washing and bathing purpose etc. besides this a number of compounds find application in agriculture, textiles, medicine, photography etc. the chemicals, those play a very important role in our daily life in a number of biological processes.

Drugs and medicines

Drugs are chemicals of low molecular masses whose intake by a living system has a physiological effect. If the drugs help in the treatment of diseases and reduce pain and suffering of the body, it is known as medicine.

Key Vocabulary

bubble - a ball of gas that appears in a liquid, or a ball formed of air surrounded by liquid that floats in the air;

liquid- a substance, for example water, that is not solid and that can be poured easily;

churn- to mix something, especially liquids, with great force;

portrayal -when you portray someone or something;

batter-a mixture of flour, milk, and often eggs used to make cakes and pancakes (= thin fried cakes), and to cover fish, etc before it is fried;

chunk-a large piece of something;

ooze- If a liquid oozes from something or if something oozes a liquid, the liquid comes out slowly

rim- the edge of something round.

Text 12 Nanotechnology

Nanotechnology is science and engineering at the scale of atoms and molecules. It is the manipulation and use of materials and devices so tiny that nothing can be built any smaller. Nanomaterials are typically between 0.1 and 100 nanometres (nm) in size – with 1 nm being equivalent to one billionth of a metre (10^9 m).

This is the scale at which the basic functions of the biological world operate – and materials of this size display unusual physical and chemical properties. These profoundly different properties are due to an increase in surface area compared to volume as particles get smaller – and also the grip of weird quantum effects at the atomic scale.

Unwittingly, people have made use of some unusual properties of materials at the nanoscale for centuries. Tiny particles of gold for example, can appear red or green – a property that has been used to colour stained glass windows for over 1,000 years.

Experimental nanotechnology did not come into its own until 1981, when IBM scientists in Zurich, Switzerland, built the first scanning tunneling microscope. This allows us to see single atoms by scanning a tiny probe over the surface of a silicon crystal. In 1990, IBM scientists discovered how to use an STM (scanning tunneling microscope) to move single xenon atoms around on a nickel surface.

Engineering at the nanoscale is no simple feat, and scientists are having to come up with completely different solutions to build from the "bottom-up" rather than using traditional "top-down" manufacturing techniques. Some nanomaterials, such as nanowires and other simple devices have been shown to assemble themselves given the right conditions, and other experiments at larger scales are striving to demonstrate the principles of self-assembly. Micro-electronic devices might be persuaded to grow from the ground up, rather like trees.

In the short term, the greatest advances through nanotechnology will come in the form of novel medical devices and processes, new catalysts for industry and smaller components for computers. In medicine, for example, we are already seeing research on: new ways to deliver drugs with contact lenses; the directing of drugs to tumours with tiny "smart bombs"; gold "nano-bullets" that seek and destroy tumours; starving cancer with nanoparticles; diagnosing diseases such as Alzheimer's, monitoring health and fighting sickness with tiny probes; and growing new organs from scratch.

Ex.1 Which words or phrases in the text mean:

A	a brain disease mainly of old people which makes a person forget things and stops them from thinking clearly	Alzheimer's
B	a group of cells in someone's body which are not growing normally	
C	a substance that makes a chemical reaction happen more quickly	
D	new or different from anything else	
E	new discoveries and inventions	
F	to think of a plan, an idea, or a solution to a problem	
G	to build something by joining parts together	
H	very strange	
I	control over something or someone	
J	in the near future	
K	a piece of equipment that is used for a particular purpose extremely small	
L	a quality of something	
M	without intending to do something	
N	If you do something from scratch, you do it from the beginning.	

Text 13 Smart Materials

Many scientists are involved in making new materials, which can have very special properties. Smart materials have one or more property that can be dramatically, and reversibly, altered by changes in the environment.

Scientists are working to find more applications for smart materials.

A whole variety of smart materials already exist including shape-memory alloys, thermochromic materials and photochromic materials.

Photochromic materials change colour when exposed to bright light. They are widely used to make lenses for glasses. The lenses adapt to light conditions: when it is bright, the lenses get darker.

Hydrogels are a new type of polymer. They are able to absorb water and swell up as the result of changes in temperature.

Hydrogels are being used to make special wound dressings. They help to:

- stop fluid loss from the wound;
- absorb bacteria and odour molecules;
- cool and cushion the wound;
- reduce the number of times the wound has to be disturbed.

The hydrogel is transparent, so medical staff can monitor the wound without having to remove the dressing.

Buckminster Fullerene

The element carbon exists in three forms or allotropes:
- graphite;
- diamond;
- fullerenes.

Fullerenes are structures made when carbon atoms join together to form tubes, balls or cages, which are held together by strong covalent bonds. The most symmetrical and most stable example is buckminster fullerene. This is a new material scientist have discovered, which consists of 60 carbon atoms joined together in a series of hexagons and pentagons, much like a leather football.

Nanoparticles

Nanoscience is the study of extremely small pieces of material called nanoparticles. Scientists are currently researching the properties of new nanoparticles.

These are substances that contain just a few hundred atoms and vary in size from 1 nm (nanometres) to 100 nm (human hair has a width of about 100 000 nm). Nanoparticles occur in nature, for example in sea spray. They can also be made accidentally, for example when fuels are burned.

Nanomaterials have unique properties because of the very precise way in which the atoms are arranged. Scientists have found that many materials behave differently on such a small scale.

Lightweight Materials

Scientists are using nanoparticles to develop lightweight materials. These materials are incredibly hard and strong because of the precise way that the atoms are arranged. One day these materials could be used to build planes.

Other Uses of Nanoparticles

Nanoparticles have a very high surface area to volume ratio. Scientists hope that this will allow them to use nanoparticles in exciting ways such as:

in new computers;
in sunscreens and deodorants;
in drug delivery systems;
as better catalysts.

Catalysts are substances that speed up the rate of a chemical reaction, but are not themselves used up. Reactions take place at the surface of the catalyst. The larger the surface area of the catalyst, the more changes can take place at once and the better the catalyst performs.

Scientists are also keen to explore the use of nanoparticles as sensors to detect biological or chemical agents at very low levels. They may also be used to make battery electrodes for electric vehicles or solar cells.

Nanoscale silver particles have antibacterial, antiviral and antifungal properties. These tiny pieces of silver are incorporated into materials to make clothes and medical dressings stay fresh for longer.

There has recently been a great deal of media interest in the development and applications of new nanoparticles. Some scientists are concerned that certain nanoparticles could be dangerous to people because their exceptionally small size may mean they are able to pass into the body in previously unimaginable ways, and could go on to cause health problems.

? Test Yourself

1 Why are smart materials special?

2 How big are nanoparticles?

3 What is the formula of buckminster fullerene?

4 Where are nanoparticles found in nature?

Text 14 Making New Chemicals

The manufacture of useful chemical involves many stages. Raw materials need to be selected and prepared, and then the new chemicals have to be made in a process known as synthesis.

Next, the useful products have to be separated from by-products and waste, each of which must also be dealt with. Finally, the purity of the product must be checked.

Some chemicals are made in **batch processes** which are used to make relatively small amounts of special chemicals such as medicines. The chemicals are made when they are needed, rather than all the time.

Continuous processes are used to make chemicals that are needed in large amounts, such as sulfuric acid or ammonia. These chemicals are made all the time. Raw materials are continuously added and the new products are removed.

Some chemicals, such as ammonia, sulfuric acid, sodium hydroxide and phosphoric acid, are made in bulk (on a large scale). Other chemicals, such as medicines, food additives and fragrances, are described as being made on a fine scale (a small scale).

Governments regulate how chemicals are made, stored and transported to protect people and the environment from accidental damage.

Medicines from Plants

Scientists can extract chemicals from plant or produce them synthetically. Chemicals can be extracted from plants by:

- crushing up the plant material.
- adding a suitable solvent and then heating the mixture so that the useful chemicals dissolve in the solvent.
- using separation techniques, such as chromatography, to separate mixtures of compounds.

Chromatography separates mixtures according to differences in solubility of the components.

Scientists can use the melting point and boiling point of a compound to establish its purity. Thin layer chromatography can also be used.

Plant materials can be used to make very useful medicines. Digitalin medicines are extracted from foxglove plants and are used to treat heart conditions.

Morphine is made from opium poppies and is used for pain relief.

Scientists have discovered that corn starch can be used to make biodegradable plastics. These plastics are useful as they break down more easily in the environment.

! Boost Your Memory

Make a flow diagram to show the stages involved in extracting chemicals from plants.

Text 15 Making and Developing New Medicines

New medicines are often very expensive to buy because of the high costs of developing and making the drugs.

The factors that affect the price of a medicine include:

Labour and energy costs. The production of new medicines is often very labour intensive as little automation is possible, at least initially.

The cost of the raw materials required, which may be very rare or expensive.

The time required for researching and developing new drugs. These processes can take many years.

Testing of the new medicine. It must pass all the testing stages and human trials required by law for it to gain a licence to be sold. This takes a lot of time and money.

Marketing of the medicine. Companies have to let the medical profession know the benefits of the new medicine.

Scientists developing new drugs need to be aware of economic considerations. The more research and development involved, the more expensive the new medicine will be. Scientists need to work out if there is sufficient demand for the new medicine for it to pay back the considerable investment needed to produce it. New drugs only have a patent for a certain length of time. Companies manufacturing the medicine pay money to the people who hold the patent and who did the initial research and development for the drug. If the time limit for the patent is set too law, the patent will have run out before the initial costs have been paid back.

Green Chemistry

The long-term sustainability of a chemical process depends on:

Whether or not the raw materials are renewable.

The atom economy of the reactions involved.

The amount and nature of waste produced.

The amount and nature of by-products produced.

The energy requirements.

The impact on the environment.

The health and safety risks.

The economic and social benefits of the products made by the reaction.

? Test Yourself

1 Why are the labour costs for new medicines often very high?

2 Why do new drugs have to be marketed?

3 Name a separation technique that separates mixtures because the components have different solubilities.

Stretch Yourself

1 Describe what happens during a continuous process.

Text 16 Nanotechnology and energy – a path to a sustainable future

Ex.1 Read the text and translate the sentences with the words below.

an electric current, tied, silver bullet, to have a positive impact on, capacitor, reinforce, fuel consumption, efficiency gains

Why is nanotechnology relevant here? Many effects important for energy happen at the nanoscale: In solar cells, for instance, photons can free electrons from a material, which can then flow as an electric current; the chemical reactions inside a battery or fuel cell release electrons which then move through an external circuit; or the role of catalysts in a plethora of chemical reactions. These are just a few examples where nanoscale engineering can significantly improve the efficiency of the underlying processes.

Nanotechnologies are not tied exclusively to renewable energy technologies. While researchers are exploring ways in which nanotechnology could help us to develop energy sources, they also develop techniques to access and use fossil fuels much more efficiently. Corrosion resistant nanocoatings, nanostructured catalysts, and nanomembranes have been used in the extraction and processing of fossil fuels and in nuclear power. There is no silver bullet – nanotechnology applications for energy are extremely varied, reflecting the complexity of the energy sector, with a number of different markets along its value chain, including energy generation, transformation, distribution, storage, and usage. Nanotechnology has the potential to have a positive impact on all of these – albeit with varying effects. Nanomaterials could lead to energy savings through weight reduction or through optimized function:

In the future, novel, nano-technologically optimized materials, for example plastics or metals with carbon nanotubes (CNTs), will make airplanes and vehicles lighter and therefore help reduce fuel consumption;

Novel lighting materials with nanoscale layers of plastic and organic pigments are being developed; their conversion rate from energy to light can apparently reach 50 % (compared with traditional light bulbs = 5%);

Nanoscale carbon black has been added to modern automobile tires for some time now to reinforce the material and reduce rolling resistance, which leads to fuel savings of up to 10%;

Self-cleaning or "easy-to-clean"-coatings, for example on glass, can help save energy and water in facility cleaning because such surfaces are easier to clean or need not be cleaned so often;

Nanotribological wear protection products as fuel or motor oil additives could reduce fuel consumption of vehicles and extend engine life;

Nanoparticles as flow agents allow plastics to be melted and cast at lower temperatures;

Nanoporous insulating materials in the construction business can help reduce the energy needed to heat and cool buildings. Nanomaterials could improve energy generation and energy efficiencies:

Various nanomaterials can improve the efficiency of photovoltaic facilities;

Dye solar cells ('Grätzel cells') with nanoscale semiconductor materials mimic natural photosynthesis in green plants;

Plastics with carbon nanotubes as coatings on the rotor blades of wind turbines make these lighter and increase the energy yield;

Nano optimized lithium-ion batteries have an improved storage capacity as well as an increased lifespan and find use in electric vehicles for example;

Fuel cells with nanoscale ceramic materials for energy production require less energy and resources during manufacturing;

The effectiveness of catalytic converters in vehicles can be increased by applying catalytically active precious metals in the nanoscale size range. We have compiled an overview of Nanotechnology in Energy that shows how nanotechnology innovations could impact each part of the value-added chain in the energy sector – energy sources; energy conversion; energy distribution; energy storage; and energy usage. The European GENNESYS project identified a range of nanomaterial application and requirements for future energy applications. In the short term, energy nanotechnology is likely to have the greatest impact in the areas of efficiency of photovoltaics (among renewables, solar has by far the biggest global energy potential) and energy storage where it can help overcome current performance barriers and substantially improve the collection and conversion of solar energy. Nanotechnology for Solar Energy Collection and Conversion is one of the five Signature Initiatives funded by the U.S. National Nanotechnology Initiative. The goals are to enhance understanding of conversion and storage phenomena at the nanoscale, improve nanoscale characterization of electronic properties, and help enable economical nanomanufacturing of robust devices. The initiative has three major thrust areas:

- improve photovoltaic solar electricity generation;
- improve solar thermal energy generation and conversion; and
- improve solar-to-fuel conversions. The thermodynamic limit of 80% efficiency is well beyond the capabilities of current photovoltaic technologies, whose laboratory performance currently approaches only 43% 2. Nanomaterials even make it possible to raise light yield of traditional crystalline silicon solar cells. By using cheaper, nanoscale materials than the current dominant technology (single-crystal silicon, which uses a large amount of fossil fuels for production), the cost of solar cells could be brought down. Numerous research labs are working on nanotechnology-enabled batteries to increase their efficiencies for electric

vehicles, home, or grid storage systems. Improving the efficiency/storage capacity of batteries and supercapacitors with nanomaterials will have a substantial economical impact. Graphene has already been demonstrated to have many promising applications in energy-related areas. Nanotechnology also has the potential to deliver the next generation lithium-ion batteries with improved performance, durability and safety at an acceptable cost. A major push on basic research for energy technologies is coming from the U.S. Department of Energy, which since 2009 has invested nearly $800m as part of the Energy Frontier Research Center (EFRC) program. For example, the Joint Center for Artificial Photosynthesis (JCAP) has developed a nanowire-based design that incorporates two semiconductors to enhance absorption of light; or the Nanostructures for Electrical Energy Storage (NEES) EFRC Center has demonstrated that precise nanostructures can be constructed to test the limits of 3-D nanobatteries by designing billions of tiny batteries inside nanopores. Against the double-whammy backdrop of an energy challenge and a climate challenge it is the role of innovative energy technologies to provide socially acceptable solutions through energy savings; efficiency gains; and decarbonization. So where does that leave 'nanotechnology'? It may not be the silver bullet, but nanomaterials and nanoscale applications will have an important role to play.

Text 17 The Life &Work of Marie Curie

Marie Curie is probably the most famous woman scientist who has ever lived. Born Maria Sklodowska in Poland in 1867, she is famous for her work on radioactivity, and was twice a winner of the Nobel Prize. With her husband, Pierre Curie, and Henri Raeqiierel, she was awarded the 1903 Nobel Prize for Physics, and was then sole winner of the 1911 Nobel Prize for Chemistry. She was the first woman to win a Nobel Prize.

From childhood, Marie was remarkable for her prodigious memory, and at the age of 16 won a gold medal on completion of her secondary education. Because her father lost his savings through bad investment, she then had to take work as a teacher. From her earnings she was able to finance her sister Bronia's medical studies in Paris, on the understanding that Bronia would, in tnm, later help her to get an education.

In 1891 this promise was fulfilled and Marie went to Paris and began to study at the Sorbonne (the University of Paris). She often worked far into the night and lived on little more than bread and butter and tea. She came first in the examination in the physical sciences in 1893, and in 1894 was placed second in the examination in mathematical sciences. It was not until the spring of that year that she was introduced to Pierre Curie.

Their marriage in 1895 marked the start of a partnership that was soon to achieve results of world significance. Following Henri Becquerel's discovery in 1896 of a new phenomenon, which Marie later called "radioactivity", Marie Curie decided to find out if the radioactivity discovered in uranium was to be found in other elements. She discovered that this was true for thorium.

Turning her attention to minerals, she found her interest drawn to pitchblende, a mineral whose radioactivity, superior to that of pure uranium, could be explained only by the presence in the orc of small quantities of an unknown substance of very high activity. Pierre Curie joined her in the work that she had undertaken to resolve this problem and that led to the discovery of the new elements, polonium and radium. While Pierre Curie devoted himself chiefly to the physical study of the new radiations, Marie Curie struggled to obtain pure radium in the metallic state. This was achieved with the help of the chemist André-Louis Debierne, one of Pierre Curie's pupils. Based on the results of this research, Marie Curie received her Doctorate of Science, and in 1903 Marie and Pierre shared with Becquerel the Nobel Prize for Physics for the discovery of radioactivity.

The births of Marie's two daughters, Irene and Eve, in 1897 and 1904 failed to interrupt her scientific work. She was appointed lecturer in physics at the Ecole Nor-male Supérieure for girls in Sevres, France (1900), and introduced a method of teaching based on experimental demonstrations. In December 1904 she was appointed chief assistant in the laboratory directed by Pierre Curie.

The sudden death of her husband in 1906 was a bitter blow to Marie Curie, but was also a turning point in her career: henceforth she was to devote all her energy to completing alone the scientific work that they had undertaken. On May 19, 1906, she was appointed to the professorship that had been left vacant on her husband's death, becoming the first woman to teach at the Sorbonne. In 1911 she was awarded the Nobel Prize for Chemistry for the isolation of a pure form of radium.

During World War I, Marie Curie, with the help of her daughter Irene, devoted herself to the development of the use of X-radiography, including the mobile units which came to be known as "little Curies", used for the treatment of wounded soldiers. In 1918 the Radium Institute, whose staff Irene had joined, began to operate in earnest, and became a centre for nuclear physics and chemistry. Marie Curie, now at the highest point of her fame and, from 1922, a member of the Academy of Medicine, researched the chemistry of radioactive substances and their medical applications.

In 1921, accompanied by her two daughters, Marie Curie made a triumphant journey to the United States to raise funds for research on radium. Women there presented her with a gram of radium for her campaign. Marie also gave lectures in Belgium, Brazil, Spain and Czechoslovakia and, in addition, had the satisfaction of seeing the development of the Curie Foundation in Paris, and the inauguration in 1932 in Warsaw of the Radium Institute, where her sister Bronia became director.

One of Marie Curie's outstanding achievements was to have understood the need to accumulate intense radioactive sources, not only to treat illness but also to maintain an abundant supply for research. The existence in Paris at the Radium Institute of o stock of grams of radium made a decisive contribution to the success of the experiments undertaken in the years around 1930. This work prepared the way for the discovery of the neutron by Sir James Chadwick and, above all, for the discovery in 1934 by Irene and Frédéric Joliot- Curie of artificial radioactivity. A few months after this discovery, Marie Curie died as a result of leukaemia caused by exposure to radiation. She had often carried test tubes containing radioactive isotopes in her pocket, remarking on the pretty blue-green light they gave off.

Her contribution to physics had been immense, not only in her own work, the importance of which had been demonstrated by her two Nobel Prizes, but because of her influence on subsequent generations of nuclear physicists and chemists.

Ex.1 Do the following statements agree with the information given in the text?

true if the statement agrees with the information
false if the statement contradicts the information
not given if there is no information on this

1 Marie Curie's husband was a joint winner of both Marla's Nobel Prizes.

2 Marie became inteiested in science when she was a child.

3 Marie was able to attend the Sorbonne because of her sister's financial contribution.

4 Marie stopped doing research for several years when her children were born.

5 Marie took over the teaching position her husband had held.

6 Marie's sister Bronia studied the medical uses of radioactivity.

Ex.2 Complete the notes below. Choose one word from the passage for each answer

Marie Curie's research on radioactivity

When uranium was discovered to be radioactive, Marie Curie found that the element called **7** .... had the same property.

Marie and Pierre Curie's research into the radioactivity of the mineral known as **8**..................led to the discovery of two new elements.

In 1911, Marie Curie received recognition for her work on the element **9**.......................

Marie and Irene Curie developed X-radiography which was used as a medical technique for **10** ....

Marie Curie saw the importance of collecting radioactive material both for research and for cases of **11** ....,.......

The radioactive material stocked in Paris contributed to the discoveries in the 1930s of the **12** .... and of what was known as artificial radioactivity.

During her research Marie Curio was exposed to radiation and as a result she suffered from **13** ....

3 Supplementary Texts

Text 1 Alchemy after the Middle Ages

Among the most important of the European alchemists was Paracelsus [parə'selsəs] (1493–1531), a Swiss traveling physician/surgeon and the first toxicologist. Paracelsus believed that the body's organs worked alchemically, that is, their function was to separate the impure from the pure, and proposed that a balance of three controlling substances (mercury, sulfur, and salt), which he called the "tria prima," was necessary for maintaining health. Paracelsus treated the plague and other diseases with an alchemical approach that included administering inorganic salts, minerals, and metals. He believed that what he called the "alkahest," the supposed universal solvent, was the philosopher's stone but had no interest in the transmutation of metals, writing, "Many have said of Alchemy, that it is for the making of gold and silver. For me such is not the aim, but to consider only what virtue and power may lie in medicines."

Robert Boyle is often considered the father of modern chemistry. In 1662, Robert Boyle (1627–1691) articulated Boyle's law, which states that the volume of a gas decreases as the pressure on it increases, and vice versa. For this and other important contributions to scientific inquiry, Boyle is sometimes called the father of modern chemistry, but he was not a scientist in the current sense of the word. Rather, he is what is called a natural philosopher, someone who studied fundamental questions about nature and the physical universe before the 19th century.

Boyle wrote two papers on the transmutation of the elements, claiming to have changed gold into mercury by means of "quicksilver," the ingredients of which he did not reveal.

This caught the attention of Isaac Newton, another enthusiastic alchemist, who, like Boyle, was motivated in his research "by the good it may do in the world." The two struck up a correspondence.

Central to Boyle's efforts was his "corpuscularian hypothesis." According to Boyle, all matter consisted of varying arrangements of identical corpuscles.

Transforming copper to gold seemed to be just a matter of rearranging the pattern of its corpuscles into that of gold.

Boyle used his 1661 text The Sceptical Chymist to explain his hypothesis and to dismiss Aristotle's four-elements theory, which had persisted through the ages. Boyle recognized that certain substances decompose into other substances (water decomposes into hydrogen and down any further. These fundamental substances he labeled elements, which could be identified by experimentation.

Boyle was a prolific experimenter who kept meticulous accounts about both his failures and successes. He was a pioneer of chemical analysis and the scientific method, endlessly repeating his experiments with slight variations to obtain better results and, unheard of among earlier alchemists, always publishing the methods and details of his work in clear terms that could be widely understood.

A new framework

By the late 18th century, the field of chemistry had fully separated from traditional alchemy while remaining focused on questions relating to the composition of matter. Experimentation based on the scientific method, the publication of research results, the search for new elements and compounds and their application in medicine and industry beneficial to all mankind, and other concerns first addressed by alchemists dating back many centuries were now the domain of modern science.

Among the most significant of the post-alchemic chemists were the French nobleman Antoine-Laurent Lavoisier (1743–1794) and the Russian chemist Dmitri Mendeleev (1834–1907). In 1789, Lavoisier wrote the first comprehensive chemistry textbook, and, like Robert Boyle, he is often referred to as the father of modern chemistry. Lavoisier agreed with Boyle that Aristotle's four-elements theory was mistaken, and in his textbook, he compiled a list of metallic and nonmetallic elements that would point toward the periodic table developed by Mendeleev in 1869. It was Mendeleev who demonstrated that the elements could be arranged in a periodic – regular and recurring – relationship to each other based on their atomic weights and who created a periodic table that could accurately predict the properties of elements that had yet to be discovered. Mendeleev's table is still used today.

Chemical questions: Our best hope for tomorrow

Just as alchemy was a touch point for myriad crafts, creations, and – for its time – cures, chemistry resides in the center of the sciences. As an inquisitive discipline, chemistry touches physics on one side and biology on the other. Chemical questions lead to environmental, industrial, and medical applications.

Often working together in research teams at universities and corporations, chemists around the world are developing new techniques and inventions. Like alchemists, sometimes the process of discovery might **entail** isolating specific components; other findings might come from developing new compounds.

Some recent research:

University of California – San Francisco biochemists identified a memory-boosting chemical in mice, which might one day be used in humans to improve memory.

Cheaper clean-energy technologies could be made possible thanks to a new discovery by a professor of chemistry at Penn State University.

The Duke Cancer Institute found that an osteoporosis drug stopped the growth of breast cancer cells, even in resistant tumors.

These are just a few examples of how modern chemistry carries on the alchemical quest for the elixir of life. (By Michelle Feder)

Paracelsus [parə'selsəs] (1493-1541), Swiss physician. He developed a new approach to medicine and philosophy based on observation and experience.

? Test Yourself

1 Who is often considered the father of modern chemistry? Why?

2 Describe Boyle's law!

3 Explain the "corpuscularian hypothesis"!

Text 2 The Birth of Modern Plastics

In 1907, Leo Hendrick Baekeland, a Belgian scientist working in New York, discovered and patented a revolutionary new synthetic material. His invention, which he named "Bakelite", was of enormous technological importance, and effectively launched the modern plastics industry.

The term "plastic" comes from the Greek plassein, meaning "to mould". Some plastics are derived from natural sources, some are semi-synthetic (the result of chemical action on a natural substance), and some are entirely synthetic, that is, chemically engineered from the constituents of coal or oil. Some are "thermoplastic", which means that, like candlewax, they melt when heated and can then be reshaped. Others are "thermosetting": like eggs, they cannot revert to their original viscous state, and their shape is thus fixed for ever, Bakelite had the distinction of being the first totally synthetic thermosetting plastic.

The history of today's plastics begins with the discovery of a series of semi-synthetic thermoplastic materials in the mid-nineteenth century. The impetus behind the development of these early plastics was generated by a number of factors – immense technological progress in the domain of chemistry, coupled with wider cultural changes, and the pragmatic need to find acceptable substitutes for dwindling supplies of "luxury" materials such as tortoiseshell and ivory.

Baekeland's interest in plastics began in 1885 when, as a young chemistry student in Belgium, he embarked on research into phenolic resins, the group of sticky substances produced when phenol (carbolic acid) combines with an aldehyde (a volatile fluid similar to alcohol). He soon abandoned the subject, however, only returning to it some years later. By 1905 he was a wealthy New Yorker, having recently made his fortune with the invention of a new photographic paper. While Baekeland had been busily amassing dollars, some advances had been made in the development of plastics. The years 1899 and 1900 had seen the patenting of the first semi-synthetic thermosetting material that could be manufactured on an industrial scale. In purely scientific terms, Baekeland's major contribution to the field is not so much the actual discovery of the material to which he gave his name, but rather the method by which a reaction between phenol and formaldehyde could be controlled, thus making possible its preparation on a commercial basis. On 13 July 1907, Baekeland took out his famous patent describing this preparation, the essential features of which are still in use today.

The original patent outlined a three-stage process, in which phenol and formaldehyde (from wood or coal) were initially combined under vacuum inside a large egg-shaped kettle. The result was a resin known as Novalak, which became soluble and malleable when heated. The resin was allowed to cool in shallow trays until it hardened, and then broken up and ground into powder. Other substances were then introduced: including fillers, such as woodflour, asbestos or cotton, which increase strength and moisture resistance, catalysts (substances to speed up the reaction between two chemicals without joining to either) and hexa, a compound of ammonia and formaldehyde which supplied the additional formaldehyde necessary to form a thermosetting resin. This resin was then left to cool and harden, and ground up a second time. The resulting granular powder was raw Bakelite, ready to be made into a vast range of manufactured objects. In the last stage, the heated Bakelite was poured into a hollow mould of the required shape and subjected to extreme heat and pressure; thereby "setting" its form for life.

The design of Bakelite objects, everything from earrings to television sets, was governed to a large extent by the technical requirements of the moulding process. The object could not be designed so that it was locked into the mould and therefore difficult to extract. A common general rule was that objects should taper towards the deepest part of the mould, and if necessary the product was moulded in separate pieces. Moulds had to be carefully designed so that the molten Bakelite would flow evenly and completely into the mould. Sharp corners proved impractical and were thus avoided, giving rise to the smooth "streamlined" style popular in the 1930s. The thickness of the walls of the mould was also crucial: thick walls took longer to cool and harden, a factor which had to be considered by the designer in order to make the most efficient use of machines.

Baekeland's invention, although treated with disdain in its early years, went on to enjoy an unparalleled popularity which lasted throughout the first half of the twentieth century. It became the wonder product of the new world of industrial expansion – "the material of a thousand uses". Being both nonporous and heat-resistant, Bakelite kitchen goods were promoted as being germ-free and sterilisable. Electrical manufacturers seized on its insulating properties, and consumers everywhere relished its dazzling array of shades, delighted that they were now, at last, no longer restricted to the wood tones and drab browns of the pre-plastic era. It then fell from favour again during the 1950s, and was despised and destroyed in vast quantities. Recently, however, it has been experiencing something of a renaissance, with renewed demand for original Bakelite objects in the collectors' marketplace, and museums, societies and dedicated individuals once again appreciating the style and originality of this innovative material.

Ex.1 Complete the summary.

Choose one word only from the passage for each answer. Some plastics behave in a similar way to **(1)** _______ in that they melt under heat and can be moulded into new forms. Bakelite was unique because it was the first material to be both entirely **(2)** ______ in origin, and thermosetting.

There were several reasons for the research into plastics in the nineteenth century, among them the great advances that had been made in the field of **(3)** _________ and the search for alternatives to natural resources like ivory.

Ex.2 Complete the flow-chart.

Choose one word only from the passage for each answer.

	The Production of Bakelite	
Phenol	→	
Formaldehyde	→	combine under vacuum
		↓
		stage one resin, called(4) ....
		↓
		cool until hardened
		↓
		break up and grind into powder
	(5) .... →	↓
	(e.g. cotton, asbestos)	

	catalyst →	
ammonia →	(6) ………. →	
formaldehyde →		
		stage two resin
		↓
		cool until hardened
		↓
		break up and grind into powder
		↓
		(7) ….. bakelite
		↓
		heat
		↓
		pour into mould
		↓
		apply intense heat and (8)...............
		↓
		cool until hardened

Ex.3 Which <u>two</u> of the following factors influencing the design of Bakelite objects are mentioned in the text?

A the function which the object would serve

B the ease with which the resin could fill the mould

C the facility with which the object could be removed from the mould

D the limitations of the materials used to manufacture the mould

E the fashionable styles of the period

Ex.4 Do the following statements agree with the information given in the text?

true	if the statement is true according to the passage
false	if the statement is false according to the passage
not given	if the information is not given in the passage

11 Modern-day plastic preparation is based on the same principles as that patented in 1907.

12 Bakelite was immediately welcomed as a practical and versatile material.

13 Bakelite was only available in a limited range of colours.

http://www.ielts-exam.net/practice_tests/40/IELTS_Reading_Passage_1/343/

Text 3 Why a Stradivarius violin sounds so good...

Ask anyone who made the world's best violins and they'll inevitably answer "Stradivari". But science is beginning to undermine the reputation of this great instrument maker whom, it seems, might owe at least part of his success to an attempt at chemical pest control, rather than just his craftsmanship.

Antonio Stradivari was born in 1644 and lived in Cremona, a city in northwest Italy. He set himself up as an instrument maker in the 1680's but his "golden period", during which he is believed to have produced some of his best instruments, didn't come until the 1700s, by which time he was over 70 years old.

About 600 of his instruments are thought to survive today and in good condition they are each worth at least $5 million. The hefty price tag reflects the fact that, not only are they 300 years old, they're thought to be genuinely unrivalled in terms of the quality and purity of the sound they produce. Effectively they're the Rolls Royce Silver Ghosts of the musical world.

Not surprisingly very few owners are willing to donate their instruments "in the name of science" to help researchers find out why they are so special. But it's been a lifetime ambition of Hungarian-born scientist, musician and violin maker Joseph Nagyvary, who's also an emeritus professor of biochemistry at Texas A&M University, to do just that. Now, thanks to some tiny wood fragments donated by restorers working on these violins, he thinks he knows the answer.

Nagyvary used a technique called infrared spectroscopy to dissect out the chemical structure of the wood in the fragments. He then compared it with similar samples collected from an old English and an old French instrument dating from the same period.

The results were striking. The trace from the Stradivarius was very different from the other European instruments. It shows signs of having been chemically brutalised. The amount of lignin in the wood was reduced, and the hemi-cellulose, which acts like a molecular bridge holding the wood together, was greatly damaged. This would dramatically alter the resonant properties of the wood and change its acoustics, accounting for the pristine sound that singles out these instruments.

But what could have caused this degradation in the wood? In an attempt to reproduce the effect, Nagyvary tried boiling and even baking samples of modern wood, but the treatment wasn't harsh enough. Instead, it seems Stradivari, or the carpenter who supplied him, must have resorted to chemical means, probably in the form of copper and iron salts, which are strongly oxidising and could conceivably have damaged the wood in this way.

To find out exactly what chemicals they must have used will require access to more wood fragments, which could take some time. "These samples are hard to get," Nagyvary says. "You cannot approach Itzhak Perlman and ask him to give you a chunk of his Stradivarius for analysis."

But why chemically massacre your future instrument anyway? Nagyvary thinks the answer is all down to a primitive attempt at preservation. "I am a heretic in this regard. I really don't think that Stradivari did this for acoustical purpose. I think that was a rather routine process around that time, in Cremona, where most woodworkers had to preserve their wood against the woodworm. Stradivari was a marvellous craftsman," Nagyvary observes, "but the magnificent sound of his instruments is a lucky accident."

Nagyvary et al., Nature 2006, vol 444: pp 565

Test 1

1. An example of a chemical compound is,

A) air;
B) brass (an alloy);
C) granite (a rock);
D) table salt.

2. Which name/symbol combination is wrong?

A) Tungstun/W;
B) Fluorine/F;
C) Silicon/Si;
D) Selenium/Sn;
E) Silver/Ag.

3. Compounds are different from mixtures because compounds ...

A) are composed of two or more substances;
B) have compositions that may vary from substance to substance;
C) always have the same set of physical properties;
D) can be separated by physical means into simpler substances.

4. Which of the following is a chemical property of iron?

A) occurs in an abundance of 4.7% in the earth's crust;
B) melts at 1535 °C;
C) attracted to a magnet;
D) rusts when exposed to moist air.

5. Convert -78 °C to °F.

A) -108 °F;
B) -61 °F;
C) -195 °F;
D) -351 °F.

6. What is the branch of chemistry that is being applied in measuring the concentration of an air pollutant?

A) analytical chemistry;
B) biochemistry;
C) inorganic chemistry;
D) organic chemistry;
E) physical chemistry.

7. T F Organic chemistry is the study of those chemical processes that are found in living systems.

8. Name the branch of science that involves the study of matter and the changes it undergoes.

9. What do we call anything that has mass and occupies space?

10. What do we call electrically charged particles that result from the gain of one or more electrons by a parent atom?

11. John Dalton proposed that all atoms of an element have identical properties. Briefly, explain why this proposal Is invalid.

12. J. J. Thomson in 1897 announced that cathode rays consisted of a stream of _______.

13. In one sentence, state Rutherford's important contribution to our knowledge of atomic structure.

14. Which of the following is NOT a physical property of matter?
A) odor;
B) compressibility;
C) flash point;
D) melting point;
E) color.

15. What kind of change always results in the formation of new materials?
A) molecular;
B) exothermic;
C) endothermic;
D) physical;
E) chemical.

16. Which of the following is a chemical property?
A) flammability;
B) color;
C) hardness;
D) odor;
E) taste.

17. Which one of the following is an example of an extensive property?
A) density;
B) specific gravity;
C) mass;
D) hardness;

E) boiling temperature.

18. Which of the following statements relating to Bohr's model of the hydrogen atom, is incorrect?

A) The lowest energy orbit has quantum number $n = 1$;

B) The highest energy orbits are furthest from the nucleus;

C) In a transition from the $n = 3$ to the $n = 1$ level, light is emitted;

D) Energy differences between energy levels can be calculated from the wavelengths of the light absorbed or emitted;

E) The greater the energy difference between two levels, the longer the wavelength of the light absorbed or emitted.

Test 2

1. **In which state does matter have a definite shape and volume?**
2. **In which state of matter are forces between particles least dominant?**
3. **What kind of change does not alter the composition or identity of the substance undergoing the change?**
4. **Conversion of ice to liquid water or liquid water to steam is an example of what kind of change?**
5. **What type of change is represented by the decay of a fallen tree?**
6. **Give an example of a chemical property of iron metal.**
7. **What do we call the starting and final materials in a chemical reaction?**
8. **What is meant in chemistry by the term "pure substance"?**
9. **What are two kinds of pure substance?**
10. **Explain what is meant in chemistry by the word "compound".**
11. **What are the two classes of mixtures?**
12. **Give an example of a heterogeneous mixture.**

13. Which of the following terms are appropriate in describing an apple?

pure substance; element; compound; mixture; homogeneous; heterogeneous

13.List the three primary particles found in an atom.

14.In a neutral atom, what number of particles is equal to the number of protons?

15.Given that He helium has an isotope predict the number of electrons 42, in a helium atom.

16.How many neutrons are present in an atom of the isotope 3 7 Li?

18. What is the term for atoms of the same element having different masses due to a different number of neutrons?

19. In one sentence, state Rutherford's important contribution to our knowledge of atomic structure.

20. Which state of matter has no definite shape or volume?

A) liquid;
B) solid;
C) vapor;
D) steam;
E) gas.

Test 3

1. Which one of the following is an example of a pure substance?

A) ethyl alcohol;
B) sugar water;
C) salt and pepper;
D) milk;
E) sand.

2. Air is a/an

A) element;
B) compound;
C) mixture;
D) molecule;
E) pure substance.

3. What type of mixture is represented by a collection of salt and pepper?

A) atoms;
B) molecules;
C) solution;
D) heterogeneous;

E) homogeneous.

4. What kind(s) of particles can be found in the nucleus of an atom?

A) protons;
B) neutrons;
C) electrons;
D) protons and electrons;
E) protons and neutrons;

5. The total mass of the protons in any neutral atom is about _____ times the total mass of electrons in the atom.

A) 0.0005;
B) 0.3;
C) 1;
D) 2;
E) 2000.

6. Who discovered the existence of the atomic nucleus?

A) Crookes;
B) Thomson;
C) Geiger;
D) Rutherford;
E) Bohr.

7. In Rutherford &Geiger's experiment which led to the discovery of the atomic nucleus, what type of particle or ray was fired at the gold foil target?

A) alpha;
B) beta;
C) gamma;
D) neutrons;
E) cathode rays.

8. Which of the following statements relating to Bohr's model of the hydrogen atom, is incorrect?

A) The lowest energy orbit has quantum number $n = 1$;
B) The highest energy orbits are furthest from the nucleus;
C) In a transition from the $n = 3$ to the $n = 1$ level, light is emitted;
D) Energy differences between energy levels can be calculated from the wavelengths of the light absorbed or emitted;
E) The greater the energy difference between two levels, the longer the wavelength of the light absorbed or emitted.

9. Who proposed that electrons could behave like waves, as well as like particles?

A) Thomson;
B) Rutherford;
C) Bohr;
D) de Broglie;
E) Heisenberg.

10. <u>True or False</u> The term "solution" refers only to homogeneous mixtures of liquids.

11. T F According to modern atomic theory, all atoms of a particular element have identical physical properties.

12. T F According to modern atomic theory, an atom cannot be created, divided, destroyed or converted to any other type of atom.

13. T F The atomic number of an ion tells us the number of protons that are present.

14. T F If an atom gains one electron, it becomes a cation.

15. T F The first experimentally based theory of atomic structure was proposed by John Dalton.

16. T F J. J. Thomson was the first to state that an atom is mostly empty space.

17.T F Short wavelengths of electromagnetic radiation have more energy than long wavelengths.

18.T F Rutherford was the first to use the term "orbit" to explain the fixed energy levels of electrons.

19.T F Niels Bohr developed a theory which accounted for the lines in the visible region of the hydrogen spectrum.

20. What kind of change does NOT alter the composition or identity of the substance undergoing the change?

A) molecular;
B) endothermic;
C) exothermic;
D) physical;
E) chemical;

Glossary

abundant	existing in large quantities
advocate	to express support for a particular idea or way of doing things
alloy	a metal that is a mixture of two or more metals
anion	an ion with a negative electrical charge
aquatic	living or growing in water; related to water
batter	a mixture of flour, milk, and often eggs used to make cakes and pancakes (= thin fried cakes), and to cover fish, etc before it is fried
bauxite	A type of rock from which aluminum is obtained
beaker	a tall cup without a handle, usually made of plastic
brass	a shiny yellow metal
bubble	a ball of gas that appears in a liquid, or a ball formed of air surrounded by liquid that floats in the air
cation	in chemistry, an ion (= type of atom) that has a positive electric charge and therefore moves towards the cathode (= negative part of electric cell) during electrolysis
Celsius	a measurement of temperature in which water freezes at 0° and boils at 100°
chunk	a large piece of something
churn	to mix something, especially liquids, with great force
combustion	the process of burning
compound	a chemical that combines two or more elements:
distinct	recognizably different in nature from something else of a similar type
DNA deoxyribonucleic acid	a chemical in the cells of living things which contains genetic information
equation	when you show that two amounts are equal using mathematical symbols
Fahrenheit	a scale of temperature on which water freezes at 32° and boils at 212° under standard conditions
fluorine	the chemical element of atomic number 9, a poisonous pale yellow gas of the halogen series. It is the most reactive of all the elements, causing severe burns on contact with skin. (Symbol: F)
given credit for the	praise that is given to someone for something they

discovery	have done
gypsum	a hard white substance that is used in making plaster of Paris
hazard	something that is dangerous and likely to cause damage
impurity	when a substance is mixed with another substance and makes it dirty or lower in quality
insipid	not having a strong taste or character, or having no interest or energy
limestone	a white or light grey rock which is used as a building material and in the making of cement
liquefy	to (cause a gas or a solid to) change into a liquid form
liquid	a substance, for example water, that is not solid and that can be poured easily
marble	a type of very hard rock which has a pattern of lines going through it, feels cold and becomes smooth and shiny when cut and polished
matter	the physical substances that exist in the universe
mixture	a substance made of other substances that have been combined
molten	describes metal or rock that is in a liquid state because of great heat
odourless	without a smell
ooze	If a liquid oozes from something or if something oozes a liquid, the liquid comes out slowly
oxide	a chemical combination of oxygen and one other element
particle	a very small part of an atom, for example an electron or a proton
portrayal	when you portray someone or something
potassium	the chemical element of atomic number 19, a soft, silvery-white reactive metal of the alkali metal group.
property	a quality of something
reactant	a substance that is part of a chemical reaction
rim	the edge of something round
rust	a dark orange substance that you get on metal when it has been damaged by air and water
selenium	the chemical element of atomic number 34, a gray

	crystalline nonmetal with semiconducting properties. (Symbol: Se)
silicon	the chemical element of atomic number 14, a nonmetal with semiconducting properties, used in making electronic circuits. Pure silicon exists in a shiny dark gray crystalline form and as an amorphous powder. (Symbol: Si)
silver	a precious shiny grayish-white metal, the chemical element of atomic number 47. (Symbol: Ag)
soluble	able to be dissolved to form a solution
thorough	careful and covering every detail
tissue	a group of connected cells in an animal or plant that are similar to each other, have the same purpose and form the stated part of the animal or plant
tungsten	the chemical element of atomic number 74, a hard steel-gray metal of the transition series. It has a very high melting point (3410°C) and is used to make electric light filaments. (Symbol: W)
welding	the activity of joining metal parts together

Әдебиеттер

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Мазмұны

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