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**«НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ
ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ»**

ПРОФЕССИОНАЛЬНЫЙ ИНОСТРАННЫЙ ЯЗЫК (АНГЛИЙСКИЙ)

Часть 1

для студентов направлений
18.03.01 «Химическая технология»,
18.03.02 «Энерго- и ресурсосберегающие процессы
в химической технологии, нефтехимии и биотехнологии»,
20.03.01 «Техносферная безопасность»

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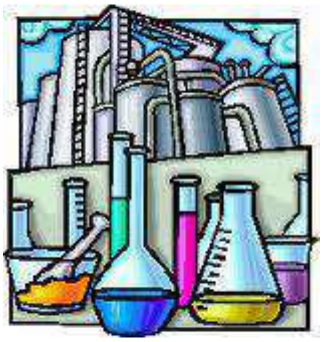
Unit 1
What is Chemical Engineering?



LEAD-IN

1. Match the words in the left-hand column with their translation in the right-hand column.

1	branch of engineering	A	ценный
2	to deal with	B	мастерство
3	convert	C	топливные элементы
4	raw materials	D	решать проблемы
5	valuable	E	бюджетный, малозатратный
6	fuel cells	F	безвредный для окружающей среды
7	applied chemistry	G	изобретать что-либо
8	to solve problems	H	превращать, преобразовывать
9	mastery	I	удобрение
10	to invent smth	J	отрасль технических наук
11	cost effective	K	полимер
12	environmentally friendly	L	эффективный
13	efficient	M	сырье
14	polymer	N	прикладная химия
15	fertilizer	O	иметь дело с

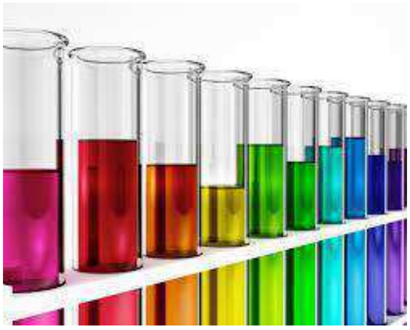
2. Match the words from the left column with their collocations from the right column.

1	to deal with	A	a polymer
2	valuable	B	effectively
3	environmentally-friendly	C	fertilizer
4	efficient	D	processes
5	to invent	E	form
6	to solve problems	F	fuel cells
7	convert	G	chemistry
8	applied	H	raw-materials

READING

3. Before reading the text about Chemical engineering, answer the questions:

1. Give your idea what chemical engineering is. Why do you think so?
2. Why have you chosen this specialty?
3. Where can the knowledge of chemistry be applied?



Chemical engineering

Chemical engineering is the branch of engineering that deals with physical science (e.g., chemistry and physics), and life sciences (e.g., biology, microbiology and biochemistry) with mathematics and economics, to the process of converting raw materials or chemicals into more useful or valuable forms. In addition, modern chemical engineers are also concerned with pioneering valuable new materials and related techniques – which are often essential to related fields such as nanotechnology, fuel cells and biomedical engineering. Within chemical engineering, two broad subgroups include 1) design, manufacture, and operation of plants and machinery in industrial chemical and related processes ("chemical process engineers"); and 2) development of new or adapted substances for products ranging from foods and beverages to cosmetics to cleaners to pharmaceutical ingredients, among many other products ("chemical product engineers").

Chemical engineering basically is applied chemistry. It is the branch of engineering concerned with the design, construction, and operation of machines and plants that perform chemical reactions to solve practical problems or make useful products.

Like all engineers, chemical engineers use math, physics, and economics to solve technical problems. The difference between chemical engineers and other types of engineers is that they apply knowledge of chemistry in addition to other engineering disciplines. Chemical engineers sometimes are called 'universal engineers' because their scientific and technical mastery is so broad.

Some chemical engineers make designs and invent new processes. Some construct instruments and facilities. Some plan and operate facilities. Chemical engineers have helped develop atomic science, polymers, paper, dyes, drugs, plastics, fertilizers, foods, petrochemicals... pretty much everything. They devise ways to make products from raw materials and ways to convert one material into another useful form. Chemical engineers can make processes more cost effective or more environmentally friendly or more efficient. As you can see, a chemical engineer can find a niche in any scientific or engineering field.

4. Answer the questions:

1. What does chemical engineering deal with?
2. How many subgroups is chemical engineering divided into?
3. Why can chemical engineering be called the applied chemistry?
4. What subjects are used to solve technical problems?
5. Why are chemical engineers sometimes called ‘universal engineers’?
6. What are the examples of chemical engineers inventions?
7. What is the impact the chemical engineers make into different processes?
8. What is the difference between chemical engineers and other types of engineers?

5. Read the Text again and say if the statements 1–10 are True (T) or False (F). If the statement is false, give the right variant.

1. Chemical engineering is a brunch of art.
2. The junction of physical science and life sciences with mathematics and economics can be called Chemical Engineering.
3. The process of converting raw materials or chemicals into more useful or valuable forms is not in the field of interests of Chemical Engineering.
4. Nanotechnology, fuel cells and biomedical engineering do not concern the field of study of Chemical Engineering.
5. There is no difference between chemical engineers and other types of engineers.
6. As the scope of interests of Chemical engineers is beyond the average they are called ‘universal engineers’.
7. The aim of Chemical engineers is to work out cheaper and simpler ways of producing things.
8. Chemical engineers make designs, invent new processes, construct instruments, plan and operate facilities.
9. Chemical engineers hardly ever use math, physics, and economics to solve technical problems.
10. The knowledge of Chemical engineers is applicable in any sphere of science.

TEXT 2

6. Before reading the text about Products and processes of production, answer the questions:

1. What is common and what is different between a product and the process of its production?
2. What is the role of chemical engineer in the process of production?

Products and processes of production

What purposes does chemical engineering serve? To understand its functions, we must distinguish between a product and the process of its production.

An automobile is a product, whereas mass production is a process. Consumers, who come into contact with products only, seldom think about production processes. Without efficient processes, however, they would not be offered such great varieties of products at such affordable prices.

Product and process both require engineering, but different kinds of engineering. In chemistry it may be confusing, because chemical reactions are usually called processes. We will not use this term and reserve “process” for production process on the industrial scale.

Students in chemistry classes shake a test tube or stir a beaker over a flame to speed up a chemical reaction. Industrial plants cannot simply shake or stir a thousand-liter tank over a furnace, not because it is too heavy but because it is too dangerous. Heat transportation and distribution is much more difficult in large containers because of their relatively small surface-to-volume ratios, and uneven distribution in a tank of chemical reactants can end in a deadly explosion.

To scale up a chemical reaction from test-tube to industrial level requires a lot of knowledge and effort. This is apparent in the Haber-Bosch process. Haber’s method for synthesizing ammonia required temperatures up to 500 °C and pressures up to 1000 atmospheres. Because such high pressure and temperature were enormously difficult to attain on the industrial scale, his invention might have remained a laboratory curiosity. Fortunately, BASF, armed with the world’s first industrial R&D facility, invested heavily in developing processes for high volume production. The complexity of scale-up was acknowledge by the Nobel Prize awarded Bosch, who headed the scaling-up project, (Haber had got his already).

7. Answer the questions to the text:

1. Why is it necessary to distinguish between a product and the process of its production?
2. What are the two ways of understanding the word "processes"?
3. What is the difference of producing reactions in laboratories and industrial plants?
4. How does the size of container influence the heat transportation and distribution?
5. What are the requirements for Haber's method for synthesizing ammonia?
6. What does the Haber's method for synthesizing ammonia given here illustrate?
7. What are the obstacles to scale up a chemical reaction?
8. Why did the Germans leave the niche of production processes chemical engineering to the Americans?

8. Read the Text again and say if the statements 1–10 are True (T) or False (F). If the statement is false, give the right variant.

1. There are no correlations between efficient processes, great varieties of products and affordable prices.
2. Consumers usually can not sort out a product from a process.
3. Both product and process are independent from engineering research.
4. The term "Chemical processes" is interchangeable with the term "chemical reactions".
5. Heat transportation and distribution is much more difficult in large containers.
6. A deadly explosion can be caused by uneven distribution in a tank of chemical reactants.
7. The Haber-Bosch process can be taken as an illustration of scaling up a chemical reaction from test-tube to industrial level.
8. Haber's method for synthesizing ammonia has remained a laboratory curiosity.
9. The processes for high volume production required a lot of investments.
10. Bosch was awarded the Nobel Prize.

9. Complete the sentences using the information from the text.

1. Product and process both require _____.
2. Efficient processes stipulate ______.
3. Shaking a test tube or stirring a beaker over a flame is necessary to _____.
4. _____ cannot simply shake or stir a thousand-liter tank over a furnace.
5. Heat transportation and distribution is much more difficult in large containers because of _____.

VOCABULARY

10. Use the suffixes -sion, -ion, -able to form nouns from the following words. Make up word combinations.

Example: *memory – memorable – a memorable journey.*

	-sion		-ion		-able
explode		react		afford	
confuse		attract		read	
cohere		correct		memory	
revise		inform		enjoy	
omit		pollute		desire	

11. Match the words to the definitions:

1	acknowledge – (v)	A	An action that is caused by another action
2	apparent – (adj)	B	Wanting to know or learn
3	explosion – (n)	C	Tell the difference between two things
4	facility – (n)	D	Describes something that one has enough money for
5	reaction – (n)	E	A sudden and violent outbreak
6	attain – (v)	F	A special equation where there are two variables called independent and dependent. For every value of the independent variable, there is EXACTLY one value for the dependent variable
7	distinguish – (v)	G	To make understanding difficult
8	process – (n)	H	A comparison of two parts of a larger number
9	curiosity – (n)	I	Obvious; easy to understand
10	confuse – (v)	J	The steps or actions needed to do something
11	affordable – (adj)	K	To give credit to
12	function – (n)	L	Reach a goal
13	ratio – (n)	M	Any easy way of learning or doing something

12. Fill in the gaps with the words from Ex. 11:

1. The movie _____ me.
2. The Haber-Bosch _____ is the industrial way of producing ammonia.
3. There are 16 kids in the class and only two are boys so the _____ of girls to boys is 14:2 (simplified to 7:1).
4. That restaurant is too expensive but this is _____.
5. It can be hard to _____ a real diamond from a man-made diamond.
6. There was an _____ after the car caught fire.
7. The empty bottles and dirty dishes make it _____ that there was a party here.
8. The actor _____ his parents when he accepted the award.
9. She _____ her degree in only three years.
10. Her scream was a ______ to his stepping on her foot.
11. She has a great _____ for languages; she speaks several very well.

13. Fill in the gaps with the necessary form of the word given:

Chemical engineers use additional knowledge of the flow and transfer of mass and heat to meet challenges on all scales, from machines _______ 1 tonnes per hour to molecular and particle assembly.	1) MAKE
Chemical Engineering is a broad profession. However, chemical engineers share ____2 which make them ideally suited to tackling a wide variety of problems. In summary, chemical engineers:	2) CHARACTERIZE
• Turn laboratory bench-top phenomena into ______3 processes	3) PRODUCE
• Have an ___4 approach to systems. They are trained to appreciate the complete process and to identify the key and critical components	4) INTEGRATE
• Work within and often manage teams of theoretical and experimental chemists, mechanical and civil engineers, _______5 and health and safety officials	5) COUNT
• Apply fundamental scientific _______ 6 and engineering principles to industrial, laboratory and molecular processes involving gas, liquid or solid handling, chemical or biological reactions and heat transfer.	6) UNDERSTAND

TRANSLATION

14. Translate from English into Russian:

1. Chemical Engineering is the profession that combines chemistry and engineering concepts to help solve problems related to world hunger, pollution of our environment, creating new materials, or meeting demands for energy.
2. Chemical engineers develop low cost processes for producing ammonia, which make it possible to manufacture important fertilizers.
3. Adding value involves making a product more desirable to a consumer so that they will pay more for it.
4. Chemical engineers are working on ways to recycle plastics, reduce pollution, and develop new sources of environmentally clean energy.
5. Chemical engineers have the background knowledge of chemistry coupled with an understanding of chemical processing.
6. Most major chemical companies hire chemical engineers to fill their technical positions in environmental engineering.
7. A degree in Chemical Engineering opens many doors for diverse, challenging and rewarding opportunities.
8. Chemical engineers develop processes and chemicals to make food products cheaper, safer, and with increased yields.
9. From these processes come products like orange juice, chocolate, corn sweeteners, citric acid, or vitamin E.
10. Chemical engineers also provide know-how for chemical processing of computer chips and integrated circuits in the electronics industry.

SPEAKING

15. Read the dialogue. Translate it into Russian:

a) Practice it with your co-students.

– Hi Linda! I haven’t seen you for ages. I heard you’ve graduated from University and got a new job? Can you tell me a little bit about it?
– Certainly! Fancy wearing a stylish white coat and working in a cool laboratory like a proper scientist?
– Wow! What are you then?
– A chemical engineer, it’s all part of the job…
– Oh, what does a chemical engineer do?
– It’s a very interesting job. You may research and develop new products,

such as synthetic materials and biofuels. You could also design manufacturing processes to turn raw materials into domestic and industrial products such as medicines, toiletries and fertilizers.

– Well, it's definitely a very important job…

b)Rearrange the words to make a sentence and tell about the chemical engineer job responsibilities.

Example: be / will / I / what / so / actually / doing
So, what will I be actually doing?

If you're working in research and development …:

1. Will / ways/ to / lab /test /new / the / products / you / develop / in
2. Computer- / production / cost-effective / the / use / models / to / safest / work out / and / most / methods
3. How / you / a pilot production / plan / to / phase / will / move / into / lab tests
4. Large-scale / you / industrial / will / processing / plan
5. To deal with / you / by-products / develop / and / waste materials / how / way / in / environmentally-friendly

In manufacturing …

1. You / will / the day-to-day / plant / to / help / operation / oversee / the / processing
2. Deal with / will / problems / production / monitor / you / and
3. Work / will / you / quality control / safety / with / and / health / managers
4. Plant designers / you / and / will / work / engineers
5. Design / equipment / and / you / other / machinery

WRITING

16. Write an annotation to the text:

There are many other roles that chemical engineers play. Some specialize in environmental engineering; monitoring, modifying plant operations and becoming expert in government regulations. Don't forget: air, water, and soil are all chemicals. Control engineers specialize in developing the advanced computer control systems and operator stations necessary to run a plant efficiently. Engineers often become managers (who would make a better plant manager or engineering manager than a chemical engineer who has come up the ranks)? Technical sales is a way for an engineer to help solve his customer's problems by matching the right process or product to the customer's needs. Of course, there would be no chemical engineers without chemical engineering professors.

Biomedical engineers apply basic chemical engineering to the medical field, primarily artificial organs and limbs. Biochemical engineers use their understanding of the chemical reactions in our bodies to identify/treat disease and reproduce some of this chemistry on a very large scale. Chemical engineers can move into non-engineering jobs. Their problem solving skills and technical rigor have proved to be an excellent basis for going into patent law, medicine, and even investment banking.

Any chemical engineers work in the chemical, petrochemical, food, pharmaceutical, pulp and paper, electronics, and consumer products industries. Some teach in universities, and others work for the government (typically in the environmental and energy areas).

You should study as much math and science in high school as possible; typically three years of science and four of math are the minimum requirement for acceptance into engineering school. A Bachelors degree (BS) can be earned in four years; five if you co-op (take paid assignments working in industry on alternate semesters). Most positions in industry require only a BS degree. Research and teaching positions typically require a Ph.D. which takes about five more years of study. Formal education is only the beginning. Engineers must always keep up with the latest technology and learn new skills.

Unit 2
Recent progress and innovations in Chemical engineering

LEAD-IN

1. Match the words in the left-hand column with their translation in the right-hand column.

1	variety	A	быть поглощенным чем-либо
2	manufacturing process	B	красители
3	sophisticated products	C	быть потребляемым
4	heavy chemicals	D	высокотехнологичный дорогостоящий продукт
5	fine chemicals	E	сложные изделия
6	dyes	F	общая рентабельность
7	drugs	G	технические возможности
8	to be consumed	H	научное исследование
9	high-tech, high-value products	I	продукты основной химической промышленности
10	scientific research	J	увеличивать, расширять
11	novel marketing techniques	K	разнообразие
12	to scale up	L	химические продукты тонкого органического синтеза
13	to be absorbed in	M	технология производства
14	profit margin	N	Новые методы сбыта продукции
15	technical capacity	O	лекарственное сырье

2. Match the words from the left column with their collocations from the right column.

1	sophisticated	A	fabrics
2	manufacturing	B	up
3	fashionable	C	chemicals
4	product	D	the efficiency
5	profit	E	products
6	scale	F	design
7	to improve	G	margin
8	heavy	H	processes

READING

3. Before reading the text about Sophisticated products and scientific research, answer the questions:

1. How do you understand the notion "sophisticated products"? Give examples of such products.
2. How do sophisticated products differ from all the rest?

Sophisticated products and scientific research

Chemicals come in great varieties, even without counting plastics and synthetic fibers, which did not exist at the historical time at issue. Most chemical do not reach consumers but are used up in manufacturing processes, such as bleaching agents in the textile and paper industries. They roughly fall into two classes. Heavy chemicals such as acid or soda are consumed by industry in enormous volume. Fine chemicals such as dyes and drugs are greater in variety and more complicated in structures, but are consumed in smaller amounts.

The German industry mainly specialized in fine chemicals. These high-tech, high-value products required sophisticated chemistry to design and technical personnel to market. To synthesize novel dyes required advanced chemistry and ample scientific research. The dyes firms were keen on product design, on making dyes for all colours of the rainbow. They were also keen to develop novel marketing techniques that helped their customers to use these sophisticated dyes on fashionable fabrics. However, they were not too keen to improve the efficiency of production processes. They produced thousands of different dyes, but the amount of each dye was small,

typically a hundred tons or so. For such small volumes, scaling up was rather easy and could readily be handled by teams of chemists and mechanical engineers. If the production processes they designed were less than maximally efficient, the little waste was easily absorbed in the fat profit margin of high-value products.

When they saw opportunities for novel products with high-volume demands, the Germans could mobilize their technical capacity in special projects to develop production processes, which they kept proprietary. This they did for the Haber-Bosch process for synthetic ammonia and fertilizer. But these were singular cases. For their core business of fine chemicals, they did not see the need for developing a discipline dedicated to efficient production processes.

4. Answer the questions:

1. What are two classes of chemicals?
2. How do two classes of chemicals differ?
3. What industry is mainly specialised in fine chemicals?
4. Why is it difficult to synthesize novel dyes?
5. What were the dyes firms keen on?
6. How many dyes did they produce?
7. What did the firms do with the little waste?
8. What volumes was scaling up efficient for?

5. Read the Text again and say if the statements 1–10 are True (T) or False (F). If the statement is false, give the right variant.

1. Only counting plastics and synthetic fibers it is possible to state that chemicals come in great varieties.
2. Most chemical do not reach consumers but are used up in manufacturing processes.
3. Chemicals constitute two classes.
4. Fine chemicals are greater in variety but they are not complex in structures.
5. Fine chemicals are consumed in enormous volume.
6. The German industry specialization is in heavy chemicals.
7. The development of novel marketing techniques were necessary to scale up market of sophisticated dyes.
8. The production processes development was conditioned by the opportunities for novel products.
9. The Haber-Bosch process for synthetic ammonia and fertilizer can serve as the example of the production processes development.
10. The case of the Haber-Bosch process encouraged further rapid growth of production processes development.

TEXT 2

6. Before reading the text about crude oil refining, match the petroleum products with the way it is used and answer the questions:

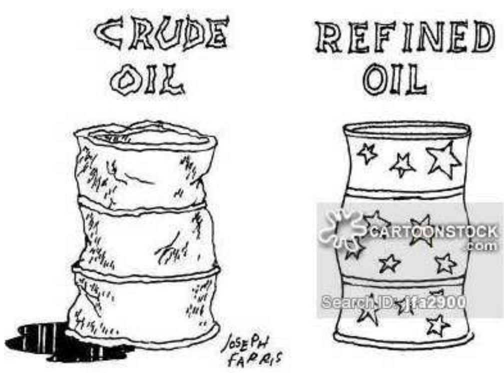
asphalt	to generate heat
diesel	jet fuel and as heating fuel
fuel oil	protects moving parts inside an internal combustion engine
gasoline	used to soundproof
kerosene	making roads
liquefied petroleum gas	is used in drywall to insulate buildings
lubricating oil	a solvent and cleaning agent
paraffin wax	in heating appliances, aerosol propellants, and refrigerants.
bitumen	used in a special type of engine
petrochemicals	in internal combustion engines

7. Which product is the heaviest? The lightest? Which is a solid? Which ones are liquids? Which burns as a gas?

Crude oil refining

Nearly every aspect of our modern lifestyle is impacted by oil. Oil is said to power our vehicles, to create medicines that keep us healthy, and to make the plastics, cosmetics, and other personal products that enhance our daily lives. However, none of these products would exist without the refining process. For example, you wouldn't put crude oil in the gas tank of your car! It has to be refined into gasoline first!

Today, crude oil is refined all over the world. The largest oil refinery is the Paraguana Refining Complex in Venezuela, which can process 940,000 barrels of oil each day.



In fact, most of the oil industry's largest refineries are in Asia and South America. Nevertheless, the practice of refining oil was created in the United States, where it continues to be an important part of the nation's economy.

8. Read the text below. For paragraphs 1–10, find the most appropriate headings A–J.

A	Kerosene	E	Gasoline	I	Liquefied petroleum gas
B	Diesel	F	Paraffin wax	J	Fuel oil
C	Lubricating oil	G	Asphalt		
D	Bitumen	H	Petrochemicals		

Products from Petroleum

The products refined from the liquid fractions of crude oil can be placed into ten main categories. These main products are further refined to create materials more common to everyday life. The ten main products of petroleum are:

___________ 1

It is commonly used to make roads. It is a colloid of asphaltenes and maltenes that is separated from the other components of crude oil by fractional distillation. Once it is collected, it is processed in a de-asphalting unit, and then goes through a process called "blowing" where it is reacted with oxygen to make it harden. It is usually stored and transported at around 300° Fahrenheit.

__________ 2

This is any fuel that can be used in a diesel engine. It is produced by fractional distillation between 392° Fahrenheit and 662° Fahrenheit. Itl has a higher density than gasoline and is simpler to refine from crude oil. It is most commonly used in transportation.

_________ 3

This is any liquid petroleum product that is burned in a furnace to generate heat. It is also the heaviest commercial fuel that is produced from crude oil. The six classes of it are: distillate fuel oil, diesel fuel oil, light fuel oil, gasoil, residual fuel oil, and heavy fuel oil. Residual fuel oil and heavy fuel oil are known commonly as navy special fuel oil and bunker fuel; both of these are often called furnace fuel oil.

________ 4

Almost half of all crude oil refined in the United States is made into gasoline. It is mainly used as fuel in internal combustion engines, like the engines in cars. Gasoline is a mixture of paraffins, naphthenes, and olefins, although the specific ratios of these parts depends on the refinery where the crude oil is processed. Gasoline refined beyond fractional distillation is often enhanced with isooctane and ethanol so that it is usable in cars. Gasoline is called different things in different parts of the world. Some of these names are: petrol, petroleum spirit, gas, petrogasoline, and mogas.

__________ 5

it is collected through fractional distillation at temperatures between 302° Fahrenheit and 527° Fahrenheit. It is a combustible liquid that is thin and clear. It is most commonly used as jet fuel and as heating fuel. In the early days of oil, it replaced whale oil in lanterns. In the early 21st century, it was used to power New York City Transit buses. Now, it is used as fuel in portable stoves, space heaters, and in liquid pesticides.

__________ 6

This is a mixture of gases that are most often used in heating appliances, aerosol propellants, and refrigerants. Different kinds of it are propane and butane. At normal atmospheric pressure, it will evaporate, so it needs to be contained in pressurized steel bottles.

__________7

It consist of base oils and additives. Mineral oils are manufactured by special processes called: solvent extraction, catalytic dewaxing, hydrocracking, and is ohydromerization. Different lubricating oils are classified as paraffinic, naphthenic, or aromatic. They are used between two surfaces to reduce friction and wear. The most commonly-known example is motor oil, which protects moving parts inside an internal combustion engine.

__________ 8

This is a white, odorless, tasteless, waxy solid at room temperature. Its melting point is between 117° Fahrenheit and 147° Fahrenheit, depending on other factors. It is an excellent electrical insulator, second only to Teflon®, a specialized product of petroleum. It is used in drywall to insulate buildings. It is also an acceptable wax used to make candles for the Jewish Menorah.

__________ 9

It is commonly known as tar, and it represents a thick, black, sticky material. If refined, it is the bottom fraction obtained by the fractional distillation of crude oil. This means that the boiling point of it is very high, so it does not rise in the distillation chamber. The boiling point is 977° Fahrenheit. It is used in paving roads and waterproofing roofs and boats. It is also made into thin plates and used to soundproof dishwashers and hard drives in computers.

__________ 10

These are the chemical products made from the raw materials of petroleum. These chemicals include: ethylene, used to make anesthetics, antifreeze, and detergents; propylene, used to produce acetone and phenol; benzene, used to make other chemicals and explosives; toluene, used as a solvent and in refined gasoline; and xylene is used as a solvent and cleaning agent.

9. Complete the sentences using the information from the text.

1. Chemical products made from the raw materials of petroleum are called _____.
2. _____'s melting point is between 47° Celsius and 64° Celsius, depending on factors.
3. A _______ is a huge, chain-like molecule made by combining many small molecules called monomers.
4. Undergoing a process called "blowing", _____ is reacted with oxygen to make it harden.
5. Nowadays ______ is widely used as fuel in internal combustion engines.
6. The other name for _____ is tar.
7. Having a higher density than gasoline, ____ is simpler to refine from crude oil.
8. _____ is a mixture of several hydrocarbons that are liquid under normal conditions.

VOCABULARY

10. Use the suffixes -ed to form participle from a verb, -ment to form a noun from a verb, and -less to present the idea of the lack of quality. Make up word combinations.

Example: *develop – developed – a highly developed industry.*

	-ed		**-ment**		**-less**
absorb		improve		odor	
consume		employ		taste	
require		require		sense	
advance		agree		rest	
develop		approve		meaning	

11. Match the words to the definitions:

1	absorb	A	The group of people employed for a purpose; the staff in an office
2	acid	B	Privately owned and protected, not public or common
3	complicate	C	Set aside for a reason
4	personnel	D	To make something difficult, or hard to deal with
5	sophisticate	E	Need
6	proprietary	F	A large amount; more than enough
7	dedicate-	G	An organisms that gets its energy from other organisms because it cannot make its own energy from non-living things in the environment
8	require	H	To take into one's self, as a sponge takes in water
9	capacity	I	To work at one thing very carefully
10	ample	J	Ability or position
11	consumer	K	A chemical, sour to the taste and having a PH balance of less than 7
12	specialize	L	Having complicated tastes and manners

12. Fill in the gaps with the words from Ex. 11:

1. The cake ________________________ 2 eggs.
2. He ________________________ ten percent of his money for charity.
3. Their computers use a ________________________ chip that no other company has.
4. All animals are ________________________ because they have to eat other things in order to get energy.
5. We have ________________________ food for 6 people.
6. He has the ________________________ to be a great businessman, but he wants to be a poet.
7. Having children ________________________ his life.
8. The ________________________ turned the test paper blue.
9. The U.S. ________________________ immigrants from all over the world.
10. He ________________________ in heart surgery.
11. Classical music is more ________________________ than pop music.
12. The office ________________________ got together after work for a cocktail party for their new boss.

13. Fill in the blanks with the words from the table:

absorbed	acid	personnel	capacity	specialize	consumer
complicate	require	dedicate	sophisticate	ample	proprietary

1. These high-tech, high-value products required ______ chemistry to design and technical personnel to market.
2. When they saw opportunities for novel products with high-volume demands, the Germans could mobilize their technical capacity in special projects to develop production processes, which they kept ________.
3. When they saw opportunities for novel products with high-volume demands, the Germans could mobilize their technical ______ in special projects to develop production processes, which they kept proprietary.
4. To synthesize novel dyes required advanced chemistry and _______scientific research.
5. Heavy chemicals such as _________ or soda are consumed by industry in enormous volume.
6. If the production processes they designed were less than maximally efficient, the little waste was easily ________ in the fat profit margin of high-value products.

SPEAKING

14.

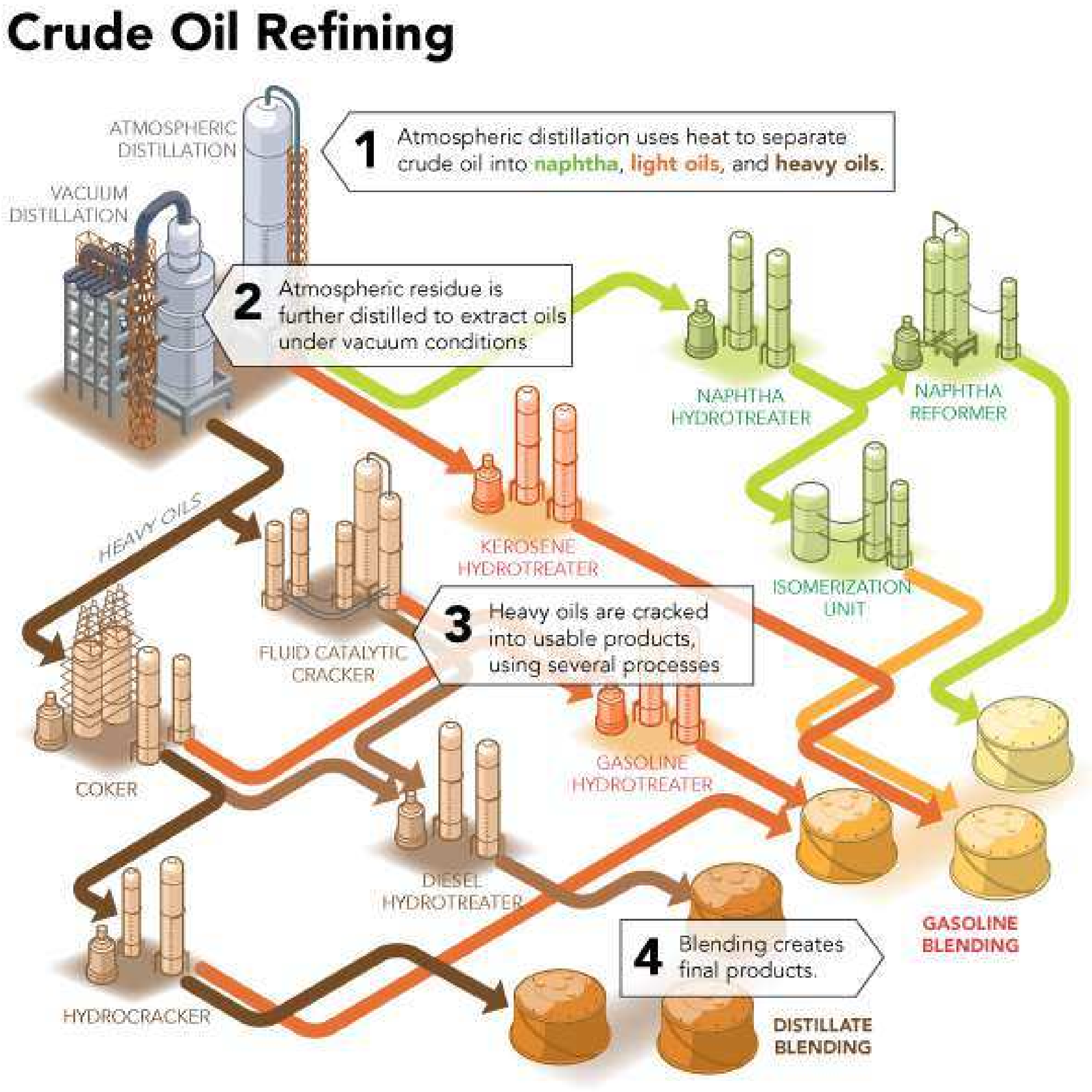
A. Put the sentences in the correct order that represents the safe order of a bulk tanker loading:

A. Check the transport emergency card
B. Connect the pipes
C. Drain the hoses
D. Load the tanker
E. Earth the tanker
F. Switch off the maser switch
G. Drive the tanker into the loading area
H. Drive the tanker out of the loading area

B. Complete the sentences. Explain how a bulk tanker is loaded safely. Use the passive:

1. First, the tanker _____.
2. Then the tanker _____.
3. Next, the _____.
4. After that, the _____.
5. Then _____.
6. Next, _____.
7. After that, _____.
8. Finally, _____.

C. Look at the picture and tell how crude oil is refined.



1. First, the heat _____.
2. Next, atmospheric residue ______.
3. Then heavy oils _____.
4. Finally, final products _____.

TRANSLATION

15. Translate from English into Russian:

1. The Chemical process industry and Chemical engineering have been inseparably entwined throughout much of their history.
2. While the spotlight usually falls on the scientist who makes the initial discovery, the hurdles of pilot testing, scale up, and commercialization are overcome by the chemical engineer.
3. It's difficult to pinpoint the exact date when chemical engineering came into being.
4. However, most agree that the Industrial Revolution marks the beginning of the events that led up to the establishment of chemical engineering as a recognizable discipline.
5. In the late 1800s, Europe's Industrial Revolution was in full swing.
6. The advent of the steam engine fueled the burgeoning textile industry and other industrial chemicals, such as sulphuric acid and soda ash.
7. The processes for these materials presented perfect opportunities for chemical engineering skills.
8. In England the processes for making sulphuric acid and soda ash had remained the same for several decades.
9. John Glover and Ernest Solvay, respectively, are credited with developing innovative processes that recycled valuable nitrates, on the one hand, and did away with toxic by-products, on the other.
10. In the early 1800s, sulphuric acid was made by the lead chamber method.

WRITING

16. Write an annotation to the text:

Substances of extremely high concern may be subject to authorisation by the Commission with regard to particular uses. The objective is to ensure that the risks linked with these substances are validly controlled and that these substances are gradually replaced by other appropriate substances or technologies where this is economically and technically viable.

The Agency publishes and regularly updates a list of substances ("list of candidate substances") identified as having characteristics of extremely high concern. These may include the following:

- CMRs (carcinogens, mutagens and reproductive toxins);
- PBTs (persistent, bioaccumulative and toxic substances);
- vPvBs (very persistent and very bioaccumulative substances);
- some substances of concern which have irreversible serious effects on humans and the environment, such as endocrine disruptors.

The inclusion of candidate substances on the list involves, under certain conditions, the requirement of information on the presence of this substance in the articles. After inclusion of this substance in Annexe XIV to the Regulation any placing on the market and use of such chemical substances is subject to authorisation. This is granted if the risks arising from the substance in question can be validly controlled. If they cannot and if no alternative exists, the Commission is to assess the level of risk and the socio-economic advantages of using the substance and decide whether to authorise it or not. Some substances, such as PBTs and vPvBs can be authorised only if the socio-economic advantages override the risks and there are no alternatives.

The burden of proof is placed on the applicant. All authorisations must be reviewed after a certain period of time, determined on a case-by-case basis.

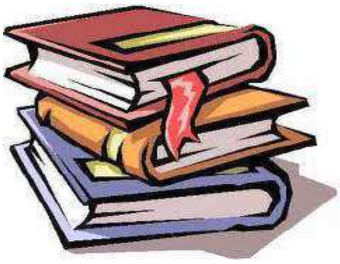
Downstream users may use a substance for an authorised use provided they obtain the substance from a company to which an authorisation has been granted and keep within the conditions of that authorisation. However, such downstream users must inform the Agency so that the authorities are fully aware of how certain substances of extremely high concern are being used.

The restriction procedure provides a safety net, making it possible to manage the risks which are not adequately covered by other provisions of the REACH system. Proposed restrictions may relate to the conditions of manufacture, use(s) and/or placing on the market of a substance, or the possible prohibition of such activities, if necessary. They are suggested by Member States or by the Agency (at the Commission's request) in the form of a structured dossier and decided on by the Commission.

The Regulation establishes a European Chemicals Agency, responsible for managing the technical, scientific and administrative aspects of REACH and ensuring consistency of decision-making at Community level.

The Agency is also to manage the registration process and play a key role in the evaluation process. It receives applications for authorisation and delivers opinions and issues recommendations in relation to the authorisation and restriction procedures.

Self-study 1



READING

TEXT 1

1. **Read the text about Energy Conservation, and then decide if the statements (1–10) are True (T) or False (F).**

Energy Conservation

The growth of energy demand lies in the growth of population and per capita energy use. These are increasing faster than the mature markets in the developed world. Infrastructure of all types is much less energy efficient and is generally in need of replacement and expansion. Even though growth and technology transfer are projected for the long-term, market conditions are no longer controlled to provide a stable environment in the short-term.

Development during the middle of the 20th century focused on creating industrial infrastructure for national monopolies. In the 21st century, development requires new technology in the energy sector. This includes cleaner fuels and renewable sources, process alterations for high efficiency and low emissions, improved process monitoring and control, new transport systems and process and product design for low energy/material use and reusability.

A few of these changes apply to central power stations but the emphasis is on end-user characteristics. End-users become a more active part of the energy sector rather than passive consumers. There will be a number of participants making independent decisions and the markets will be influenced, but not directed, by public sector incentives and rules. Deregulation of the utility industry has led to numerous mergers and acquisitions. A group of global corporations is emerging, geared to competition and replacing the structure of local regulated monopolies. The debt crises of the 1980s along with the free market philosophy of the 1990s has led to restructuring of the public sector.

The independent power producers (IPP's) became a serious part of the utility industry during the 1980s. They offered relatively small, modern plants and altered the basic industry concepts of how power resources could be procured.

Even more radical was an expanded concept of demand-side management. Under regulatory mandates and incentives, utilities procured blocks of guaranteed energy conservation. This demonstrated that end-users and third-part service providers could be structured to provide improved end-use power efficiency. Major consumers find Dictionary of energy efficiency technologies themselves no longer captive and the trend is for large users to analyze their energy use and shop among various suppliers. To serve these customers, specialist brokers and marketers have emerged. This has created new packaged products for rates and services.

1. The more the population grows, the more the energy demand grows.
2. Infrastructure of all types lack energy efficiency.
3. In the 21st century, development is also focused on creating industrial infrastructure for national monopolies.
4. New technology in the energy sector implies processes alteration and improvement in monitoring and control.
5. The major changes concern the central power stations but not the end-user.
6. In spite of the debt crises of the 1980s along with the free market philosophy of the 1990s, the public sector did not undergo any changes.
7. The independent power producers (IPP's) introduced a new industry concepts of how power resources could be procured.
8. The changes showed that end-use power efficiency can be improved.
9. Specialist brokers and marketers did not meet the demands of the new market.
10. The changes in Energy Conservation policy brought up new packaged products.

TEXT 2

2. Read the text about Chemical products. For questions 1–5, choose the best answer A, B, C or D.

Chemical products

Chemical products are essential to modern living standards. They can be divided into three broad classes:

1. Commodity or bulk chemicals: These are produced in large volumes and purchased on the basis of chemical composition, purity and price. Examples are sulphuric acid, nitrogen, oxygen, ethylene and chlorine.

2. Fine chemicals: These are produced in small volumes and purchased on the basis of chemical composition, purity and price. Examples are chloropropylene oxide (used for the manufacture of epoxy resins, ion-exchange resins and other products), dimethyl formamide (used, for example, as a solvent, reaction medium and intermediate in the manufacture of harmaceuticals), and etc.

3. Specialty or effect or functional chemicals: These are purchased because of their effect (or function), rather than their chemical composition. Examples are pharmaceuticals, pesticides, dyestuffs, perfumes and flavorings.

Because commodity and fine chemicals tend to be purchased on the basis of their chemical composition alone, they are undifferentiated. For example, there is nothing to choose between 99.9 % benzene made by one manufacturer and that made by another manufacturer, other than price and delivery issues. On the other hand, specialty chemicals tend to be purchased on the basis of their effect or function and are therefore differentiated. For example, competitive pharmaceutical products are differentiated according to the efficacy of the product, rather than chemical composition. An adhesive is purchased on the basis of its ability to stick things together, rather than its chemical composition and so on.

However, undifferentiated and differentiated should be thought of as relative terms rather than absolute terms for chemical products. In practice, chemicals do not tend to be completely undifferentiated or completely differentiated.

Commodity and fine chemical products might have impurity specifications as well as purity specifications. Traces of impurities can, in some cases, give some differentiation between different manufacturers of commodity and fine chemicals. For example, 99.9 % acrylic acid might be considered to be an undifferentiated product. However, traces of impurities, at concentrations of a few parts per million, can interfere with some of the reactions in which it is used and can have important implications for some of its uses. Such impurities might differ between different manufacturing processes.

Not all specialty products are differentiated. For example, pharmaceutical products like aspirin (acetylsalicylic acid) are undifferentiated. Different manufacturers can produce aspirin and there is nothing to choose between these products, other than the price and differentiation created through marketing of the product.

1) What is the prominent differentiating factor for competitive pharmaceutical products?
   a) affect
   b) effect
   c) efficacy
   d) efficiency
2) Chemical products can be called undifferentiated if
   a) it is impossible to identify their components
   b) there chemical composition is almost identical
   c) it is elementary substance
   d) it extraterrestrial matter
3) The terms "differentiated" and "undifferentiated" are used as relative terms rather than absolute terms for chemical products because;
   a) scientists have not defined them yet
   b) there is little difference between them
   c) the term may damage the image of the company
   d) chemicals do not tend to be completely undifferentiated or differentiated
4) Traces of impurities can, in some cases, serve as:
   a) differentiation between different manufacturers of chemicals
   b) evidence of the manufacturer's dishonesty
   c) evidence of the authenticity of the chemicals
   d) the label of quality
5) Traces of impurities, at concentrations of a few parts per million, can
   a) not influence further reactions
   b) produce undesirable effect on to the further reactions
   c) lead to explosion
   d) demonstrate the accuracy of instruments

VOCABULARY AND GRAMMAR

3. Choose the word (A, B, C or D) that best fits the gap.

1. The refinery is _____ from the admin block.
   a) managed
   b) ruled
   c) guided
   d) ordered
2. Some products ______ the refinery in tankers.
   a) are left
   b) are leaving
   c) leave
   d) were left
3. Kerosene _____ to the airport by a pipeline.
   a) takes
   b) is taking
   c) took
   d) is taken
4. The crude oil _____ in the distillation towers.
   a) is refined
   b) refined
   c) is refund
   d) refines
5. Tankers ______ their oil at the jetty.
   a) are unloaded
   b) unload
   c) uploaded
   d) are uploading
6. The crude oil _____ in the tanks.
   a) stores
   b) is being stored
   c) is storing
   d) is stored
7. The distillation towers _____ the crude oil.
   a) are distilled
   b) distill
   c) are being distilled
   d) have distilled

8. The first chemical engineering course _____ at the University of Manchester in 1887.
   a) was given
   b) was gaved
   c) had been given
   d) is given
9. Chemical products _____ essential to modern living standards.
   a) are being
   b) was
   c) are
   d) is being
10. The formula for Coca-Cola _____ a secret for over 100 years.
   a) has been kept
   b) was kept
   c) is kept
   d) keep

TRANSLATION

4. Translate from English into Russian:

1. The first chemical engineering course was given in 1887 by George E. Davis in the form of twelve lectures covering various aspects of industrial chemical practice.
2. In 1904 Evans introduced three more "chemical engineering" courses.
3. In the post-war years, new additions to the faculty added to the excellence of an already flourishing program.
4. The 70's saw a growing emphasis in the school toward fundamental and interdisciplinary research on engineering science.
5. The research programs of the school were also augmented by the work of J. Henry Rushton on high pressure thermodynamics.
6. They calculated the methoxyl content of spruce protolignin to be 14.8 %.
7. Ewald found this to be true for hexaphenylethane.
8. Wartenberg recalculated the heat of formation of boron trifluoride.
9. At 0 C and low pressures, conditions under which Roberts had claimed the hydrogen layer to be complete.
10. 99.9 % acrylic acid might be considered to be an undifferentiated product.

WRITING

5. Write an annotation to the text:

Everything around you is made of molecules, not just water. But have you ever seen a drawing of a rubber molecule? What about a wood molecule or a cotton molecule? These things, which you see and use every day, are also made of molecules. But what are these molecules like? We know that a water molecule is made of one oxygen atom and two hydrogen atoms. What kinds of atoms, and how many atoms, are there in a rubber molecule?

Over 100 years ago no one knew the answer to these questions. In the early 1900s, no one knew what rubber molecules were like. No one knew the molecular structure of the molecules that made up a lot of natural materials, like rubber, wood, cotton, silk, and some new artificial materials called plastics. Scientists called these mystery materials polymers.

These polymers did strange things that scientists didn't quite understand. One of the strangest things was their molecular masses. When scientists determined the molecular mass of water, they got an answer of 18. When they determined the molecular mass of carbon dioxide, they got 44. But polymers were just plain weird. When scientists tried to determine their molecular masses, they got huge numbers, in the thousands or higher! Nothing like this had ever been seen before.

Could these high molecular masses be for real? Some scientists thought that small molecules were clumping together in giant clusters called colloids. According to this theory, the high molecular mass was the combined molecular mass of all the molecules in the cluster.

There was a simpler theory, but not many scientists accepted it. This theory said that polymers were made of giant molecules, each containing thousands of atoms, all joined together by covalent bonds. According to this theory, the extremely high molecular masses were observed because the molecule in rubber, wood, and cotton really did have a molecular masses in the thousands or higher. One German scientist named Hermann Staudinger began to strongly support this theory sometime around 1917. He invented a name for his big molecules. He called them macromolecules.

Why did anyone care about the molecular structure of polymers? What did it matter anyway? We knew how to use them, and that's what really matters, isn't it? Of course, the usefulness of any material is important. But the apparent high molecular masses of polymers challenged scientists' basic understanding of what kinds of molecules atoms could form. What's more, being able to understand the molecular structures of polymeric materials could help people trying to make new polymeric materials. Remember, a few new synthetic polymers had been discovered, but that was all by accident. Scientists wanted to know how to design and build new polymeric materials with better properties than the materials found in nature, or the few synthetic polymers that had been discovered accidentally. Knowing the molecular structures of polymers would give scientists a starting point to design and build new materials from the ground up, atom by atom.

Staudinger never could decisively prove to his peers that polymers were made of macromolecules, no matter how strongly he believed his theory was correct. He argued for years with other scientists in Europe about his theory. Then, across the ocean in the United States, far away from the debates and controversy, a scientist named Wallace Carothers had a plan to help settle the question of whether polymers were colloids or macromolecules.

CONTROL WORK № 1

Variant 1

READING

TEXT 1

1. Read the text and complete the statements (1–5) with the most suitable ending A, B, C or D.

When the Russian scientist Dmitri Ivanovich Mendeleyev devised the Periodic Table in 1869, he was able to use it for much more impressive feats of deduction. He correctly predicted elements that had not yet been discovered: not just that they existed, but what they behaved like, their densities, and their melting points.

To understand how and why this information is encrypted in the Periodic Table, we need – and not before time, to define what we mean by an element. We got a pretty good working definition from Lavoisier: if you cannot break a substance down into clearly distinct and still more fundamental constituents, it stands a good chance of qualifying as an element. But the problem with this definition is that it depends on how good a chemist you are, or ultimately on the capabilities of your contemporaneous chemical technology. For example, Lavoisier listed as elements ‘lime’ and ‘magnesia’. But neither of these qualifies: lime is calcium oxide, a compound of calcium and oxygen, and magnesia is magnesium oxide. Both calcium and magnesium were first isolated in more or less pure form by the English chemist Humphry Davy in 1808, using the technique of electrolysis – splitting compounds with electricity. The metals’ avidity for oxygen is too great for them to be parted by the chemical reactions available to Lavoisier, but electricity will do the job. Davy also found the elements sodium and potassium this way in 1807.

So how can we know that today’s elements are not just extremely intimate compounds waiting to be split? And for that matter, if elements are meant to be fundamental and irreducible substances, how is it that gold was made from mercury in 1941, or that The Times of 12 September 1933 was able to announce a startling new discovery: Transformation of Elements’?

1) The Periodic Table, devised by the Russian scientist Dmitri Ivanovich Mendeleyev in 1869, could predict correctly:
   a) whether the element existed
   b) whether the element existed, its density and conductivity

c) whether the element existed, its density and melting point
d) whether the element existed, its density, conductivity and colour

2) The working definition of an element from Lavoisier does not suit any more because:
a) the modern chemists are not as good as lavoisier's contemporaries were
b) the notions of the periodic table are out of date
c) scientists do not possess the facilities necessary for such measurements any more
d) the capabilities of our contemporaneous chemical technology have improved

3) Lavoisier was wrong to list as elements 'lime' and 'magnesia' because:
a) these elements had been discovered previously
b) they can be parted further
c) they represented one and the same substance
d) he had made mistakes calculating their density

4) The technique of electrolysis allowed to:
a) split compounds with electricity into more or less isolated pure form.
b) measure the density and melting point of an element
c) say whether the element existed, its density and melting point
d) measure the conductivity of an element

5) In the last paragraph the author wonders if:
a) it was possible to make gold from mercury in 1941
b) we have come to the limits of the pureness of the elements
c) the times announced a new discovery "the transformation of elements" in 1933
d) elements are meant to be fundamental and irreducible substances

TEXT 2

2. Read the text. Decide if the statements (1–10) are True (T) or False (F).

The elements in the modern table increase in atomic weight as one goes from left to right and from top to bottom – but the weights do not advance in even steps. The progression is defined not so much by atomic weight as by atomic number. This is defined as the number of protons in the respective atomic nuclei. The atomic weight of an element – the quantity chemists could weigh with scales and balances – depends on the number of protons and neutrons, which have virtually equal masses. In light nuclei, there is a roughly equal number of each; heavier atoms have an increasing preponderance of neutrons. But the number of protons is the more fundamental quantity, since it determines the positive charge on the nucleus. Until Rutherford spread the idea that atoms contain positively charged protons, there was no concept of atomic number, let alone what it might imply.

So the right way to order the elements in sequence is by atomic number, which progresses by one from each element to the next. This number tells us how many electrons the atoms of each element possess: the number of electrons is equal to the number of protons, since the protons and electrons balance one another's charge, making the atom electrically neutral. An atom's electron count is crucial, because all chemical behaviour is determined by these particles. When atoms join together to form compounds, they do so by using their electrons as a kind of glue. There are two main ways of doing this. Some atoms like to share electrons: one of their electrons pairs up with one in another atom, making a kind of handshake. Other atoms will shed or gain electrons, becoming electrically charged ions. In the methane molecule, a carbon atom makes electronic handclasps with four hydrogen atoms. In table salt, sodium atoms donate one electron each to chlorine atoms, making the sodiums positively charged ions and the chlorines negatively charged ions (called chloride). The sodium and chloride ions then stick together by electrostatic attraction.

1. The elements in the modern table increase in atomic weight as one goes from right to left and from top to bottom.
2. The progression is defined by atomic weight not by atomic number.
3. The atomic number is defined as the number of protons in the respective atomic nuclei.
4. Rutherford confuted the idea that atoms contain positively charged protons.
5. The right way to order the elements in sequence is by atomic number, which progresses by one from each element to the next.
6. The atomic number tells us how many electrons the atoms of each element possess.
7. The number of electrons is not equal to the number of protons, though the protons and electrons balance one another's charge, making the atom electrically neutral.
8. When atoms join together to form compounds, they do so by using their electrons as a kind of glue.
9. In table salt, sodium atoms accept one electron each to chlorine atoms, making the sodiums positively charged ions and the chlorines negatively charged ions (called chloride).
10. The sodium and chloride ions stick together by atomic attraction.

VOCABULARY AND GRAMMAR

3. Choose the correct item A, B, C or D.

1) Samuel M. Kier _____ horizontal cylindrical stills that only held 5 to 6 barrels of oil at a time.
   a) used
   b) was used to
   c) get used to
   d) used to
2) Today, pipelines, railroads, tankers, and trucks transport crude oil to refineries where it _____ into the products we use every day.
   a) is transforming
   b) are being transformed
   c) transforms
   d) is transformed
3) There are many environmental programs that _____ oil refining a safer, cleaner industry.
   a) are made
   b) have made
   c) are maked
   d) making
4) When deciding to start a new program or venture for your firm, its important to measure its'______.
   a) value-effectiveness
   b) price -effectiveness
   c) cost effectiveness
   d) cost-effective
5) Stockmarkets are considered the best examples of _____ markets.
   a) affecting
   b) effective
   c) affective
   d) efficient
6) _____ enhance the growth of plants.
   a) fertilizers
   b) stabilizers
   c) catalysts
   d) inhibitors

7) A large molecule, or macromolecule, composed of many repeated subunits is called _____.
   a) polycrystal
   b) monomer
   c) polymer
   d) polygon

8) He _____ the girl's name now.
   a) is remembered
   b) has remembered
   c) remembers
   d) has been remembered

9) A prize _____ to whoever solves this equation.
   a) will be given
   b) gives
   c) will be giving
   d) was giving

10) When the manager arrived, the problem _____.
   a) had solved
   b) had already solved
   c) had been solving
   d) had already been solved

TRANSLATION

4. Translate the sentences from English into Russian.

1. Creating plutonium atom by atom in the Berkeley cyclotron was no way to gather a critical mass.
2. Enrico Fermi demonstrated a better means of synthesizing plutonium in 1942, when he and co-workers produced the first controlled nuclear chain reaction in a reactor at the University of Chicago.
3. This used natural uranium fuel, which was converted to plutonium by self-sustaining neutron emission and capture.
4. The chain reaction was held in check by rods of cadmium.
5. Fermi's 'atomic pile' was just a prototype.
6. The problem of how to build an atomic bomb was tackled by the physicists, chemists, and engineers at the Los Alamos complex in New Mexico.
7. Most major chemical companies hire chemical engineers to fill their technical positions in environmental engineering.

8. A degree in Chemical Engineering opens many doors for diverse, challenging and rewarding opportunities.
9. Chemical engineers develop processes and chemicals to make food products cheaper, safer, and with increased yields.
10. From these processes come products like orange juice, chocolate, corn sweeteners, citric acid, or vitamin E.

WRITING

5. Write an annotation to the text:

It is important to match mixing equipment capabilities with process requirements. While it is desirable to have an optimum design and operating conditions for every step in the process sequence, it is seldom practical to do so. For example, specialty and pharmaceutical processes require the use of multipurpose reactors. An important consideration is to understand how less-than-ideal equipment will function in all stages of operation.

Documenting mixing performance data is vital to future troubleshooting. During the life of the equipment, modifications of both processes and equipment are common. For example, increased production requirements could lead to higher process concentrations and viscosity. Under such conditions, mixing may become inadequate, leading to regions of stagnation. Documented performance conditions for the original process are useful for diagnosing how the process responds to new conditions. A simple design or operational change can often meet the new challenge.

Mixing intensities vary greatly throughout a stirred vessel. While turbulent mixing can exist in the impeller region, transitional or laminar-flow conditions can exist elsewhere. Energy dissipation near the impeller is 40–50 times greater than in other regions. Common practice introduces feed to the surface of the liquid. While this avoids plugging problems and feedpipe stagnation, it places the feed in a weakly mixed region.

Computational fluid dynamics or CFD (also known as computational fluid mixing, CFM) was introduced to the chemical process industries in the late 1980s. CFD/CFM is a numerical technique for solving fluid relationships such as conservation, transport, and the Navier-Stokes equations.

Commercial CFD software enables one to predict the effects that geometry, feed location, physical properties, and operating conditions have on conditions in the vessel. Typical results predict velocity profiles, rates of energy dissipation, concentrations, and flow streamlines as they would occur in the vessel. This tool enables one to appreciate the good and bad features for each considered design.

CFD simulations are based on assumptions. Some are low risk, but some impose high risk.

Experimental validation is important particularly for nontrivial applications. Validation is advisable.

Published velocity profile data can often help to validate results. At the time of this writing, CFD is weak in its ability to model large-scale turbulence and multiphase flow.

Variant 2

READING

TEXT 1

1. Read the text and complete the statements (1–5) with the most suitable ending A, B, C or D.

Aristotle was perfectly at liberty to be sceptical about atoms, because the arguments for and against were all philosophical. Somewhat remarkably, the same was true even at the end of the nineteenth century, when several distinguished scientists shared Aristotle's view. Wilhelm Ostwald, a German physical chemist who won the Nobel Prize in 1909, typified the conviction of many scientists that atomism was merely a convenient hypothesis and not to be taken too literally.

All this changed in 1908 when the French physicist Jean Perrin showed that the dancing motions of tiny grains suspended in water were consistent with Albert Einstein's idea that they were being struck by particles too small to see: molecules of water, composed of atoms of hydrogen and oxygen. Even Ostwald was persuaded: atoms are real.

Some would hardly have suspected otherwise. Once John Dalton, a diffident Manchester Quaker, had taken to drawing pictures of atoms in 1800, it was tempting to take them for granted. Dalton had every confidence in the "solid, massy, hard, impenetrable, movable particles" that Isaac Newton envisaged over a hundred years earlier, and he imagined them as eternal, unchangeable bodies, however inaccessible to the human eye. Dalton appreciated the kinship of his idea with that of Democritus, and so he borrowed the Greek philosopher's term: atomos became "atom". His drawings depicted circular particles embellished with dots, lines, shading, or other symbols to distinguish different elements, which combined in fixed ratios to make "compound particles" (which we would now call molecules).

1) The author thinks that Aristotle could:
   a) deny the existence of matter
   b) deny the existence of philosophy
   c) prove the idea of the existence of atoms
   d) doubt the existence of atoms

2) From the text we learn that atomism:
   a) had been supported by scientists until 1909
   b) was advised not to be taken too seriously by the scientists of the beginning of XX century
   c) was introduced as a hypothesis by Wilhelm Ostwald
   d) had become the leading concept at the beginning of XX century
3) Jean Perrin's experiment with dancing motions of tiny grains suspended in water proved that:
   a) grains suspended in water were being struck by molecules of water, composed of atoms
   b) motions of grains suspended in water had nothing in common with Albert Einstein's idea of particles too small to see
   c) Wilhelm Ostwald and his hypothesis of atomism outdated
   d) particles were too small to see
4) The concept of atoms as eternal, unchangeable bodies, however inaccessible to the human eye belonged to:
   a) John Dalton
   b) Isaac Newton
   c) Wilhelm Ostwald
   d) Democritus
5) The depicted circular particles embellished with dots, lines, shading, or other symbols to distinguish different elements, combined in fixed ratios were meant to introduce:
   a) electrons
   b) "compound particles" i.e. molecules
   c) protons
   d) nuclei

TEXT 2

2. Read the text. Decide if the statements (1–10) are True (T) or False (F).

Chemists and physicists have collaborated since the middle of the twentieth century to make new elements: substances never before seen on Earth. They are expanding the Periodic Table, step by painful step, into uncharted realms where it becomes increasingly hard to predict which elements might form and how they might behave. This is the field of nuclear chemistry. Instead of shuffling elements into new combinations – molecules and compounds – as most chemists do, nuclear chemists are coercing subatomic particles (protons and neutrons) to combine in new liaisons within atomic nuclei. It is alchemy's goal realized at last: the transmutation of one element to another. The ancient alchemists were doomed to fail because it is simply not possible to transmute the elements using chemical energy (that is, the energy involved in the making and breaking of bonds between atoms). Everything changed, however, with the discovery of radioactivity at the end of the nineteenth century – a discovery that led to one of the most remarkable, fruitful, and fateful eras in the history of chemistry. It began in a leaky wooden shed in the School of Chemistry and Physics in Paris, which Marie Curie and her husband Pierre used as a laboratory. In one sense that story ended over the city of Hiroshima in southern Japan in 1945; but in another sense it has never really ended. We are now irrevocably in the nuclear age.

1. The collaboration of physics and chemists since the middle of the twentieth century was devoted to making an atomic bomb.
2. Physics and chemists are expanding the Periodic Table, step by step where it becomes increasingly hard to predict which elements might form and how they might behave.
3. Exploring elements with new atomic mass is the field of nuclear physics.
4. Nuclear chemists do not shuffle elements into new combinations.
5. Nuclear chemists "make up" new atomic nuclei.
6. The alchemy's goal to transmute one element to another has come true.
7. It is possible to transmute the elements using chemical energy.
8. Chemical energy is the energy involved in the making and breaking of bonds between atoms.
9. The discovery of radioactivity was a next step in the history of chemistry.
10. The nuclear age started in the well equipped laboratories of the School of Chemistry and Physics in Paris.

VOCABULARY AND GRAMMAR

3. Choose the correct item A, B, C or D.

1) The term ______ denotes materials in minimally processed or unprocessed in states.
   a) stuff
   b) raw material
   c) draft material
   d) rough material

2) Being _____ means having a lifestyle that helps the Earth more than you hurt.
   a) environmentally loyal
   b) environmentally aware
   c) environmentally friendly
   d) environmentally careful
3) Eventually _____ begin to understand nature and can see chemical processes around them in other everyday events.
   a) workers
   b) mechanics
   c) scientists
   d) chemical engineers
4) A _____ is a way to convert a fuel such as hydrogen or methane directly into electricity through a chemical reaction called electrolysis.
   a) fuel sale
   b) fuel cage
   c) fuel cell
   d) fuel change
5) There is also a _____ that increases the rate of the reaction at the electrodes.
   a) catalyst
   b) fatalist
   c) economist
   d) inhibiter
6) Fuel cells that use hydrogen react with oxygen to form the byproduct of water, making them useful for high tech applications where clean power _____.
   a) needs
   b) needed
   c) is needed
   d) are need
7) Platinum wires _____ because other substances, such as copper, will react with the oxygen or the salt to pollute your solution with the products of this reaction.
   a) is recommended
   b) are recommended
   c) recommend
   d) were recommended

8) Local police ____just _____ the bank robber.
   a) was arrested
   b) have arrested
   c) had been arresting
   d) have been arrested
9) Many accidents _____ by dangerous driving.
   a) are caused
   b) have been caused.
   c) caused
   d) are causing
10) Weekends _____ outdoors by most English people.
   a) spend
   b) are spended
   c) has been spent
   d) are spent

TRANSLATION

4. Translate the sentences from English into Russian.

1. If one single element divides the modern world from that before the Second World War, it is the unassuming grey solid called silicon.
2. This element is everywhere, and always has been.
3. Silicon is the second most abundant element in the Earth's crust, since most common rocks have crystalline frameworks made from silicon and oxygen: they are silicates.
4. Quartz and sand are composed of silicon and oxygen alone: silicon dioxide, or silica.
5. These natural compounds of silicon are the raw material for the oldest technology: stone tools more than two million years old have been found in Africa.
6. Some time around 2500 BC, Mesopotamian artisans found that sand and soda could be melted in a furnace to produce a hard, greenish translucent substance: glass.
7. They coloured it with metal-containing minerals and used it to make gorgeous vessels and ornaments.
8. Glass-making was improved in the Middle Ages when craftsmen discovered how to remove the greenish tint (due to iron impurities).
9. To awed churchgoers, the multicoloured windows telling the stories of the Gospels in glowing light must have been as captivating as a modern movie.

10. The perfecting of grinding methods for making lenses opened up the heavens to Galileo and his contemporaries, bringing a concrete reality to the previously immaculate celestial realm.

WRITING

5. Write an annotation to the text:

Adsorption is the phenomenon that selectively segregates atoms or molecules between a fluid and a solid. In some ways, it is like absorption, except the liquid-phase absorbent is replaced with a solid-phase adsorbent. Sometimes solids could be said to absorb or adsorb fluids, i.e., the distinction is blurred. Here, the focus is on selective uptake (and release) by porous solids, especially for process applications. Another subtle distinction occurs when vapor is adsorbed from a gas; it is like condensation, except that the driving force is subtle molecular forces rather than a temperature gradient. When applied as a unit operation, adsorption can be used to split mixtures containing significant percentages of adsorbable components or purify streams containing trace amounts of contaminants. These separations, whether for gases or liquids, are accomplished by allowing the fluid and solid phases to interact under controlled conditions. Molecules that are selectively taken up are called adsorbates, and the solid surface that attracts the adsorbate is called the adsorbent. Unfortunately, there is not sufficient space to provide case studies for any of the hundreds of unique applications of adsorption. On the other hand, most of the topics discussed here are the subject of dozens of technical papers each year, many of which appear in specialized journals, including (alphabetically) Adsorption, Carbon, Langmuir, Microporous and Mesoporous Materials (formerly Zeolites), Reactive Polymers, and other more general titles. Some subjects are also treated in much greater detail in books, many of which are listed in the bibliography that follows. It is an understatement to say that adsorption is a diverse field. It impacts separation processes, materials science, catalysis, soil science, pharmaceutical products, environmental applications, and other widely different fields.

Adsorption can perform many separations that are impossible or impractical by conventional techniques, such as distillation, absorption (gas–liquid), and even membrane-based systems. Adsorption has found recent applications in solving environmental problems and meeting stringent quality requirements. Important applications of adsorption fall in the category of purification, as cited by Yang (1987), but they represent only a small fraction of the uses of adsorption. The largest single application of adsorption is for water treatment. It employs nearly 100 million pounds of activated carbon annually in the U.S. Alone, to remove compounds that could be toxic or merely pose problems of taste or odor. It was first used for municipal water treatment in powdered form in the late 1930s, and as granules in the 1960s. In addition, activated carbon has been used to decolorize sugar since the 1920s. Another widespread purification application is the pressure-swing air dryer found on heavy trucks and buses for their air-brake systems. Those would probably go unnoticed were it not for the abrupt, audible “blowdown” of these adsorbers, which sounds like a tire blowing out or a hydraulic system failure. A third, very widespread application is in the seal between thermopane windows. They employ 3A zeolite (as a powder mixed with caulk or as particles within an aluminum frame) to adsorb moisture in the air space, preventing it from fogging the internal glass surface.

Variant 3

READING

TEXT 1

1. Read the text and complete the statements (1–5) with the most suitable ending A, B, C or D.

In 1869 Lockyer discovered a new element, and it was one that had never been seen on Earth. The astronomer identified it from its imprint in the light emitted by the sun. Atoms absorb light at precise and particular wavelengths. This means that the spectrum of sunlight – the light spread out into its different colours by a prism – is interrupted by very narrow dark bands like a bar code where elements in the sun's atmosphere have absorbed the light. Lockyer saw an absorption line that corresponded to none of those measured in the laboratory for the known elements, and he concluded that it must be due to a new, hitherto unseen, substance. The French astronomer Pierre Janssen saw the same thing at the same time from his Paris observatory. The new element became named helium, after helios, the Greek word for the sun. Helium is the lightest of the so-called noble gases, which are extremely unreactive elements. This is why they had not been seen earlier, for they do exist on Earth. Terrestrial helium was first found twenty-seven years after Lockyer and Janssen saw it in the sun. Lockyer's studies of the solar spectrum revealed to him that the sun is a miasma of chemical elements. Where did they come from? In 1873 Lockyer developed the theory, later expounded in his Chemistry of the Sun (1887), that in the hottest (blue-white) stars the stellar matter is broken apart into the constituents of atoms themselves: subatomic particles, the protyle discussed by Dumas. Then, as the stars cooled, these particles combined to form regular elements – including some, like helium, not (then) known on Earth. Lockyer thought that stars began as loose aggregates of gas and dust, replete with all manner of elements. As this material gathers more tightly under gravity's pull, it heats up until it becomes hot enough to break apart atoms into protyle. Then, while still contracting, the star cools through yellow- and red-hot, and the protyle condenses into progressively heavier elements. Thus there was a stellar evolution of elements, echoing Darwin's evolution of species.

1) According to the text, the year1869 was marked by:
   a) the birth of a famous scientist lockyer
   b) the discovery of a new element unseen on the earth
   c) a sun flair
   d) an imprint in the sun
2) The spectrum of sunlight interrupted by very narrow dark bands can be compared to:
   a) a bar graph
   b) a curve
   c) a pie chart
   d) a bar code
3) Lockyer decided that the substance is new and unseen because:
   a) an absorption line corresponded to none of those measured in the laboratory for the known elements
   b) the sun's atmosphere have absorbed the light
   c) the light was spread out into its different colours by a prism
   d) atoms did not absorb light at precise and particular wavelengths
4) The new element became named helium:
   a) because it is the lightest of the so-called noble gases
   b) as it does not exist on earth
   c) after helios, the greek word for the sun
   d) as it is extremely unreactive element
5) Lockyer's studies of the solar spectrum revealed to him that the sun is:
   a) the hottest (blue-white) star
   b) broken apart into the constituents of atoms
   c) a miasma of chemical elements
   d) began as loose aggregates of gas and dust

TEXT 2

2. Read the text. Decide if the statements (1–10) are True (T) or False (F).

Thanks to the nuclear tests of the 1950s and 1960s, plutonium is now detectable in minute traces – just a few atoms – in the body of every person on Earth. It is not really dangerous in such small quantities; but plutonium is nevertheless hazardous if ingested and absorbed into bone marrow, where its alpha radiation can destroy cells or initiate cancers. But for chemists, the hydrogen bomb tests had a happier fallout too. Scientists at the Mike test collected coral from a nearby atoll contaminated with radioactive debris, and sent it to Berkeley for analysis. There the nuclear chemists found two new elements, with atomic numbers 99 and 100. They were named after two of the century's most creative physicists: einsteinium and fermium.

There are several spaces in the Periodic Table between plutonium (element 94) and einsteinium (element 99). But by 1952 these had already been filled by scientists at Berkeley, using the cyclotron to bombard heavy nuclei with particles that, when captured, increased the nuclear mass. In 1944 Glenn Seaborg, Albert Ghiorso, and Ralph James made elements 95 and 96 this way. Kept secret until after the war, they were respectively called americium and curium. Seaborg, Ghiorso, and others went on to make berkelium (element 97) in 1949 and californium (element 98) in 1950. The New Yorker wondered why they had not gone for broke, naming these two 'universitium' and 'offium' so as to reserve berkelium and californium for the next two elements. The Berkeley team responded by explaining that they did not wish to be beaten in the race by some New Yorker who could then call elements 99 and 100 "newium" and "yorkium".

It was not an entirely flippant comment. By the 1950s laboratories elsewhere in the world had caught on to the Berkeley technique of making elements using nuclear bombardment in particle accelerators. The Berkeley radiochemists were still leading the race when they made element 101 in 1955; and Dmitri Mendeleyev might have been either amused or perturbed to find himself immortalized, as mendelevium, in a Periodic Table that was now expanding at an alarming rate. But element 102 produced a contested finish. A group in Stockholm believed they had made it in 1957, and proposed the patriotic name nobelium, after the Swede Alfred Nobel. Their claims could not be confirmed by other element-makers, however, and element 102 was not really made until 1958 by Ghiorso and co-workers. In the same year, it was reported by a Russian team at the Joint Institute for Nuclear Research (JINR) in Dubna. No one saw fit to dispute the Swedish name on this occasion; but such unanimity was not to last.

1. Just a few atoms of plutonium in the body of every person are extremely hazardous.
2. Alpha radiation of plutonium can destroy cells or initiate cancers.
3. The hydrogen bomb tests had led to new discoveries.
4. The nuclear chemists found five new elements in coralls.
5. The discovered elements were called after famous composers.
6. The cyclotron is used to bombard heavy nuclei with particles that, when captured, increase the nuclear mass.
7. Element 102, named nobelium, after the Swede Alfred Nobel, was produced in 1957.

8. In the same (1958) year, it was reported by a Russian team at the Joint Institute for Nuclear Research (JINR) in Dubna.
9. The Berkeley technique of making elements using nuclear bombardment in particle accelerators remained unknown to other laboratories.
10. It is impossible to produce element 103.

VOCABULARY AND GRAMMAR

3. Choose the correct item A, B, C or D.

1) _____ are the steps through which raw materials are transformed into a final product.
   a) materialism
   b) material processor
   c) material process
   d) manufacturing process
2) Being _____ means having a lifestyle that helps the Earth more than you hurt.
   a) environmentally loyal
   b) environmentally aware
   c) environmentally friendly
   d) environmentally careful
3) Components of petroleum are separated using a technique called _____ distillation.
   a) portional
   b) fractional
   c) partial
   d) fragment
4) Petroleum, in one form or another, _____ since ancient times.
   a) got used to
   b) used to
   c) was used
   d) has been used
5) The trend in product mix continued to move to high value-added technologically ______ such as Oil Country Tubular Goods.
   a) sophisticated products
   b) sophists manufactures
   c) experienced products
   d) cultivated products

6) The manufacturing process begins with the product design, and materials specification from which the product _____.
   a) is being made
   b) is made
   c) is done
   d) is making
7) Process manufacturing is common in the food, beverage, _____, pharmaceutical, consumer packaged goods, and biotechnology industries.
   a) chemical
   b) chemistry
   c) alchemy
   d) chemists
8) Yesterday at this time she ________ for the job.
   a) was interviewed
   b) has been interviewed
   c) was being interviewed
   d) were interviewed
9) This issue _________ by the employees during the last meeting.
   a) was brought up
   b) is brought up
   c) has been brought up
   d) had been brought up
10) Women ________________ to be smarter than men.
   a) were said
   b) were being said
   c) has been said
   d) are said

TRANSLATION

4. Translate the sentences from English into Russian.

1. Glass changed the view of our place in the universe.
2. For a long time, silica was considered to be an element for it is not easy to persuade silicon and oxygen to part company.
3. Humphry Davy suspected that silica was not elemental, but silicon itself was not isolated until 1824, when Jons Jacob Berzelius prepared it in a form called amorphous silicon.
4. This is a solid in which the atoms are not regularly arrayed as they are in a crystal, but are more jumbled.

5. Glass is also amorphous, its silicon and oxygen atoms in mild disarray.
6. Crystalline silicon was not made until 1854, by the French chemist Henri Deville.
7. But it took us a very long time to figure out what this pure silicon is good for.
8. It occupies that curious no man's land in the Periodic Table where metals (to the left) give way to non-metals (to the right).
9. Silicon is not a metal, but it does conduct electricity – albeit poorly.
10. It is a semiconductor.

WRITING

5. Write an annotation to the text:

In selecting metals and alloys as materials of construction, one must have knowledge of how materials fail, for example is, how they corrode, become brittle with low-temperature operation, or degrade as a result of operating at high temperatures. Corrosion, embrittlement, and other degradation mechanisms such as creep will be described in terms of their threshold values. Transient or upset operating conditions are common causes of failure. Examples include start-ups and shut-downs, loss of coolant, the formation of dew point water, and hot spots due to the formation of scale deposits on heat transfer surfaces. Identification and documentation of all anticipated upset and transient conditions are required.

Corrosion debris is a related problem. In some applications, materials with nominally low corrosion rates produce considerable corrosion debris. Such problems are always associated with units that contain large surface areas exposed to the corroding fluid. Examples include hea exchanger surfaces and packed beds. The materials selection process must document and organize such information.

This section will discuss problems that can complicate the selection procedure. Such problems include the variability of materials selection criteria, conflicting project objectives such as mini-mizing capital cost, and mandatory criteria such as those in governing engineering codes. Other topics discussed include organization of the information needed for the materials selection process, a procedure for materials selection, and the use of a materials selection diagram.

Many engineers associate materials selection only with the design and construction of new facilities, plant additions, or plant renovations. However, it is also part of a plant's routine maintenance activities, being a subject of discussion between operations, planning, and maintenance personnel.

Such discussions usually illustrate the need for both short-term and long-term solutions. For simple jobs such as replacements in-kind or for jobs with which the responsible engineer has prior experience, materials selection is usually a straightforward task. However, some jobs involve complex combinations of requirements, which may include 1) demanding mechanical requirements such as thermal cycling, 2) conservative design requirements such as "leak-before-break", 3) stringent process-related requirements such as avoiding process contamination, 4) special fabrication requirements such as postweld heat treatment (PWHT), 5) aggressive corrodents or crack-inducing agents, 6) upset or transient operating conditions (i.e., nonstandard operating conditions), 7) limited capital budgets, and 8) aggressive project schedules.

Variant 4

READING

TEXT 1

1. Read the text and complete the statements (1–5) with the most suitable ending A, B, C or D.

When Ernest Rutherford (1871–1937) decided to anatomize the atom, he chose gold for the same reason that medieval artists used it to decorate their altarpieces: it can be hammered into very, very thin sheets of almost gossamer transparency. This, concluded the New Zealand-born physicist, meant that he could study a sample only a few atoms thick. That was important, for Rutherford wanted to find out what was in the atom. So he needed a thin section, for much the same reason that the microscopist pares off a thin sliver of tissue for investigation. He needed to see through it. I was brought up to look at the atom as a nice hard fellow, red or grey in colour, according to taste', Rutherford once said. But in 1907 he found that atoms were not so hard at all. They were mostly empty space. Working at Manchester University in England, Rutherford and his students Hans Geiger and Ernest Mardsen fired alpha particles from radioactive elements at thin gold foil, and found that the particles could 'see' right through this ponderous element. Mostly they passed through the foil with scarcely any deflection from their course. Geiger helped to invent the instrument that detected the alpha particles, which he later developed into the Geiger counter.

Of course, you would expect a bullet to fly right through gold leaf. But an alpha particle is a bullet much lighter than a single atom of gold. Rutherford deduced in 1908 that it is essentially an electrically charged helium atom: a helium ion. Helium has an atomic weight of 4; that of gold is 197. No matter how thin the foil is, alpha particles will not get through if atoms are like Rutherford was told they are. But the surprise of finding alpha particles passing through gold foil was nothing compared with what Marsden found subsequently. A small number of alpha particles did not pass through at all, but bounced right back. By now accustomed to the idea that atoms are tenuous things, the researchers had drastically to revise their ideas. 'It was quite the most incredible event that has ever happened to me in my life', Rutherford later recalled of seeing Marsden's findings. It was almost as incredible as if you fired a 15-inch shell at a piece of tissue paper and it came back and hit you.

1) Ernest Rutherford chose gold for anatomizing the atom because:
   a) medieval artists used it to decorate their altarpieces
   b) he could study a sample of gold only
   c) it is a metal of gods
   d) it can be hammered a few atoms thick
2) Rutherford wanted to find out:
   a) the reason why the microscopist pares off a thin sliver of tissue for investigation
   b) what was in the atom
   c) why there were mostly empty space
   d) if the atom is as a hard substance, red or grey in colour
3) The experiment with alpha particles from radioactive elements and thin gold foil showed that:
   a) the alpha particles passing through the foil became radioactive
   b) the gold foil became radioactive
   c) particles passed through the foil without any deflection from their course
   d) the special instrument – Geiger counter – was necessary to complete the experiment
4) An essentially electrically charged helium atom can be called:
   a) a helium ion
   b) a helium molecule
   c) a helios
   d) a heliox
5) The discovery that a small number of alpha particles did not pass through at all, but bounced right back made Rutherford feel:
   a) surprised
   b) bounced back
   c) confused
   d) ashamed

TEXT 2

2. Read the text. Decide if the statements (1–10) are True (T) or False (F).

Isotopes answer a puzzle that troubled chemists ever since Dalton proposed his atomic theory. Dalton said that the key property of an atom is not its size or shape but its weight. Each element is characterized by an atomic weight defined relative to that of hydrogen. The fact that these relative atomic weights were usually whole numbers, more or less (carbon's is 12.011, oxygen's 15.999), led Prout to suppose that all elements might be made from hydrogen. The steadily increasing weights gave Mendeleyev, Meyer, and others a kind of index by which to order the elements and reveal their periodic behaviour. But not all elements conformed so neatly to this picture. Chlorine, for instance, has a relative atomic weight of 35.45, which is close neither to 35 nor to 36. This forced Dumas to conclude that the basic building block of the atom might be smaller than a hydrogen atom. But, with atomic weights like 24.3 and 28.4 (as listed for magnesium and silicon in Mendeleyev's revised 1902 table), how small do you go? Furthermore, Mendeleyev was compelled to place tellurium and iodine out of sequence in ascending atomic weight in order to maintain the periodicities in his original table. And cobalt and nickel seemed to have the same atomic weight!

Francis Aston explained all this in 1919 using his "mass spectrograph". Previously, chemists had weighed elements trillions upon trillions of atoms at a time. Aston's machine was able to sort out moving atoms one by one according to their mass, by making them into electrically charged ions and using electric fields to bend their trajectories. He found that atoms of the same element possessed a range of different masses, each one of which was indeed an integer multiple of the mass of the hydrogen atom (i.e., essentially the mass of the proton). Sulphur atoms, for example, could have masses of 32, 33, and 34 times that of hydrogen.

1. Isotopes make a puzzle that troubled chemists ever since Dalton proposed his atomic theory.
2. The key property of an atom is not its size or shape but its weight.
3. Each element is characterized by an atomic weight defined relative to that of hydrogen.
4. The steadily increasing weights gave Mendeleyev and others a kind of index by which to order the elements and but weighs could not reveal their periodic behaviour.
5. All the elements followed the periodical order neatly.
6. Chlorine has a relative atomic weight of 35.
7. The irregularities in the order of atomic weights allowed to suggest the existence of a building block smaller than a hydrogen atom.
8. Francis Aston found that atoms of the same element possessed a range of different masses, each one of which was indeed an integer multiple of the mass of the hydrogen atom.
9. Francis Aston introduced a machine that was able to sort out moving atoms one by one according to their mass.
10. Sulphur atoms can have masses of 33, 34, and 35 times that of hydrogen.

VOCABULARY AND GRAMMAR

3. Choose the correct item A, B, C or D.

1) Fractional distillation begins when the crude oil, which is a mixture of different hydrocarbons, _____ into a high-pressure steam boiler.
   a) is being put
   b) was put
   c) is put
   d) has been put
2) To become a chartered chemical engineer, you _____ to have studied to Masters level, either completing a four-year MEng in chemical engineering or a BEng followed by the relevant Masters.
   a) have needed
   b) had needed
   c) needs
   d) will need
3) Any company involved in _____ conversion of raw materials into a product needs chemical engineers.
   a) large-scale
   b) large-volume
   c) spacious
   d) broadside
4) By 347 AD, oil _____ from bamboo-drilled wells in China.
   a) got produced
   b) produced
   c) was produced
   d) has been produced
5) The world's first oil refinery _____ in 1856 by Ignacy Łukasiewicz.
   a) had been built
   b) has built
   c) built
   d) was built
6) The demand for petroleum as a fuel for lighting in North America and around the world _____ quickly.
   a) growed
   b) have grown
   c) grew
   d) has been grown

7) About 80 percent of the world's readily accessible reserves _____ in the Middle East, with 62.5 percent coming from the Arab 5: Saudi Arabia, UAE, Iraq, Qatar and Kuwait.
   a) are located
   b) are locating
   c) has been located
   d) have been located
8) He ________ by the professor not to talk in class.
   a) was told
   b) has been told
   c) was being told
   d) told
9) By tomorrow evening, the car ________ by me.
   a) was being bought
   b) will have been bought
   c) was bought.
   d) has been bought
10) As he explained later, this story ________ by most students.
   a) is misunderstood
   b) was misunderstood
   c) has been misunderstood
   d) had misunderstood

TRANSLATION

4. Translate the sentences from English into Russian.

1. Crystalline silicon was not made until 1854, by the French chemist Henri Deville.
2. But it took us a very long time to figure out what this pure silicon is good for.
3. It occupies that curious no man's land in the Periodic Table where metals (to the left) give way to non-metals (to the right).
4. Silicon is not a metal, but it does conduct electricity – but poorly.
5. It is a semiconductor.
6. Technically this means rather more than "bad conductor". Metals conduct electricity because some of their electrons come free of their parent atoms and are at liberty to roam through the material.
7. Their motion corresponds to an electrical current.
8. A semiconductor also has wandering electrons, but only a few. When palladium was first discovered, no one seemed to want it.

9. Its discoverer, William Hyde Wollaston, offered it for sale in a London shop as “new silver”, at six times the price of gold.
10. Hoping to profit from his discovery, at first he chose not to disclose to the scientific community how he obtained the metal.

WRITING

5. Write an annotation to the text:

Thermodynamics has played an increasingly important role over the years in the engineering analysis and synthesis of chemical processes. There has been an expansion of this role with the success of vapor-pressure-fitted van der Waals equations of state and group contribution methods. By far the major part of computer time in chemical process design is now devoted to thermodynamic calculations. This chapter presents the thermodynamic methods needed to perform the analysis and synthesis, to start from basic principles, to describe the phenomena, to develop the methods, and to illustrate applications. In a brief review of the terminology of thermodynamics, the portion of the universe that is studied is called a system

The rest of the universe that interacts with the system is the surroundings. The system is open if it exchanges mass with its surroundings. A closed system cannot exchange mass with its surroundings. The system is adiabatic if it does not exchange heat with the surroundings. A system is isolated if it is precluded from exchanging mass or energy with its surroundings. A system at equilibrium does not change with time, and no transport flux of momentum, heat, or mass occurs. An equilibrium system is characterized by a reversible response to differential changes in external forces. A small increase of applied pressure produces a compression effect on the fluid; a small decrease of pressure produces an expansion effect. For a system at pressure p either reversible compression or reversible expansion takes place, depending on the sign of dp.

Similarly, with a differential increase in temperature of the surroundings from its equilibrium temperature, heat is absorbed by the equilibrium system; conversely, heat is rejected by the system with an infinitesimal decrease in temperature of the surroundings.

A reversible process is an ideal process taking place at near zero speed in an equilibrium system. Equilibrium and reversibility go hand in hand. A system can be composed of several phases. A phase is a homogeneous part of a system. The phases of a system at equilibrium are also at equilibrium. An extensive property of a system is the sum of the parts of the system. Thus volume is extensive. The extensive property of an equilibrium phase is directly proportional to its mass m. An intensive property, like density, temperature, or pressure, is independent of extension and assumes a uniform value in an equilibrium phase.

The state of an equilibrium phase is specified by its chemical composition and a relatively few intensive properties, generally two, e.g., temperature and pressure, temperature and mass density, or density and pressure. The number and kind of intensive properties required are determined by experience. To specify the state of a nonequilibrium system generally requires more than the values of a few intensive properties. Thus a system undergoing heat transfer may require a mathematical function to describe its temperature distribution and thus its state.

Unit 3
Ecological and social responsibilities of Chemical engineers

LEAD-IN

1. Match the words in the left-hand column with their translation in the right-hand column.

1	exemption	A	зоны целевого использования вод
2	downstream	B	водосборный, гидрографический бассейн
3	discharge	C	смежный регион
4	waiver	D	рассеивание, разброс
5	deleterious impact	E	подходить, относиться
6	designated use (DU) zones	F	разрешенное отступление
7	contiguous region	G	послабление, льгота
8	underperformance	H	рассредоточенный источник загрязнения
9	sewer	I	защита заболоченных участков
10	dispersion	J	стратегия замещения
11	pertain	K	перерабатывающий сектор
12	watershed	L	канализационный коллектор, сток
13	nonpoint source pollution	M	отрицательное влияние
14	wetland protection	N	снижение качества, недовыполнение
15	replacement strategy	O	сброс, слив

2. Match the words from the left column with their collocations from the right column.

1	Environment protection	A	standards
2	Water quality	B	overflow
3	deleterious	C	pollution
4	Water	D	Act
5	combined sewer	E	mixing
6	Industrial	F	association
7	Environment Protection	G	impact
8	stream	H	sites

READING

TEXT 1

3. Before reading the text about Clean water, answer the questions:

1. What is EPA?
2. What aims does it follow?

Clean water

The EPA (Environment protection association) typically allows exemptions downstream of point source discharges ("stream mixing") as well as for relatively rare conditions where a significant increase in flow diminishes water quality (for example, storm sewer flooding). Waivers based on mixing are regulated and require that mixing zones do not extend throughout a body of water or from bank to bank of a river or stream. Additionally, waivers will not allow deleterious impact to designated use (DU) zones. A contiguous region meeting Water Quality Standards (WQS) must be maintained.

"WET WEATHER FLOW" CONDITIONS

Due to heavy rainfall, wastewater overflows from sewers or industrial facilities may result in underperformance versus WQS. Nevertheless, affected sewer systems, typically combined sewer overflow (CSO) or municipal separate storm sewer systems, remain subject to National Pollutant Discharge

Elimination System (NPDES) regulations. CSO systems, found in older residential or municipal areas, allow transportation of both rainwater and raw sewage within a common stream; storm sewer systems separate the two flows.

Attention to the public health challenges posed by CSO sewers focus on control of pathogen dispersion. From NPDES perspectives, CSO systems are restricted from discharging untreated sewage during periods of dry weather.

NPDES regulates storm sewers that discharge to surface waters because of the potential for the water line to contain various levels of contaminants such as metals, oils, and pesticides permits for storm sewer systems tend to focus on response planning and “design against failure” rather than on actual effluent stream concentrations.

Industrial sites may or may not require individual NPDES permits for storm water runoff pertaining to overflow drainage into surface water or storm sewer sewage systems. Frequently, these conditions will be covered under NPDES documentation via the site’s storm water pollution prevention plan (SWPPP).

Additionally, a spill prevention control and countermeasure (SPCC) plan may be required at facilities where oil materials are stored. Importantly, edible oils are often included in this designation.

NONPOINT SOURCE POLLUTION

Nonpoint source runoff is the major source of water pollution. Topsoil runoff from farms and pastures represents the major source of this pollution. Contrasting the federal position on point sources, the Environment Protection Act (EPA) provides grants and other modes of assistance and incentive to such polluting states. The EPA’s objective is to curtail pollution from such erosion sources and to define auditable levels of watersheds.

WETLAND PROTECTION

The “wetland protection program” addresses the displacement of dredged or fill-material into defined wet areas such as bottomland hardwood swamps, intermittent streams, or oceans.

The wetland protection program requires that any commercial activity requiring the destruction of existing wetlands be essentially dependent on the presence of water. If not, the activity will be relocated to an unprotected area. Prior to construction on a protected wetland area, demonstration of destruction mitigation plans along with a wetland replacement strategy and/or a plan for improving an existing wetland must be presented.

4. Answer the questions to the text:

1. What criterion regulate the water quality?
2. What are the cases of exceptions from the standard?
3. What are the reasons of underperformance versus WQS?
4. What is the focus of attention posed by CSO sewers?
5. What is the aim of SWPPPs?
6. What is required where oil materials are stored?
7. What do you know about wetland protection program?
8. How is water quality regulated in our country?

5. Read the Text again and say if the statements 1–10 are True (T) or False (F). If the statement is false, give the right variant.

1. Water Quality Standards do not allow any exemptions in water quality.
2. Waivers will not allow deleterious impact to designated use (DU) zones.
3. Heavy rainfall, wastewater overflows from sewers or industrial facilities might be the cause of worsening the water quality.
4. Attention to the public health challenges posed by WQS sewers focus on control of pathogen dispersion.
5. National Pollutant Discharge Elimination System regulates storm sewers that discharge to surface waters.
6. Industrial sites must not require individual NPDES permits for storm water runoff.
7. Nonpoint source runoff is the major source of water pollution.
8. The Environment Protection Act objective is to overflow drainage into surface water or storm sewer sewage systems.
9. Edible oils are not included in a spill prevention control and countermeasure plan.
10. The “wetland protection program” addresses such areas as bottomland hardwood swamps, intermittent streams, or oceans.

6. Before reading text 2, answer the questions:

1. How did the responsibilities of environmental professionals change over the past few decades?
2. What do you know about pollutant types?

TEXT 2

Increased attention to both local and global environmental issues over the past few decades has resulted in heightened focus on these issues. This new attention has increased the workload, knowledge base, and responsibilities of environmental professionals. Issues ranging from the impact of pollution on human health, global climactic change, national security risks, and nuclear fuel processing pose serious concerns. As with any issue within our society, consideration to health and environment is made with attention to economics and commerce. Known cases exist where deleterious financial impact resulted from negative consumer perceptions of a corporation's environmental or human health-related policies. "Green marketing" wears a friendly neighbour label and instills a barrier-to-entry against competitive products.

The costs associated with environmental and personal safety policies (the "compliance burden") pose real challenges to corporations. However, these costs serve as prudently invested dollars when weighed against the ramifications of environmental policy inaction, whether as regulatory fines or market share loss.

BACKGROUND AND POLLUTANT TYPES

The Clean Air Act (CAA) establishes monitoring and reporting mechanisms, air pollution inventories and reporting thresholds, and economic incentives for controlling and/or reducing pollutan emissions from manufacturing sectors of all types. The CAA monitors the National Ambient Air Quality Standards (NAAQS) via State Implementation Plans (SIP) to ensure consistent air quality for all residents. Each SIP adheres to the requirements of the CAA by assigning applicable air pollutants to one of two categories:

Criteria Pollutants:

Pollutants for which a primary (personal safety threshold) or secondary (environmental threshold) limit exists. These limits reflect the efforts of experimental science, with criteria pollutants including common pollutants and those that are harmful based on long-term cumulative exposure, or that typically occur in very low amounts.

Hazardous Air Pollutants (HAPs) are pollutants possessing known carcinogenics or exhibiting other extreme pathological symptoms in humans and/or in the environment.

Criteria Pollutants and Smog

The adverse effects on human health due to smog include shortness of breath in those with compromised pulmonary function, and may include increased asthma frequencies in young children. Long-term exposure often permanently impairs human respiratory and immune system function, and can lead to death; historical records indicate that 4000 Londoners died in December 1952 due to exposure to unsafe smog levels.

Smog contains high concentrations of ground level ozone (O3). Ozone naturally exists at high (stratospheric) altitudes, but volatile organic compounds VOCs) and other criteria pollutants found in gasoline, organic solvents, and paints promote increases at ground level. Criteria pollutants include combustion products, participates (of various sizes), and volatile organics. Of significance, the EPA includes some slow evaporating, low-vapor pressure compounds such as butyl cellosolve as volatile organic materials.

Hazardous Air Pollutants

Many chemicals pose serious risk to humans and to the ecosystem if not controlled. Many VOCs are within this group, and are regulated within the National Emissions Standards for Hazardous Air Pollutants (NESHAP). They often are carcinogens at low exposure levels, impact reproduction efficiency and fetal development, or yield serious injury or death upon even slight exposure. Since HAP chemical lists often change, this site and its related links need to be revisited periodically. Delisting of certain chemicals (e.g., acetone) can have significant regulatory and fiscal ramifications. Listed HAP materials may appear as pure compounds, as components of a chemical mixture, or as a by-product of a chemical reaction. Regardless of a facility's pollutant type, the pollutant must be categorized, its levels quantified and then compared to regulatory listings and de minimis reporting levels. If a facility emits criteria or other regulated pollutants in excess of specified levels, it is classified as a major source (see description below). The major source threshold varies by location and pollutant. Material Safety Data Sheets (MSDS) are needed for all materials utilized and/or produced within a facility, whether as a raw material, an intermediate, or a by-product, and must be available to assist in determining a chemical's standing relative to its level of hazard within several categories.

When available, even more detailed information is preferred.

7. Answer the questions:

1. What does the pollution impact on?
2. What does the clean Air Act regulate?
3. What are two categories of air pollutant? Define them.
4. What is the influence of smog on human health?
5. What are the components of criteria pollutants?
6. Why are the Hazardous Air Pollutant dangerous?
7. How can HAP materials appear in the air?
8. How should HAP materials be treated?

8. Read the Text again and say if the statements 1–10 are True (T) or False (F). If the statement is false, give the right variant.

1. The environmental professionals have suffered an increased work load recently.
2. A wider range of issues pose serious concerns to the environmental professionals.
3. Negative consumer perceptions of a corporation's environmental or human health-related policies can result in financial losses.
4. CAA is the abbreviation for Clean Air Association.
5. Air pollutants can be referred to three categories.
6. Criteria pollutants are pollutants for which a primary or secondary (limit exists.
7. Smog is referred to HAP.
8. HAP chemical lists often change.
9. Delisting of certain chemicals (e.g., acetone) from HAP chemical lists can have significant regulatory and fiscal ramifications.
10. Listed HAP materials may appear as pure compounds, as components of a chemical mixture, or as a by-product of a chemical reaction.

9. Make the sentences negative:

1. The EPA typically allows exemptions from the WQS.
2. Waivers based on mixing are regulated and require that mixing zones do not extend throughout a body of water.
3. Infrequent measurements of water quality result in large statistical errors.
4. Attention to the public health challenges posed by CSO sewers focus on control of pathogen dispersion.
5. The wetland protection program requires that any commercial activity.
6. The EPA's objective is to curtail pollution from such erosion sources.

VOCABULARY

10. Use suffixes -ant, -age, to form nouns or adjectives, and the prefix dis- to form the verbs from the following words. Make up word combinations.

Example: *memory – memorable – a memorable journey.*

	-ant		-age	dis-	
pollute		drain			charge
radiate		short			appoint
intoxicate		mile			qualify
malign		shrink			infect
participate		patron			regard

11. Match the words to the definitions:

1	curtail	A	A point that marks a change in direction
2	drainage	B	remove, usually from a bottom of a body of water
3	edible	C	Any organism or virus that causes infection and harm to another
4	discharge	D	To cut off or cut short
5	watershed	E	To use a specific mathematical trick, formula, or technique to solve a problem
6	pesticide	F	The act of allowing a fluid to escape
7	pathogen	G	The act of removing water from below the surface of an area
8	apply	H	The act of diffusing something
9	dredge	I	A waste pipe that carries away sewage or surface water
10	spill	J	Able to be eaten; good for eating
11	sewer	K	To officially release someone
12	dispersion	L	Chemicals that are spayed on plants to kill other living things that are harming the plants

12. Fill in the blanks with the words from the table:

1. Insecticides are _________________________ that kill insects.
2. World War II was a _________________________ in European history.
3. Jane _________________________ the Pythagorean Theorem to a triangle to figure out the length of each of its sides.

4. The Ebola virus is one of the most dangerous known __________.
5. Their house had a problem with ______, often causing their basement to flood.
6. The teacher _________ his presentation because it was too long and inappropriate to show to a class.
7. After the war, many soldiers were __________ from the army.
8. The eggs will only be ____________ after they are cooked.

13. Fill in the blanks changing the words given:

TOTAL DAILY MAXIMUM LOAD LEVELS

______1 measurements of water quality result in large statistical errors in _____2 of performance versus WQS. When the available evidence indicates achieving WQS standards unlikely or impossible via _____3 of source control technologies, the EPA imposes total maximum daily load (TDML) levels of individual ______4 discharge from point sources.	1) FREQUENCY 2) ESTIMATE 3) APPLY 4) POLLUTION
Unfortunately, application of TMDL rules does not typically result in achievement of WQS due to the large impact of nonpoint sources (e.g., soil runoff). Nonetheless, TMDLs for such defined pollutants as clean sediments, nutrients (nitrogen and phosphorus), ______5 acids/bases, heat, metals, cyanide, and synthetic organic chemicals are enforced.	5) PATHOLOGY
Caps are established, with margins of _____6 and completed facility TDML plans and strategies are provided to the EPA for approval or _______7.	6) SAFE
The time defined within a TDML plan does not necessarily have to equal 1 day, and a reserve for future polluting activities is typically comprehended.	7) PROVE
Approved agencies or parties will regularly audit site _______8 against a facility's TMDL plan.	8) PERFORM

TRANSLATION

14. Translate from English into Russian:

1. Congress directed The Environment Protection Act to use a "technology-based" and performance-based approach to significantly reduce emissions of air toxics from major sources of air pollution.
2. Under the "technology-based" approach, The Environment Protection Act develops standards for controlling the "routine" emissions of air toxics from each major type of facility within an industry group.
3. These standards are known as "maximum achievable control technology (MACT) standards".
4. They are based on emissions levels that are already being achieved by the better-controlled and lower-emitting sources in an industry.
5. This approach assures citizens nationwide that each major source of toxic air pollution will be required to employ effective measures to limit its emissions.
6. Also, this approach provides a level economic playing field by ensuring that facilities that employ cleaner processes and good emission controls are not disadvantaged relative to competitors with poorer controls.
7. Toxic (also called hazardous) air pollutants are those pollutants that are known or suspected to cause cancer or other serious health effects.
8. The degree to which a toxic air pollutant affects a person's health depends on many factors.
9. Scientists estimate that millions of tons of toxic pollutants are released into the air each year.
10. Most air toxics originate from manmade sources, including both mobile sources (e.g., cars, buses, trucks) and stationary sources (e.g., factories, refineries, power plants).

SPEAKING

15. With your partner:

- discuss what environmental problems face the world today;
- explain the terms: deforestation, ozone layer, pollution, global warming, recycling, alternative energy;
- exchange your opinions about the following questions:

What are CFCs and how do they effect the environment?
What are alternative forms of energy?
What is the Ozon layer? What does it do? What is happening to it?
How are forests good for the environment? What is happening to them?

Be ready to share your ideas in the group.

WRITING

16. Write an annotation to the text:

Robert Boyle (1627–1691) was born at Lismore Castle, Munster, Ireland, the 14^{th} child of the Earl of Cork. As a young man of means, he was tutored at home and on the Continent. He spent the later years of the English Civil Wars at Oxford, reading and experimenting with his assistants and colleagues. This group was committed to the New Philosophy, which valued observation and experiment at least as much as logical thinking in formulating accurate scientific understanding. At the time of the restoration of the British monarchy in 1660, Boyle played a key role in founding the Royal Society to nurture this new view of science.

Although Boyle's chief scientific interest was chemistry, his first published scientific work, *New Experiments Physico-Mechanicall*, *Touching the Spring of the Air and Its Effects* (1660), concerned the physical nature of air, as displayed in a brilliant series of experiments in which he used an air pump to create a vacuum. The second edition of this work, published in 1662, delineated the quantitative relationship that Boyle derived from experimental values, later known as "Boyle's law": that the volume of a gas varies inversely with pressure.

Robert Boyle at the age of 37, with his air pump in the background. François Diodati reengraved this image from an engraving by William Fairthorne, Opera varia (1680).

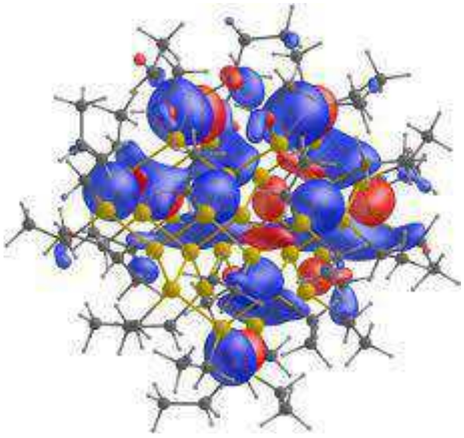
Courtesy Edgar Fahs Smith Memorial Collection, Department of Special Collections, University of Pennsylvania Library.

Boyle was an advocate of corpuscularism, a form of atomism that was slowly displacing Aristotelian and Paracelsian views of the world. Instead of defining physical reality and analyzing change in terms of Aristotelian substance and form and the classical four elements of earth, air, fire, and water – or the three Paracelsian elements of salt, sulfur, and mercury – corpuscularism discussed reality and change in terms of particles and their motion. Boyle believed that chemical experiments could demonstrate the truth of the corpuscularian philosophy. In this context he defined the term element in Sceptical Chymist (1661) as certain primitive and simple, or perfectly unmingled bodies; which not being made of any other bodies, or of one another, are the ingredients of which all those called perfectly mixt bodies are immediately compounded, and into which they are ultimately resolved.

He was probably referring to the uniform corpuscles – which were as yet unobserved – out of which corpuscular aggregates were formed, not using "elements" as What aims does it follow and others used the term in the 18th century to refer to different substances that could not be broken down further by chemical methods. In his experiments Boyle made many important observations, including that of the weight gain by metals when they are heated to become calxes. He interpreted this phenomenon as caused by fiery particles that were able to pass through the walls of glass vessels.

Boyle also wrote extensively on natural theology, advocating the notion that God created the universe according to definite laws.

Unit 4
Biotechnologies and safety



LEAD-IN

1. Match the words in the left-hand column with their translation in the right-hand column.

1	recombinant DNA technology	A	новейшие технологии
2	industrial microbiology	B	крупномасштабный процесс
3	novel techniques	C	воздухораспределитель
4	fermented beverage	D	опасность
5	high yield	E	промышленная микробиология
6	large-scale process	F	увеличиваться в разы
7	to be equipped with	G	достигнуть максимума
8	hazard	H	напиток полученный при брожении
9	baffle	I	извлечение продукта
10	air sparger	J	рекомбинантная ДНК технология
11	to multiply exponentially	K	биологический катализатор, фермент
12	to reach a maximum	L	очистка
13	biological catalyst	M	высокопродуктивный
14	product recovery	N	быть оснащенным
15	purification	O	разделитель

2. Match the words from the left column with their collocations from the right column.

1	recombinant	A	seed
2	sweet	B	modified
3	newly	C	price

4	genetically	D	refreshments
5	disease-free	E	operations
6	large-scale	F	DNA technology
7	low-	G	volume
8	high-	H	developed

READING

3. Before reading the text about Biotechnology, answer the questions:

1. Where can biotechnology be applied?
2. Do you think that the future of biotechnology is in food industry or chemical industry? Why?
3. How dangerous might biotechnology be to the biological systems?

Biotechnology

Biotechnology is broadly defined as "commercial techniques that use living organisms, or substances from those organisms, to make or modify a product, including techniques used for the improvement of the characteristics of economically important plants and animals and for the development of microorganisms to act on the environment". This very broad definition includes not only the newly developed recombinant DNA technology, but also the traditional areas involving agriculture, animals, human heath, and industrial microbiology. Since ancient days, people utilized microorganisms to produce fermented beverages (alcohol, sweet refreshments) and food (cheese, soy sauce, fermented vegetables, sweets, and bread), though they did not understand those biological changes. People crossbred plants and animals for better yields.

However, in recent years, the term biotechnology is being used to refer to novel techniques such as recombinant DNA. This technique is also known as genetic engineering, a misleading description of scientific endeavors. Previously expensive and rare pharmaceuticals (such as insulin for diabetics, a human growth hormone to treat children with dwarfism, interferon to fight infection, vaccines to prevent diseases, and monoclonal antibody for

diagnostics) are now produced from genetically modified microbial cells or hybridoma cells inexpensively and in large quantities. Disease-free seed stocks and healthier, higher-yielding food animals have been developed. Important crop species can be modified to have traits that resist stress, herbicides, and pests. Furthermore, recombinant DNA technology can be applied to develop genetically modified microorganisms so that they will produce various chemical compounds with higher yields than available from unmodified microorganisms.

Biochemical Engineering

In order to cultivate genetically modified cells in large quantities, we need to develop a large-scale process that is technologically efficient and economically viable. Raw materials are treated and mixed with other ingredients that are required for cells to grow well. The liquid medium, sterilized and introduced to a bioreactor or fermenter, is typically equipped with agitators, baffles, air spargers, and sensing devices for the control of the operating conditions. A pure strain of microorganisms is introduced into the vessel. The number of cells multiplies exponentially after a certain period of lag time and reaches a maximum cell concentration as the medium is depleted.

The fermentation is then stopped and the contents are pumped out for the product recovery and purification. This process is operated either by batch or continuous mode. For large-scale operations, biochemical engineers work with biological scientists to: 1) obtain the best biological catalyst (microorganism, animal cell, plant cell, or enzyme) for a desired process, 2) design and operate the bioreactor in the most efficient way, and 3) separate the desired products from the reaction mixture in the most economical way. Biological processes have advantages and disadvantages as compared with traditional chemical processes. Bioprocessing is most promising for high-price, low-volume products such as pharmaceuticals, medical enzymes, and analytic reagents. There are, however, several products produced through bioprocessing that are low-price, high-volume products. Some example of these are high-fructose corn syrup (and enzymes involved on the process such amylase and glucose isomerase) and laundry additives (protease enzyme).

Lastly, the word fermentation needs to be discussed due to the confusion caused by different definitions of the word. Traditionally, fermentation was defined as the process for the production of alcohol or lactic acid from glucose. A broader definition of fermentation is an enzymatically controlled transformation of an organic compound.

4. Answer the questions:

1. What is “biological technology”?
2. How old is biotechnology?

3. What are the early examples of implementing biotechnology into household?
4. What is necessary in order to cultivate genetically modified cells in large quantities?
5. What is the synonym for "recombinant DNA"?
6. Where can recombinant DNA technology be applied?
7. What are advantages and disadvantages of biological processes as compared with traditional chemical processes?
8. Are the words "fermentation" and "enzymatically controlled transformation of an organic compound" synonyms?

5. Read the Text again and say if the statements 1–10 are True (T) or False (F). If the statement is false, give the right variant.

1. The definition of "biotechnology" includes only the newly developed recombinant DNA technology.
2. Biotechnology is the cutting edge branch of chemistry.
3. DNA recombination technique is the synonym for genetic engineering.
4. Recombinant DNA technology can be applied to only microorganisms.
5. A pure strain of microorganisms introduced into the vessel is enough to start the process of to cultivate genetically modified cells in large quantities.
6. The number of cells multiplies exponentially after a certain period of lag time.
7. The process of fermentation can be stopped to add other contents.
8. Bioprocessing is most promising for high-price, low-volume products such as pharmaceuticals, medical enzymes, and analytic reagents.
9. There are, however, several products produced through bioprocessing that are not low-price, high-volume products.
10. Fermentation was traditionally defined as the process for the production of alcohol or lactic acid from glucose but the term needs further specification.

6. Before reading the text Safety at work, answer the questions:

1. What do you know about safety at work?
2. What rules regulate it?
3. Do you follow the regulations?
4. What measures can be applied to the rule-breakers?

Safety at work

Training students to practice safe behavior in the laboratory is essential to producing competent engineers. Creating students who instinctively and thoughtfully incorporate an awareness of safety in every experiment and process is an intensive effort; entire courses are devoted to chemical hygiene and accident prevention. Throughout the curriculum, developing safe habits in students in a wet or unit operations laboratory requires raising student awareness of obvious and hidden hazards, and motivating students to monitor their own and others' safety. Rather than simply going through the motions of following lab safety rules set by the faculty and college safety officer, students must participate in observing and resolving safety violations in the lab.

This activity can be accomplished in a 1–2 hour lab period and is designed to familiarize students with the location of personal protective and safety response equipment and materials, alert students to common housekeeping safety violations, and help students develop methods for avoiding and responding to safety issues. Before the class period, 10–20 examples of common hazards are placed throughout the lab. Setup requires less than an hour for 3 people. The staged hazards can include:

- unidentified liquid spills;
- improperly or unlabelled containers;
- hot plate placed next to flammables cabinet;
- liquids stored above eye level;
- inspection tag removed from fire extinguisher;
- access blocked to fire extinguishers and safety showers;
- contents removed from first aid kit;
- open containers of food placed in lab;
- bottles of chemicals placed in "food grade storage" cabinet. (we re-labeled a non-food grade cabinet as food grade storage);
- metal stored with glass in drawers;
- blocked aisles or exits;
- inaccessible safety equipment;
- faculty members without eye protection.

Faculty members work with the safety officer to ensure these hazards are staged in a safe manner and removed immediately after the activity is completed.

Student teams draw a map of the laboratory, including the location of all emergency exits, PPE and safety response materials, and Materials Safety Data Sheets. As the teams tour the laboratory, they must note all potential and existing safety hazards on their laboratory sketch. Once their time of the lab is concluded, students work together to list possible consequences, suggest methods for avoiding the hazard, and develop response procedures.

After all groups have finished, student observations are compared with those of the faculty. Each safety violation is awarded a point value, and the team with the highest score wins safety glasses for the entire team. In addition each team turns in a laboratory map, hazard list, and response sheet, and faculty score this sheet.

7. Answer the questions:

1. Why is it necessary to train students to practice safe behaviour?
2. What is the aim of courses devoted to chemical hygiene and accident prevention?
3. What does the course develop?
4. How does the described course differ from the previous one?
5. What is the course procedure?
6. Group by characteristics such as mentioned above according to the hazard rate.
7. What is the role of faculty members in the course?
8. What is the outcome of the course?

8. Read the Text again and say if the statements 1–10 are True (T) or False (F). If the statement is false – give the right variant.

1. Safe behaviour in the laboratory is among the competences of an engineer.
2. Creating students who instinctively and thoughtfully incorporate an awareness of safety in every experiment and process is a spontaneous effort.
3. To practice motivating students to monitor their own and others' safety is optional.
4. Faculty member and safety officer work in collaboration to train students.
5. Open containers of food placed in lab are not in the list of hazards.
6. Metal is usually stored with glass in drawers.
7. Blocked aisles or exits are unacceptable.
8. Faculty member and safety officers apply different methods of training students.
9. Students and faculty members' observations are never compared.
10. Each safety violation is awarded a point value, and the team with the highest score wins safety helmet for the entire team.

9. Put questions to the statements:

1. Training students to practice safe behavior in the laboratory is essential to producing competent engineers.
2. Raw materials are treated and mixed with other ingredients that are required for cells to grow well.
3. Traditionally, fermentation was defined as the process for the production of alcohol or lactic acid from glucose.
4. After all groups have finished, student observations are compared with those of the faculty.
5. People crossbred plants and animals for better yields.

VOCABULARY

10. Use suffixes -ous, -fy, to form adjectives or verbs, and the prefix cross – to form verbs from the following words. Make up word combinations.

Example: *memory – memorable – a memorable journey.*

	-ous		-fy	cross-	
hazard		modification			breed
variant		purification			fertilize
danger		simplification			link
picture		amplification			pollination

11. Match the words to the definitions:

1	deplete	A	able to live or exist without outside help
2	modify	B	to do something to someone to make them healthy
3	mislead	C	to use up and run out of something
4	viable	D	someone or something who unsettles a preexisting balance
5	exponentially	E	a scientific invetion that affects living things
6	treat	F	deceive; trick
7	yield	G	a living thing. They can be unicellular or multicellular
8	agitator	H	a group of organisms that can mate and produce offspring that can also mate to produce offspring

9	organism-	I	to change something
10	biotechnology-	J	the molecule responsible for inheritance of traits from one generation to the next. It is the instructions for making an living thing
11	species-	K	extremely rapid growth. (10^{10} is an exponent)
12	DNA, deoxyribonucleic acid	L	to give an advantage to someone else

12. Fill in the blanks with the words from the table:

1. Bacteria, humans, dog, cats, trees, algae and mushrooms are all examples of ________.
2. An electric mixer is a great ____________ for cookie dough.
3. When you get onto a highway, you must ____ to faster moving cars.
4. The ____________ in a single human cell measures 6.5 feet in length and carrries all the information needed to make an entire human being.
5. Horses and donkeys are not the same ________ because even though they can produce a mule as an offspring, mules are sterile and cannot further reproduce.
6. Cloning is a ________ because it is an invention of humans that affects living things.
7. The email telling me how to get rich quickly was not real, it was ___.
8. The bus was _________________ to allow wheelchairs on board.
9. The U.S. Buys oil from other countries because it has________ its own supply.
10. The doctor ___________________ his sickness with a new medicine.
11. In the 1990's, internet use grew ________________.
12. The airline is not _____________ and needs government help.

13. Fill in the blanks changing the words given:

Plants are a ___________1 source of chemical compounds such as pharmaceuticals, flavours, pigments, fragrances, and ________2. These products, known as secondary metabolites, are usually _____3 in trace quantities in plants and have no obvious ______4 function. They serve as a chemical interface between the producing plants and their surrounding environment, such as adaptations to __________5 stresses and chemical	1) VALUE 2) AGROCHEMISTRY 3) PRODUCTION 4) METABOLISM 5) INVIRONMENT

defenses against microorganisms. Despite substantial advances in synthetic organic chemistry, many secondary metabolic compounds are either too difficult or _____6 to synthesize (e.g., rose oil). Most plants that produce ________7 useful substances are grown in tropical and subtropical regions of the world. As a result, the _______8 and costs of these materials depend on the political and economic circumstances of the countries involved.	6) COST 7) COMMERCE 8) AVAILABLE

14. Match the word to its definition:

1	eye protection	A	something to wash the contaminated part of the body as soon as possible
2	safety equipment	B	something that informs employees that equipment has been inspected and is safe and in working order
3	inaccessible	C	lacking a label or tag
4	aisles or exits	D	being or having an unknown or unnamed source
5	safety showers	E	in an improper way
6	fire extinguisher	F	protective clothing, helmets, goggles, or other garment or equipment designed to protect the wearer's body from injury by blunt impacts, electrical hazards, heat, chemicals, and infection, for job-related occupational safety and health purposes, and in sports, martial arts, combat, etc.
7	inspection tag	G	way to escape from a building
8	flammable	H	a spill occurs when the contents of something, usually in liquid form, is emptied out onto a surface, often unintentionally.
9	unlabelled	I	capable of being reached only with great difficulty or not at all
10	improperly	J	possible to burn
11	liquid spills	K	protective gear for the eyes, which comes in many types depending upon the threat that is to be reduced
12	unidentified	L	an active fire protection device used to extinguish or control small fires, often in emergency situations

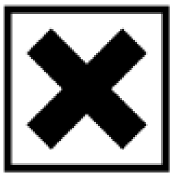
15. Match the word to its picture:


1


2


3


4


5


6

a) highly flammable

b) harmful\irritant

c) toxic

d) explosive

e) oxidizing

f) corrosive

SPEAKING

16. Tell your partner:

• your name;
• where you work now (or want to work);
• what you do (or will do in your job).

Tell your partner about:
• things you must not do in your work place and why;
• accidents you can have in your workplace and why.

TRANSLATION

17. Translate from English into Russian:

1. Biochemical engineering involves the scale-up of biological processes.
2. One of the earliest examples of the successful scale-up of a biological process was the production of penicillin during World War II.
3. Industrial microbiologists used stirred-tank fermenters to culture molds on a large scale.
4. During the 1960s and 1970s, biochemical engineering grew rapidly with the increased needs forthe development of biological processes in the food, beverage, and pharmaceutical industries.
5. The activities in bioprocessing grew even further as Arab oil embargos prompted the use of renewable energy sources, such as biomass.

6. For example, cellulose, a major component of wood, can be broken down enzymatically to glucose, hence producing ethanol via yeast fermentation.
7. The research for the utilization of renewable resources dwindled in the early 1980s because of the reduction in energy prices.
8. However, the area found another opportunity to grow as biologists discovered a way to manipulate genes of living organisms.
9. The manipulation of genes is known as genetic engineering or biotechnology.
10. The competent person must find and assemble the available information on the chemical, but it will not be necessary to carry out any new tests.

WRITING

18. Write an annotation to the text:

Alice Hamilton (1869–1970) was a founder of industrial toxicology in the United States. Her long career investigating the hazards to which workers were exposed – especially from contact with poisonous materials – earned her great gratitude and respect, even from many of the industrialists whose businesses she studied. As Bradley Dewey, president of Dewey and Almy Chemical Company, wrote in 1934 to the technical director of a firm that sold solvents:

"I don't know what your Company is feeling as of today about the work of Dr. Alice Hamilton on benzol [benzene] poisoning. I know that back in the old days some of your boys used to think that she was a plain nuisance and just picking on you for luck. But I have a hunch that as you have learned more about the subject, men like your good self have grown to realize the debt that society owes her for her crusade. I am pretty sure that she has saved the lives of a great many girls in can-making plants and I would hate to think that you didn't agree with me."

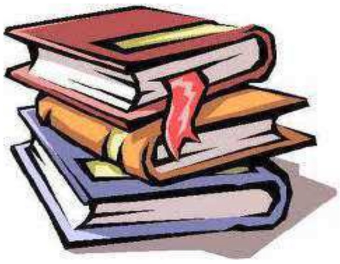
Hamilton was one of four daughters and a son born to one of the founding families of Fort Wayne, Indiana. Her sister Edith became famous as the author of The Greek Way (1930) and other works about classical culture, after a career as the headmistress of a girls' school in Baltimore. Alice planned to become a medical doctor. After attending a girls' boarding school that gave scant attention to science, she spent a summer being tutored in chemistry and physics before entering the University of Michigan Medical School. (At that time U.S. Medical schools accepted students directly from high school.) At Michigan she became fascinated with the subject of pathology and decided to become a research scientist rather than enter clinical practice. After completing her medical training, she returned briefly to the University of Michigan for graduate studies, but soon she and her sister Edith set out for Germany to pursue their respective fields – bacteriology and classics. Unlike their male counterparts, the sisters were not welcomed into the German universities. Robert Koch, a founder of bacteriology, and Paul Ehrlich rejected Alice Hamilton's request to work with them in Berlin, but she was well received by Ehrlich's former colleagues in Frankfurt, including his cousin, Carl Weigert. Upon her return to the United States, Hamilton became a research assistant at Johns Hopkins Medical School, where she worked mainly with Simon Flexner, a pathologist who went on to head the Rockefeller Institute in New York.

In 1897 Hamilton accepted an appointment as professor of pathology at the Women's Medical School of Northwestern University, which was dissolved soon after. She later worked as a bacteriologist at Chicago's Memorial Institute for Infectious Diseases. In Chicago she lived for many years at Jane Addams's Hull House, the most famous of the settlement houses founded by churches and universities at the dawn of the 20th century. Settlement houses, staffed by idealistic college graduates, offered help to immigrants and other poor people who lived and worked in congested and run-down inner cities. Among the projects she carried out at Hull House, Hamilton applied her medical expertise to finding the causes for the high incidence of typhoid fever and tuberculosis in the surrounding community. In the tuberculosis study she identified bad working conditions as one of the factors that weakened the resistance of poor immigrants to the disease.

In 1919, as the leading expert in the field of industrial medicine, Hamilton was appointed assistant professor at Harvard Medical School, whose faculty and student body were all male. She was in fact the first woman professor in any field in the entire university. The mutually agreeable plan was for her to be in residence six months of each year; the rest of the time was to be spent on her surveys. In part because of this unusual arrangement, when she retired in 1935, she was still an assistant professor.

Throughout her long life Hamilton maintained an active concern for international affairs and individual civil liberties. She was a member of the League of Nations Health Committee from 1924 to 1930. Because of the threat to humanity posed by the Nazis, she supported the entry of the United States into World War II – in contrast to her stance on World War I. Because she often publicly supported the right of people to hold and express unpopular views, she attracted the suspicion of authorities, and her activities were followed by the Federal Bureau of Investigation, even when she was in her 90s.

Self-study 2



READING

TEXT 1

1. Read the text. Decide if the statements (1–10) are True (T) or False (F).

Scientific engineering confers great economic advantages. Plants and raw materials account for a much higher percentage of costs in chemical industries than in other manufacturing, where labour costs are higher. Capital costs, much of it lies in financing, are especially high for high volume productions, where they can consume up to one half of product revenues. Tinkering and modifying expensive plants, which delay operation and boost financial costs, are doubly unwelcome. High capital costs put a premium on the ability to understand operating principles in the planning and design stage, which is a goal of chemical engineering.

Britain was among the first to establish a heavy chemicals industry, and after an initial success, lost the competition on fine chemicals. In fact, chemical engineering was first envisioned by the British George Davis, whose pioneering ideas the Americans acknowledged.

To answer a question raised, it may be well to compare chemical engineering with another American innovation, industrial engineering that facilitated mass production of mainly mechanical products such as cars. Fabrication and assembly of mechanical products are labour intensive. Shortage of labour, especially skilled labour, in America forced Americans to automate manufacturing processes and develop assembly of interchangeable parts from early days. Trying to substitute human workers by machines, industrial engineering focused on worker-machine interfaces, such as the time-motion study well known to historians. In contrast to the mechanical industries, the chemical industry is more capital intensive than labour intensive, and chemical engineering addressed only physical processes. Furthermore, the materials handled in chemical processing are mostly fluids, which are more susceptible to mathematical representation and generalization than mechanical pieces that come in infinite varieties of specific shapes. The style of chemical engineering is quite different from that of industrial engineering. However, the differences seem to be determined more by the technical characteristics of the industrial works at hand than by local cultural fashions.

1. A goal of chemical engineering is to understand high capital costs.
2. A heavy chemicals industry was established in the continental Europe.
3. The pioneering ideas of George Davis did not find the support of his contemporaries.
4. Industrial engineering can be compared with mass production of vehicles.
5. Chemical engineering is considered to be the American's innovation.
6. Shortage of skilled labour resulted in decay of mass production industries.
7. The chemical industry is more capital intensive than labour intensive.
8. Chemical engineering addressed both physical and moral processes.
9. The style of chemical engineering is quite different from that of industrial engineering.
10. Technical characteristics of the industrial works differ the chemical engineering from the industrial engineering.

TEXT 2

2. Read the text. For questions 1–5, choose the best answer A, B, C or D.

Any chemical process can be characterized in terms of three major components: prereaction, reaction, and postreaction. Usually (but not necessarily) the first and last comprise only physical operations such as mixing, heating, vaporization, distillation, crystallization, extraction, absorption, adsorption, and so on. No chemical reaction is involved except in cases where physical separation is facilitated or enhanced by a deliberately imposed reaction (to be distinguished from the reaction of interest). The middle component constitutes the actual chemical reaction occurring in the process, i.e., the reaction of interest. The reaction can be of any type, involving one or more phases, and is performed in reactors of various designs. The design depends on the system used, such as gas, liquid, gas-liquid, liquid-liquid, gas-solid, gas-liquid-solid, and so forth. In the 1930s and 1940s, the analysis and design of reactors was usually referred to as applied reaction kinetics.

Then, around 1960, the term chemical reaction engineering was used (by Octave Levenspiel) to describe this area of chemical engineering.

Chemical reaction engineering (CRE) has grown in over half a century as a highly sophisticated area of chemical engineering. The first attempts were centered round the development of common principles that cut across various industries. As chemical engineers applied these principles to other emerging areas such as biochemical processes, electrochemical processes, photochemical processes, sonochemical processes, and others, new theories had to be developed to accommodate the special needs of different areas. Thus a new trend became discernible where CRE retained its core value and structure but many specialized areas (e.g., biochemical reaction engineering, electrochemical reaction engineering, photochemical reaction engineering, and microreactor engineering) began to spin off with roots in CRE. This inclusiveness of CRE has been its hallmark over the last 30 years.

1) Chemical process can NOT be characterized in terms of :
   a) prereaction
   b) reaction
   c) postreaction
   d) afterreaction
2) Physical separation facilitated or enhanced by a deliberately imposed reaction can cause:
   a) dissimilation
   b) chemical reaction
   c) rust
   d) evaporation
3) In the 1930s and 1940s, applied reaction kinetics was the term to describe:
   a) the analysis and design of reactors
   b) the capacity of reactors
   c) the type of reactors
   d) the durability of reaction
4) Chemical reaction engineering centers round the development of common principles that:
   a) enhance the development of chemistry
   b) cut across various industries
   c) raise the environmental awareness
   d) provide the cutting edge inventions
5) According to the text, it is possible to say that CRE:
   a) has declined in the course of time
   b) deteriorated the conditions of further development for many engineering areas
   c) became the “mother” of many specialized areas of engineering
   d) has been drastically supported by the government

VOCABULARY AND GRAMMAR

3. Choose the word (A, B, C or D) that best fits the gap.

1) An example of white biomechanics is the using of enzymes as industrial catalysts to either produce valuable chemicals or destroy _____ chemicals.
   a) poisonous
   b) hazardous
   c) dangerous
   d) unhealthy
2) The code ensures that all chemicals for use at work, including impurities, by-products and intermediates, and wastes that may be formed, _____ to determine their hazards.
   a) are evaluated
   b) evaluated
   c) to be evaluated
   d) has been evaluated
3) The provisions of this code should _____ as basic requirements for preventing or reducing the risks to workers' health and safety when using hazardous chemicals.
   a) considered
   b) be consider
   c) is considered
   d) be considered
4) You smoke, ______ you?
   a) smoke
   b) does
   c) don't
   d) are
5) How ______ a chemical probe _____ in cells?
   a) are used
   b) is used
   c) does use
   d) do use
6) If I _____ to Leipzig, I'll visit the Zoo.
   a) will go
   b) go
   c) went
   d) has gone

7) She wouldn't have had two laptops if she _____ the contract.
   a) had not signed
   b) did not sign
   c) does not sign
   d) have not signed

8) If you _____ a lighter jacket, the car driver would have seen you earlier.
   a) have been worn
   b) wore
   c) wear
   d) had worn

9) You don't like jazz, ______ you?
   a) do
   b) like
   c) don't
   d) will

10) _____ a temperature change on mixing 10ml ethanol and 10ml hexane?
   a) why there is
   b) that is why
   c) why is there
   d) why does it

TRANSLATION

4. Translate from English into Russian:

1. Dangerous substances are used in a wide range of industrial and commercial activities.
2. Over the years, many workers have contracted occupational diseases through exposure to such substances.
3. Typical examples include occupational dermatitis (non-infective dermatitis), chemical poisonings (e.g., by derivatives of arsenic, phosphorus and lead), occupational cancers and the group of diseases known as the pneumoconioses (e.g., asbestosis, siderosis, coal worker's pneumoconiosis and silicosis).
4. The potential for contracting an occupational disease will vary according to the potential for harm of the substance concerned.
5. The important role is played by its form (e.g., solid, liquid, gas, dust etc), the route of entry into the body, the precautions taken (both physically by the employer and personally by the worker), and the dose received.

6. Other substances, while not directly entering the body, can be dangerous – e.g., flammable, explosive, cryogenic substances, contact with which can result in burns, physical damage such as major injuries, and skin irritation.
7. Some 1,400 of the more common dangerous chemicals have been classified.
8. Each substance is identified by its chemical name or its unique international number, and the classification and other information can be read directly from the List.
9. Where a substance is not on the Approved Supply List, then suppliers have to classify the substances themselves on the basis of the properties described in the Regulations.
10. The competent person must find and assemble the available information on the chemical, but it will not be necessary to carry out any new tests.

WRITING

5. Write an annotation to the text:

Engineers will almost certainly be tempted to do something that is either unethical, if not illegal, on more than one occasion. Selecting a course of action that is ethical is not always easy and often requires careful planning.

In general, an engineer signs a legal contract with his employer to protect propriety information for at least several years. The engineer also needs to consider how to maintain good relations with his associates and the public. As an analogy, ethics in many ways is like a stool with three or four legs. The rights of the employer (or client), the public, industrial associates, plus the engineer, all need to be considered and balanced.

First, ethics and legal matters are not equivalent. A course of action may be on occasion legal, but not necessarily ethical. How is ethics defined? As defined here, and by many, ethics is the code adapted by a group, profession, and a country. For example, offering money to a political official is generally considered in the United States as a bribe. Hence, it would often be considered not only unethical but also illegal. Yet in certain countries, providing a gift to a key government official might be considered as a way of life and a method of taxation. The old saying was, “When in Rome, do as the Romans do”. Since industry is rapidly becoming more internationalized, many engineers will have experiences with individuals from other cultures. Hence, another complication is added to maintaining high ethical standards.

The American Institute of Chemical Engineers plus other professional societies have adapted, as guidelines, codes of ethics. The engineers should serve with fidelity the employer and the public.

At all times, the engineer uses his skills to advance human efforts, to increase his technical competence, and to increase the prestige of the engineering profession. Based on personal experience, nothing, and let me repeat nothing, can tarnish one's reputation in the eyes of his colleagues more than to be thought to act unethically.

Several areas in which disagreements can occur between an employer and an employee are as follows:

1. Confidential information: What is confidential information? Incidences have occurred in which an employer claims that specific information is confidential. Yet the company has permitted the information to be published in the open technical literature. Often the engineer is not certain just what is and what is not confidential.

2. What information can an employee take from one company to a second? Often details on the manufacture of a new catalyst are considered proprietary; yet if the employee developed a new method of designing a heat exchanger, the information might not be considered proprietary. An engineer supposedly improves and becomes more of an expert while he is with the first employer.

3. Assuming an engineer becomes convinced that a process or certain equipment has serious safety problems, but the employer insists that the current set-up is safe. What course of action should the engineer follow? With current laws, an engineer can be held liable for suppressing information on potential hazards. At the very least, it is recommended that the engineer address written correspondence on this matter to the top management of his company.

4. Stolen information: Situations have occurred in which an individual leaving one company fills his briefcase with confidential reports. When an employee at either the first or second company learns of this, what action should he take?

5. Technical reports have been published in which incorrect or misleading information has been published on a competitor's process.

Many industries and individuals find that they need to consult to an increased extent with attorneys in planning their actions and programs.

CONTROL WORK № 2

Variant 1

READING

TEXT 1

1. Read the text and complete the statements (1–5) with the most suitable ending A, B, C or D.

Supramolecular Chemistry

Supramolecular chemistry or – as sometimes called – supramolecular science is located at the meeting point provided by the design and investigation of organized, informed, and functional supramolecular architectures. As a bottom-up approach, supramolecular chemistry is concerned with the next step in increasing complexity beyond the molecule toward the supramolecule and organized polymolecular systems on a nanometric size scale, held together by non-covalent interactions. This type of molecular interactions forms the basis of the highly specific recognition, reaction, transport, and regulation processes that occur in biology. Due to weak intermolecular bonds, supramolecules are in general thermodynamically less stable, kinetically more labile, and dynamically more flexible so that a type of "soft chemistry" emerges. Binding of a substrate σ to a receptor ρ yields the supramolecule σρ and involves recognition, transformation, and translocation. The association and organization of functional supramolecules may lead to molecular and supramolecular devices.

According to a consideration of Lehn there was in the beginning the Big Bang and physics reigned. Then chemistry came along at milder temperatures; particles formed atoms; these united to give more and more complex molecules, which in turn associated into aggregates and membranes, defining primitive cells out of which life emerged. In this sense chemistry is settled between the laws of physics and the rules of life.

1) Supramolecular chemistry is the synonym for _____.
   a) megametric science
   b) polymer chemistry
   c) multimolecular chemistry
   d) supramolecular science

2) Supramolecular chemistry study lies _____.
   a) beyond the field of chemistry
   b) on the boundary of several subjects
   c) in the field of nuclear physics
   d) beyond the healthy boundaries
3) Supramolecules are in general thermodynamically less stable due to _____.
   a) more kinetic lability
   b) polymer chemistry
   c) weak intermolecular bonds
   d) supramolecular bonds
4) The association and organization of functional supramolecules may lead to ___.
   a) molecular and supramolecular devices
   b) more complex molecules
   c) thermo dynamical instablility
   d) association into aggregates and membranes
5) According to the text, after the Big bang the chemistry _____.
   a) came along at milder temperatures
   b) supermolecule organized polymolecular systems
   c) chemistry settled between the laws of physics and the rules of life
   d) formed recognition, reaction, transport, and regulation processes

TEXT 2

2. Read the text. Decide if the statements (1–10) are True (T) or False (F).

Job Safety Analysis, What is it?

Job Safety Analysis (JSA) is a tool that can help identify hazards on the job.

We all need a little something more to do. There is a suggestion about the something more that can benefit **imi** (that is all of us) in our effort to reduce the number of injuries and accidents that occur on the job. That is JSA. JSA is a systematic analysis of each task in a job which identifies potential hazards and provides procedure for workers to follow to avoid the hazards.

Experts will tell you that JSA is a tool for Supervisors or Safety Professionals to use to reduce on the-job injuries, but in our line of work I think that everyone of us can participate in JSA. After all, very few of us actually sit at a work station and do the same things over and over. Our jobs require that we are mobile and much of the time on our own. So, what I am asking you to do is to think about your job. Do a JSA. Identify any hazards that are present and either pass along that information to your supervisor. An example of a JSA that we have attempted to address is slippery surfaces on trucks or other equipment. (I know we are not effect here, yet.) We have installed additional non-slip surface materials on fenders and steps and built racks to reduce climbing on trucks.

What JSA requires is that you break every job into little bits of activity. Analyze each activity with and eye towards identifying hazards. Develop a solution or procedure to eliminate the hazard and then implement the solution.

Seems simple, yes! I know it is not that simple, but neither is it difficult. It requires honest thought about what you are doing.

Identify a hazard, then identify a solution.

The identification of the hazard is not the only area where your help is needed. We also need help in coming up with good solutions. You are the expert in the job tasks that you perform. But, you do not have to do it alone. Terry or I am available to provide assistance.

1. Each location of **imi** has a Safety Policy.
2. The Safety Policy includes a Statement of Responsibility and General Safety Rules.
3. **imi** has a written Hazard Communication Policy.
4. The Hazard Communication Policy provides information about the chemicals that we work with.
5. The hazards of chemicals and proper handle instruction are found on the MSDS.
6. We have Confined Spaces at our facilities.
7. Procedures for dealing with Confined Spaces are provided in our Policies Manual.
8. Hard hats, safety glasses, hearing protection, dusk masks, and chemical gloves are provided as needed for the exposure by the Company.
9. Each employee can do a JSA.
10. Every employee is a member of the **imi** Safety Committee.

VOCABULARY AND GRAMMAR

3. Choose the correct item A, B, C or D.

1) All reactions in living organisms occur involving enzymes, catalysts of protein nature, where enzymes are the perfect host _____.
   a) molecules
   b) materials
   c) basis
   d) base

2) Supramolecular assemblies can form at random and self-assembly _____ with the release of large amounts of heat.
   a) be accompanied
   b) accompanies
   c) is accompanied
   d) is accompanying

3) While traditional chemistry focuses on the covalent bond, supramolecular chemistry _____the weaker and reversible noncovalent interactions between molecules.
   a) examined
   b) examines
   c) is examining
   d) has been examined

4) In 1894, Fischer suggested that enzyme-substrate interactions take the form of a "lock and key", the fundamental principles of molecular recognition and host-guest _____.
   a) chemistry
   b) relations
   c) dependence
   d) reliance

5) The importance of supramolecular chemistry _____ by the 1987 Nobel Prize for Chemistry which was awarded to Donald J. Cram, Jean-Marie Lehn, and Charles J. Pedersen
   a) established
   b) had been established
   c) was established
   d) was establishing

6) If he _____ thirsty, he would have drunk some water.
   a) is
   b) had been
   c) was
   d) were

7) They need help, ______ they?
   a) doesn't
   b) do
   c) need
   d) don't

8) She would go to the Job Centre if she _____ a job.
   a) had wanted
   b) wants
   c) will want
   d) wanted

9) _____ more than one chemical probe as well as a negative control for the same target?
   a) why do you recommend
   b) why you recommend
   c) why is you recommend
   d) why does you recommend

10) Your brother is in Canada, ______ he?
   a) does
   b) isn't
   c) is
   d) doesn't

TRANSLATION

4. Translate the sentences from English into Russian:

1. In the early 1890s, the British physicist Lord Rayleigh found that nitrogen obtained by two different means seemed to have a different density.
2. Being extracted from air, it was very slightly denser than that made by decomposition of ammonia (a compound of nitrogen and hydrogen).
3. He and Ramsay investigated both forms of nitrogen, and Ramsay found that atmospheric nitrogen had an inert component that he was finally able to separate.
4. They were able to collect only tiny amounts.
5. Rayleigh lamented in 1894 that “The new gas misled me a life”.

6. Anaerobic biological wastewater treatment has numerous advantages over conventional aerobic processes.
7. An important problem, which is to be considered with regard to any engine, is the question of its efficiency.
8. Anaerobic bioreactors were augmented with an oxygen-transferring membrane to improve treatment performance.
9. When iron and water are heated in a closed vessel, the hydrogen and the oxide of iron which are produced react with one another to give back water and iron.
10. The next step to be taken in this process involves the treatment of camphor with acetic acid.

WRITING

5. Write an annotation to the text:

Bioreactor design

A bioreactor is a reactor in which enzymes or living cells catalyze the biochemical transformations. It is frequently called a fermenter whether the transformation is carried out by living cells or in vivo cellular components (enzymes). Fermentation originally referred to the metabolism of an organic compound under anaerobic conditions. However, modern industrial fermentation includes both aerobic and anaerobic cultures of organisms. Currently, bioreactor and fermenter can be regarded as synonyms.

Bioreactors

Stirred-Tank Bioreactor (or Fermenter)

In laboratories, cells are usually cultivated in Erlenmeyer flasks on a shaker. The gentle shaking effectively suspends the cells, enhances the oxygenation through the liquid surface, and aids the transfer of nutrients without damaging the structure of the cells.

For a large-scale operation, the stirred-tank fermenters (STF) are widely used. They are employed for both aerobic and anaerobic fermentation of a wide range of cells including microbial, animal, and plant cells. The mixing intensity can be varied widely by choosing suitable impellers and by varying agitating speeds. The mechanical agitation and aeration are effective for the suspension of cells, oxygenation, mixing of the medium, and heat transfer. The STF was one of the first large-scale fermenters developed in the pharmaceutical industries for the production of penicillin. Its performance and characteristics have been extensively studied. Large industrial STFs are usually built with stainless steel, but laboratory-scale fermenters are often made of glass with a stainless steel top plate. Although the agitator is effective in mixing the fermenter content, it can damage a shear-sensitive cell system such as mammalian or plant cells.

The physical configuration of a typical fermenter is as follows: The height of the vessel is two to three times the vessel diameter and a fermenter is usually agitated with two or three turbine impellers. The impeller diameter to tank diameter ratio is generally 0.3 to 0.4. For multiple impeller systems, the distance between impellers is usually 1 to 1.5 impeller diameters. Four equally spaced baffles are usually installed to prevent a vortex formation that reduces the mixing efficiency. For aerobic fermentation, a single orifice sparger or ring sparger is used to aerate the fermenter. The pH in a fermenter can be maintained by employing either a buffer solution or a pH controller. The temperature is often controlled by heat transfer through a heating coil.

Variant 2

READING

TEXT 1

1. Read the text and complete the statements (1–5) with the most suitable ending A, B, C or D.

Safety monitoring systems

Safety monitoring is concerned with the measurement and evaluation of safety performance. It may take the following forms:

1. Safety surveys: This is a detailed examination of a number of critical areas of operation or, perhaps, an in-depth study of all health and safety related activities in a workplace.

2. Safety tours: These are an unscheduled examination of a working area, frequently undertaken as a group exercise (e.g., foreman, safety representative and safety committee member), to assess general compliance with safety requirements (e.g., fire protection measures and use of machinery safety devices).

3. Safety audits: A safety audit fundamentally subjects each area of an organisation's activities to a systematic critical examination with the object of minimising injury and loss. It generally takes the form of a series of questions directed to examining factors such as the operation of safe systems of work, compliance with the Statement of Health and Safety Policy and the operation of hazard reporting systems.

4. Safety inspections: A scheduled inspection of a premises or working area to assess levels of legal compliance and observation of company safety procedures. Safety inspections are frequently undertaken by company safety specialists and trade union safety representatives.

5. Safety sampling: A system designed to measure by random sampling the accident potential in a workplace or process by identifying defects in safety performance or omissions. Observers follow a prescribed route through the working area noting deficiencies in performance, e.g., concerning the wearing of personal protective equipment or the use of correct manual handling techniques. In some cases, individual topics in the safety sampling exercise are ranked according to importance with a maximum number of points achievable. At the end of the exercise a total score is identified which gives an indication of the performance level at that point in time.

1) Safety monitoring is concerned with _____ of safety performance.
   a) the measurement and evaluation
   b) the protection and correction
   c) inspections and fining
   d) legal compliance and observation
2) If the examination of a working area happens out of schedule, it is called _____.
   a) safety inspections
   b) safety surveys
   c) safety tours
   d) safety audits
3) Safety audits take the form of _____.
   a) assessing general compliance
   b) threatening
   c) traditional feast
   d) a series of questions
4) Company safety specialists and trade union safety representatives usually:
   a) identify defects in safety performance or omissions
   b) inspect premises or working areas
   c) give detailed examination of a number of critical areas of operation
   d) follow a prescribed route through the working area
5) An in-depth study of all health and safety related activities in a workplace is _____.
   a) safety survey
   b) safety audit
   c) safety inspection
   d) safety sampling

TEXT 2

2. Read the text. Decide if the statements (1–10) are True (T) or False (F).

Supramolecular Materials

Organic supramolecular materials are of interest because of their interaction and recognition capabilities. Examples are organic nanotubes formed by self-assembly of cyclic peptide units. Networks of self-assembled actin filaments play a basic role in the physicochemical behavior of cells and vesicles.

Technologies resorting to self-organization processes should be able to bypass nanofabrication procedures by making use of the spontaneous formation of the desired suprastructures and devices from instructed and functional building blocks. In the future, supramolecular devices may be organized In the future, supramolecular devices may be organized by recognition-directed self-assembly into well-defined architectures with novel properties.

Components and molecular devices such as molecular wires, channels, resistors, rectifiers, diodes, and photosensitive elements might be assembled into nanocircuits, artificial transmembrane ion channels. Tubes and channels are ubiquitous in living systems. Constructed from various proteins these conduits are responsible for numerous biological functions such as ion flow, signal transduction, an molecular transport. Artificial transmembrane ion channels were constructed from cyclic peptide structures containing alternating D- and L-aminoacids, where D and L refer to the amino acid chirality. These cyclic subunits adopt a flat ring conformation, allowing them to stack on top of one another to form a hydrogen-bonded, hollow tubular structure.

1. Organic supramolecular materials are of interest because of their interaction and recognition capabilities.
2. Networks of self-assembled actin filaments do not play any role in the physicochemical behavior of cells and vesicles.
3. In the future, supramolecular devices may be organized by recognition-directed self-assembly into a masterpiece of architecture.
4. Unfortunately, it is impossible to introduce novel properties into well-defined architectures.
5. Nanocircuits can consist of molecular wires, channels, resistors, rectifiers, diodes, and photosensitive elements.
6. Tubes and channels are very common in living systems.
7. Constructed from various proteins these conduits are not responsible for numerous biological functions such as ion flow, signal transduction, a molecular transport.
8. Tubes and channels in living systems are constructed from the same proteins.
9. Cyclic peptide structures contain alternating D- and S-aminoacids.
10. These cyclic subunits stack on side of one another to form a hydrogen-bonded, hollow tubular structure.

VOCABULARY AND GRAMMAR

3. Choose the correct item A, B, C or D.

1) If we walk so slowly, we _____ late.
   a) will being
   b) will be
   c) be
   d) would be

2) ______ metal that is in liquid form at room temperature?
   a) what only
   b) what is the only
   c) what only is
   d) what does only

3) How many actual double bonds _____ the benzene ring ______?
   a) does … possess
   b) do … possesses
   c) possesses
   d) has … possess

4) When you are trying an unfamiliar procedure for the first time, it _____ a good idea to practice at least one "dry run" without chemicals.
   a) should be
   b) were
   c) would have been
   d) is

5) Information of cases indicating the hazardous components _____ from some testing done.
   a) obtained
   b) has been obtained
   c) is obtaining
   d) has obtained

6) Workers _____ not to pour liquids down drains or use hoods to get rid of volatile chemicals.
   a) need not be taught
   b) might be taught
   c) should be taught
   d) cannot be taught

7) Keeping floors clean and dry _____ prevent slip and fall injuries – the third-leading cause of worker injury and lost work time.
   a) will help
   b) help
   c) helping
   d) had helped

8) You are John, _____?
   a) are you
   b) aren't you
   c) do you
   d) don't you

9) If I _____ about your birthday, I would have you bought a present.
   a) had known
   b) know
   c) would know
   d) knew

10) They're working on the project, _____?
   a) do they
   b) are they
   c) don't they
   d) aren't they

TRANSLATION

4. Translate the sentences from English into Russian:

1. Evidence that inhibition of spontaneously produced nitric oxide improves cell functionality is questionable.
2. A laboratory-scale bioreactor was re-evaluated, with the aim of improving its use for the perfused culture of rat hepatocytes.
3. In contrast to conventional culture systems, the flat membrane bioreactor (FMB) showed good functionality and biochemical competence during 2–3 days.
4. Hepatocytes cultured in the FMB, specifically in a "sandwich" configuration, were functionally stable, as shown by a high rate of urea biosynthesis.
5. The effect of cyclosporin A CsA on the modulation of urea and spontaneous NO production demonstrated flexibility.
6. In that minor changes could be observed at diverse time intervals and in a non-destructive way.

7. The monitoring of nitrite levels during various steps of isolation and culture suggested that spontaneously produced NO has a negative impact on hepatocyte metabolic and functional integrity.
8. In spite of the sophisticated techniques that are being used for the preparation of bioreactors, hepatocytes survived for longer periods,
9. Our data have shed light on some factors that could be important for the successful use of similar models for pharmacotoxicological and other biomedical applications.
10. Optimal bromate reduction activity was observed at approximately 35 degrees C.

WRITING

5. Write an annotation to the text:

Alternative Fermenters

Many alternative fermenters have been proposed in order to provide better aeration, heat transfer, and cell retention. They are usually classified based on their vessel type such as tank, column, or loop fermenters. Another way to classify fermenters is based on how the fermenter contents are mixed: by compressed air, by mechanical agitators, or by external liquid pumping.

The most simple fermenter is the bubble column fermenter (or tower fermenter), which is usually a long cylindrical vessel with a sparging device at the bottom. The fermenter contents are mixed by rising air bubbles that also provide the oxygen needs of the cells. Since the fermenter does not have any moving parts, a bubble-column fermenter is energy efficient with respect to the amount of oxygen transfer per unit energy input. As the cells settle, high cell concentrations occur in the lower portion of the column without any separation device. However, bubble-column fermenters are limited to aerobic fermentation. Furthermore, the rising bubbles may not provide adequate mixing for optimal growth. As the cell concentration increases in a fermenter, high airflow rates are required to maintain the cell suspension and mixing.

The increased airflow rate can cause excessive foaming and high retention of air bubbles, which decreases the productivity of the fermenter. As bubbles rise in the column, they often coalesce rapidly, leading to a decrease in the oxygen-transfer rate. Therefore, column fermenters tend to be inflexible and limited to a relatively narrow range of operating conditions.

To overcome the weaknesses of the column fermenter, alternatives have been proposed. A tapered column fermenter can maintain a high airflow rate at the lower section of the fermenter where the cell concentration is high. Several sieve plates can be installed in the column for the effective gas–liquid contact and the breakup of the coalesced bubbles. The cylindrical column can be divided into multiple stages with stirrers. This configuration is analogous to stirred-tank fermenters connected in series. To enhance the mixing, the fermentation broth can be recirculated by using a pump.

A loop fermenter is a tank or column fermenter with a liquid circulation loop. Depending on how the liquid circulation is induced, it is often classified into three types: air-lift, stirred loop, and jet loop. The liquid circulation of the air-lift fermenter, is induced by sparged air, which creates a density difference between the bubble-rich liquid in the riser (inner column) and the bubble-depleted liquid in the downcomer (space between the inner and the outer tubes). The liquid circulation and mixing are enhanced by installing a propeller or by circulating liquid externally using a pump. However, the addition of a propeller or pump diminishes the advantages of an air-lift fermenter as being simple and energy efficient.

Variant 3

READING

TEXT 1

1. Read the text and complete the statements (1–5) with the most suitable ending A, B, C or D.

Risk assessment

A risk assessment may be defined as: "an identification of the hazards present in an undertaking and an estimate of the extent of the risks involved, taking into account whatever precautions are already being taken".

It is essentially a four-stage process:

a) identification of all the hazards;

b) measurement of the risks;

c) evaluation of the risks; and

d) implementation of measures to eliminate or control the risks.

There are different approaches which can be adopted in the workplace, e.g.: a) examination of each activity which could cause injury; (b) examination of hazards and risks in groups, e.g. machinery, substances, transport; and/or (c) examination of specific departments, sections, offices, construction sites.

In order to be suitable and sufficient and to comply with legal requirements, a risk assessment must:

a) identify all the hazards associated with the operation, and evaluate the risks arising from those hazards, taking into account current legal requirements;

b) record the significant findings if more than five persons are employed, even if located in different locations;

c) identify any group of employees, or single employees as the case may be, who are especially at risk;

d) identify others who may be specially at risk, e.g. visitors, contractors, members of the public;

e) evaluate existing controls, stating whether or not they are satisfactory and, if not, what action should be taken;

f) evaluate the need for information, instruction, training and supervision;

g) judge and record the likelihood of an accident occurring as a result of uncontrolled risk, including the 'worst case' likely outcome;

h) record any circumstances arising from the assessment where serious and imminent danger could arise; and

i) provide an action plan giving information on implementation of additional controls, in order of priority, and with a realistic timescale.

1. In this text, the definition for risk assessment does NOT take into account everything but ____.
   a) previous assessment
   b) whatever precautions are already being taken
   c) different approaches which can be adopted in the workplace
   d) examination of specific departments
2. Which is true about a four-stage process of risk assessment:
   a) identification, measurement, evaluation and implementation of measures to eliminate the risks
   b) identification, measurement, recording and judgment of the danger
   c) identification, measurement, evaluation and punishment of the authorities
   d) identification, recording, measurement and filing the data
3. Approaches which can be adopted in the workplace can:
   a) examine each activity which could cause injury
   b) examine hazards and risks in groups, e.g. machinery, substances, transport whatever precautions are already being taken
   c) examine specific departments, sections, offices, construction sites
   d) all mentioned above
4. Risk assessment must be _____.
   a) adopted by the president of the country
   b) approved by the upper house of parliament
   c) suitable and sufficient and to comply with legal requirements
   d) examined by specific departments
5. Risk assessment process does not take into the account:
   a) visitors, members of the public
   b) persons employed, but located in different locations
   c) family members of the workers
   d) contractors

TEXT 2

2. Read the text. Decide if the statements (1–10) are True (T) or False (F).

Renewable Energy

The growing world population, rising standards of living in the developing world, and the limited supply of fossil fuels, which accounts for 85 % of the world's energy needs, have an impact on global energy security, economics, and climate. Solutions to these global challenges require a global effort. In addition to energy conservation and increased efficiency in the use of energy, access to clean, affordable, reliable, and sustainable energy production – especially renewable energy – will be essential to enhancing global peace, alleviating poverty and growing our economics.

There is no doubt that many current developments in nanoscience have the potential to make a big impact on energy problems. Two recent reports published by the Basic Energy Science Advisory Committee (BESAC) of the US Department of Energy, at present with the physics Nobel laureate Steven Chu as Energy Secretary, paint an enticing picture of a sustainable and prosperous future facilitated by new technologies. European activities accelerate the development of new technologies as discussed at the conference on Nanotechnology for Sustainable Energy, organized by the European Science Foundation (ESF).

New approaches involving nanotechnology as discussed in the following sections may make large-scale use of solar energy possible and will contribute to the further development of hydrogen storage and fuel cells. New batteries will permit the efficient storage of cleanly generated energy.

1. Global energy security, economics, and climate were influenced by the limited supply of fossil fuels.
2. There are no solutions to these global challenges.
3. Energy conservation and increased efficiency in the use of energy are the only ways out of the crises.
4. Access to sustainable and clean energy production can help to solve important social problems.
5. Global peace, alleviating poverty and growing our economics can be obtained only by implementing new sources of energy.
6. Many current developments in nanoscience have the potential to make a big impact on energy problems.

7. According to the text, Steven Chu, the Energy Secretary of the Basic Energy Science Advisory Committee has become the physics Nobel laureate.
8. Nanotechnology can make large-scale use of solar energy possible.
9. Nanotechnology will contribute to the further development of hydrogen storage and fuel cells.
10. New batteries for the efficient storage of cleanly generated energy will be unnecessary.

VOCABULARY AND GRAMMAR

3. Choose the correct item A, B, C or D.

1) The first chemical engineering course _____ at the University of Manchester in 1887 by George E. Davis in the form of twelve lectures covering various aspects of industrial chemical practice.
   a) gave
   b) was given
   c) was giving
   d) were given
2) If you _____ me, I will bring you the book.
   a) reminded
   b) will remind
   c) would remind
   d) remind
3) At Purdue University, which _____ as a land-grant university in 1874, the first chemical engineering course was offered in 1902.
   a) had been established
   b) established
   c) is established
   d) were established
4) The first BS in chemical engineering _____ to Benjamin M. Ferguson (a former Purdue quarterback!) in May 1909.
   a) had been awarded
   b) awarded
   c) was awarded
   d) would be awarded

5) Traces of impurities can give some differentiation between different manufacturers of _____ commodity and chemicals.
   a) thin
   b) fine
   c) light
   d) pure

6) She hates TV. She thinks television is a waste of time. If she _____ any television at all, it is usually a documentary or a news program.
   a) watches
   b) watch
   c) will watch
   d) would watch

7) Stop asking me what Amanda bought you for Christmas. Even if I _____ knew what she bought you, I _____ you.
   a) knew … would not tell
   b) had known … would not have told
   c) know ….. will not t ell
   d) had known … would not tell

8) We've done our job, ______?
   a) aren't we
   b) do we
   c) have we
   d) have not we

9) Commodity and fine chemical products might have _____ specifications as well as purity specifications.
   a) filthy
   b) unclean
   c) impurity
   d) dirty

10) _____ the nucleus of an atom?
   a) what do orbits
   b) what orbits does
   c) what does orbit
   d) what orbits

TRANSLATION

4. Translate the sentences from English into Russian:

1. In an aerobic bioreactor landfill, leachate is removed from the bottom layer, piped to liquids storage tanks, and re-circulated into the landfill in a controlled manner.
2. Air is injected into the waste mass, using vertical or horizontal wells, to promote aerobic activity and accelerate waste stabilization.
3. In an anaerobic bioreactor landfill, moisture is added to the waste mass in the form of re-circulated leachate and other sources to obtain optimal moisture levels.
4. Biodegradation occurs in the absence of oxygen (anaerobically) and produces landfill gas.
5. Landfill gas, primarily methane, can be captured to minimize greenhouse gas emissions and for energy projects.
6. The hybrid bioreactor landfill accelerates waste degradation by employing a sequential aerobic-anaerobic treatment.
7. Operation as a hybrid results in the earlier onset of methanogenesis compared to aerobic landfills.
8. The bioreactor accelerates the decomposition and stabilization of waste.
9. At a minimum, leachate is injected into the bioreactor to stimulate the natural biodegradation process.
10. Bioreactors often need other liquids such as stormwater, wastewater, and wastewater treatment plant sludges to supplement leachate to enhance the microbiological process.

WRITING

5. Write an annotation to the text:

Plant cells

Plants are a valuable source of chemical compounds such as pharmaceuticals, flavors, pigments, fragrances, and agrochemicals. These products, known as secondary metabolites, are usually produced in trace quantities in plants and have no obvious metabolic function. They serve as a chemical interface between the producing plants and their surrounding environment, such as adaptations to environmental stresses and chemical defenses against microorganisms. Despite substantial advances in synthetic organic chemistry, many secondary metabolic compounds are either too difficult or costly to synthesize (e.g., rose oil). Most plants that produce commercially useful substances are grown in tropical and subtropical regions of the world. As a result, the availability and costs of these materials depend on the political and economic circumstances of the countries involved. To produce secondary metabolic products from plants, exogenous plant tissue instead of a whole plant may be cultivated as a suspension culture in an aseptic condition. Such cultivation provides several advantages: 1) Plant cells can be cultivated where they are needed regardless of weather and geographical conditions. 2) The product quality and yields can be well controlled by eliminating problems encountered in the processing of botanicals. 3) Some metabolic products can be produced from suspension cultures in higher quantities than those observed in whole plants. It is a challenge to cultivate plant cells on a large scale and to maximize the production and accumulation of secondary metabolites. This can be accomplished by selecting proper genotypes and high-yielding cell clones, formulating suitable media to cultivate the cells, and designing and operating effective cell culture systems. Plant cells and microbial organisms are, however, so different that the culture conditions and reactor configuration generally need to be modified. Since plant cells are 10 to 100 times larger than bacterial and fungal cells, the metabolism of plant cells is slower than that of microbial cells by about one order of magnitude. Hence, only high value-added, low market-volume products are economically feasible to be produced from plant cell culture techniques. Potential products are 1) Food products: color, flavors, oils, sweeteners, and spices 2) Pharmaceuticals: alkaloids, steroids, shikonin, rosmarinic acid, 3) Agricultural chemicals Plant tissue cultures can be divided into two major types: unorganized growth cultures and organized growth cultures. Unorganized growth cultures lack any recognizable structure of the original plant. Callus cultures are amorphous cell aggregates arising from the unorganized growth of explants on an aseptic solid nutrient medium.

Suspension (or cell) cultures consist of cells and cell aggregates, growing dispersed in liquid medium. They are usually initiated by placing pieces of a friable callus culture in moving liquid medium. Suspension culture is generally preferred for mass propagation of plant cells because it can be maintained and manipulated similar to submerged microbial fermentation.

Organized growth cultures maintain their original organ structure such as root cultures and embryo cultures. Root cultures can be established from root tips taken from many plants. The “hairy root” clones that are produced can be cultivated to produce metabolites.

Embryo cultures may be established from embryos removed from sterilized seeds, ovules, or fruits. Embryo cultures can be employed for the rapid production of seedlings from seeds that have a protracted dormancy period.

Variant 4

READING

TEXT 1

1. Read the text and complete the statements (1–5) with the most suitable ending A, B, C or D.

Maintaining the risk assessment

The risk assessment must be maintained. This means that any significant change to a workplace, process or activity, or the introduction of any new process, activity or operation, should be subject to risk assessment. If new hazards come to light, then these should also be subject to risk assessment.

The risk assessment, furthermore, should be periodically reviewed and updated. This is best achieved by a suitable combination of safety inspection and monitoring techniques, which require corrective and/or additional action where the need is identified.

Typical monitoring systems include:

a) preventive maintenance inspections;
b) safety representative/committee inspections;
c) statutory and maintenance scheme inspections, tests and examinations;
d) safety tours and inspections;
e) occupational health surveys;
f) air monitoring; and safety audits.

Useful information on checking performance against control standards can also be obtained reactively from the following activities:

a) accident and ill-health investigation;
b) investigation of damage to plant, equipment and vehicles; and
c) investigation of 'near miss' situations.

1) Change that is NOT subjected to risk assessment is: _____.
a) change to a workplace
b) introduction of any new process, activity or operation
c) change to process or activity
d) change of a director

2) The risk assessment, furthermore, should be periodically _____.
a) checked and investigated
b) reviewed and updated
c) controlled and administrated

d) governed and overseen

3) Typical monitoring systems do NOT include:
a) safety tours
b) inspections
c) occupational health surveys
d) package tours

4) Accident and ill-health investigation are the sources of useful information for _____.
a) checking performance
b) control standards
c) safety audits
d) investigation of damage to plant

5) The text is about _____.
a) maintaining the risk assessment
b) monitoring systems
c) checking performance against control standards
d) investigation of damage to plant

TEXT 2

2. Read the text. Decide if the statements (1–10) are True (T) or False (F).

Solar Energy – Photovoltaics

Unlike other resources, solar energy is almost limitless. Several parts of Earth receive good solar radiation of about 600–800 watts/m2. An hour of solar radiation on Earth provides 14 terawatt-years of energy, almost the same as the world's total annual energy consumption and the resource presented by terrestrial insolation by far exceeds that of all other renewable energy sources combined.

Presently, solar collection contributes only a tiny amount (about 0.03 %) to the world's energy needs, but the annual growth of the solar cell market is impressive, at about 40 % per year, led in particular by Germany and Japan .

According to the radiation spectrum of the sun, there are two routes for solar energy conversion: solar photovoltaics, including emerging nanotechnological developments and solar thermal energy generation making, e.g., use of thermoelectric materials. Although the performance of solar power is impressive, its costs continue to be daunting: an average of $0.25 per kilowatt-hour versus $0.05–0.08 for various biomass-based fuels.

Worldwide growth of photovoltaics is extremely dynamic and varies strongly by country. By the end of 2014, cumulative photovoltaic capacity increased by more than 40 gigawatt (GW) and reached at least 178 GW, sufficient to supply 1 percent of the world's total electricity consumption of currently 18,400 TWh. As in the year before, the top installers of 2014 were China, followed by Japan and the United States, while the United Kingdom emerged as new European leader ahead of Germany and France. Germany remains for one more year the world's largest producer of solar power with an overall installed capacity of 38.2 GW. The newcomers of the year were Chile and South Africa, which entered straight into the world's Top 10 ranking of added capacity. There are now 20 countries around the world with a cumulative PV capacity of more than one gigawatt. Thailand, the Netherlands, and Switzerland, all crossed the one gigawatt-mark in 2014. The available solar PV capacity in Italy, Germany and Greece is now sufficient to supply between 7 % and 8 % of their respective domestic electricity consumption.

1. Unlike other resources, solar energy has no limits.
2. Not all parts of Earth receive good solar radiation.
3. An hour of solar radiation on Earth is enough for the world's total annual energy consumption.
4. Solar collection is widely used.
5. There are more than five ways of solar energy conversion:
6. Solar energy is very cheap.
7. There is a huge demand on solar energy.
8. Germany and Japan refused to use solar power.
9. There are now less than 20 countries around the world with a cumulative PV capacity of more than one gigawatt.
10. The available solar PV capacity in Italy, Germany and Greece is now sufficient to supply between 15 % and 20 % of their respective domestic electricity consumption.

VOCABULARY AND GRAMMAR

3. Choose the correct item A, B, C or D.

1) The chemical engineers introduce a general conceptual framework for thinking about chemical ______, delineated the general operations, very much like natural scientists do to natural phenomena.
   a) procedures
   b) processes
   c) prospects
   d) production

2) Oil and natural gas are naturally occurring _____.
   a) hydrocaotchouc
   b) hydrocarb
   c) sulfides
   d) hydrocarbons

3) Crude oil is also a mixture that usually occurs as a _____ .
   a) liquid
   b) tar
   c) asphalts
   d) vapor

4) Some chemicals require special disposal procedures, and cannot _____ the drain.
   a) be dumped down
   b) be drained
   c) dumped down
   d) dump down

5) When working with chemicals, chemical safety goggles, gloves, and a lab _____ should be the first pieces of equipment on your list.
   a) overwear
   b) suit
   c) dress
   d) coat

6) She doesn't like him, _____?
   a) is she
   b) doesn't she
   c) does she
   d) isn't she

7) He _____ so many accidents if he drove more carefully.
   a) hadn't
   b) wouldn't have
   c) hasn't
   d) won't have

8) If the weather is nice tomorrow, she _____ along the river to school.
   a) will walk
   b) walked
   c) would walk
   d) would walked

9) Nobody here speaks English. Too bad Gloria isn't here. If she _____ with us, she (can) act as our interpreter.
   a) is …. can act
   b) were …. could act
   c) had been … could have acted
   d) was … acted

10) They didn't start the meeting at two o'clock, _____?
   a) didn't they
   b) had not the
   c) did they
   d) weren't they

TRANSLATION

4. Translate the sentences from English into Russian:

1. A bioreactor is a vessel in which is carried out a chemical process which involves organisms or biochemically active substances derived from such organisms.
2. Bioreactors are commonly cylindrical, ranging in size from some liter to cube meters, and are often made of stainless steel.
3. Under optimum conditions the micro-organisms or cells will reproduce at an astounding rate.
4. The vessel's environmental conditions like gas (i.e., air, oxygen, nitrogen, carbon dioxide) flowrates, temperature, pH and dissolved oxygen levels, and agitation speed need to be closely monitored and controlled.
5. In the continuous flow, stirred tank reactor is fed into the bioreactor at a constant rate, and medium mixed with cells leaves the bioreactor at the same rate.
6. A fixed bioreactor volume is maintained and ideally, the effluent stream should have the same composition as the bioreactor contents.
7. The culture is fed with fresh medium containing one and sometimes two growth-limiting nutrients such as glucose.
8. The concentration of the cells in the bioreactor is controlled by the concentration of the growth-limiting nutrient.
9. A steady state cell concentration is reached where the cell density and substrate concentration are constant.
10. Oxygen is poorly soluble in water -and even less in fermentation broths- and is relatively scarce in air (20.8 %).

WRITING

5. Write an annotation to the text:

Animal cells

Animal cells are classified as eukaryotic cells, and they can be cultivated in nutritional medium outside the donor's body. Such cultured cells grow in number and size. Tissue culture methodologies are employed to study cancer cells and malignant tumors, to determine tissue compatibility in transplantation, and to study specific cells and their interactions.

The mammalian cell culture technique can be employed to produce human growth hormones, interferon, plasminogen activators, viral vaccines, interleukins, and monoclonal antibodies. Traditionally, these biochemicals had been produced using living animals. However, the quantity obtained from these methods is limited for clinical usage. Blood and lymph are rather atypical connective tissues with liquid matrices. Cells from blood or lymph fluids are suspension cells, or non-anchorage dependent when grown in culture. Most normal mammalian cells are anchorage dependent, that is, they require a surface for attachment and growth. The most widely used anchorage-dependent cell types are epithelial or fibroblast (broadly classified as connective) cells. Anchorage-dependent cells require a wettable surface such as glass or plastic Petri dishes and roller bottles. Bottles are laid on a slowly rotating roller in an incubator. A 1-liter bottle typically contains 100 mL of medium to facilitate cells both to grow on the wall and to be exposed to medium and gas. However, roller bottles are suitable only for small-scale laboratory use. The nutritional requirements of mammalian cells are more stringent than those of microorganisms since they do not metabolize inorganic nitrogen. Therefore, many amino acids and vitamins should be provided. Typical medium contains amino acids, vitamins, hormones, growth factors, mineral salts, and glucose. Furthermore, the medium needs to be supplemented with 2 % to 20 % (by volume) of mammalian blood serum. The serum provides components that have not yet been identified but are necessary for culture viability. The serum in the medium is not only expensive but also can be the source of virus or mycoplasma contamination. Since the chemical nature of serum is not well defined, its contents may vary batch after batch, which can affect cell growth. Many different proteins in serum often complicate the downstream separation processes. For these reasons, serum-free media have been formulated, which contain purified hormones and growth factors that can substitute for serum supplements.

GRAMMAR REFERENCES

PASSIVE VOICE

В английской грамматике существует такое понятие как залог. Он бывает либо *действительным* (активным), либо *страдательным* (пассивным). Если подлежащее само выполняет действие, мы относим его к категории действительного *залога*, например, «мама часто печет пироги». В данном предложении отчетливо видно, кто именно выполняет действие, поэтому мы переводим его в одном из времен действительного залога, в данном случае – в настоящем неопределенном времени – “mother often bakes cakes”.

Теперь рассмотрим другое предложение, например «мне часто звонят», или «мне подарили букет роз». В данном случае совершенно не ясно кто именно выполняет действие, т.е. звонит и дарит цветы. Не подлежащее выполняет действие, оно испытывает воздействие со стороны другого лица. В *страдательном залоге* внимание обращают на результат действия.

Времена *страдательного залога* (**Passive Voice**) образуются при помощи вспомогательного глагола **to be** (в соответствующей временной форме) и причастия прошедшего времени **Past Participle**:

is locked/is being locked и т.д.

Past Participle правильных глаголов образуется добавлением к инфинитиву окончания **-ed**: to invite – invit**ed**.

При добавлении к глаголу **-ed** иногда происходят изменения в его написании: to stop – stopp**ed**. Past Participle неправильных глаголов необходимо запомнить: **to tell – told – told**.

Таблица всех времен в страдательном залоге

	Present	**Past**	**Future**	**Future in the Past**
Simple (indefinite)	The ball **is taken** *every day*.	The ball **was taken** *yesterday*.	The ball **will be taken** *tomorrow*.	The ball **would be taken** *the next day*.
Continuous (Progressive)	The ball **is being taken** *now*.	The ball **was being taken** *at 7 o'clock yesterday*.	не используется	не используется
Perfect	The ball **has** *already* **been taken**.	The ball **had been taken** *by 7 o'clock yesterday*.	The ball **will have been taken** *by 7 o'clock tomorrow*.	The ball **would have been taken** *by 7 o'clock the next week*.
Perfect Continuous	не используется	не используется	не используется	не используется

При образовании вопросительной формы страдательного залога вспомогательный глагол ставится перед подлежащим:

Is the ball **taken**?

Would the ball **be taken**?

При образовании отрицательной формы страдательного залога частичка **not** ставится после вспомогательного глагола:

The ball **is not taken**. The ball **would not be taken**.

Сравните предложения в действительном и страдательном залоге и обратите внимание на то, что дополнение в глаголе-сказуемом в действительном залоге (the room) становится подлежащим в страдательном залоге.

Active Voice:	**Passive Voice**:
Someone **cleans** the room every day. Кто-то убирает комнату каждый день.	The room **is cleaned** every day. Комнату убирают каждый день.

Употребление страдательного залога (The Passive Voice)

1. Страдательный залог употребляется, когда в центре внимания говорящего находится лицо/предмет, который подвергается действию.

The key **has been stolen**. – Ключ украли.

2. Страдательный залог употребляется, если лицо/предмет, совершившее действие, неизвестно.

The shirts **have** just **been ironed**. – Рубашки только что погладили (неизвестно кто именно погладил рубашки).

3. Страдательный залог употребляется, если действующее лицо/предмет, не представляет интереса.

She **has been invited** to the restaurant. – Ее пригласили в ресторан. (нас не интересует, кто именно пригласил ее в ресторан, а интересует она сама).

4. Времена в страдательном залоге употребляются согласно тем же правилам, что и соответствующие времена действительного залога. Например, когда речь идет о действии, которое находится сейчас в развитии, употребляется форма Present Continuous.

The room **is being cleaned** at that moment. – Комнату в этот момент моют.

5. Если в страдательном обороте указывается *лицо*, совершающее действие, тогда употребляется предлог **by**, а если указывается *орудие/инструмент/средство/вещество*, совершающее действие, тогда употребляется предлог **with**.

I was hit **by my sister**. – Меня ударила моя сестра. (лицо)

I was hit **with a ball**. – Меня ударили мячом. (орудие)

6. В страдательном залоге **не употребляются**:

- непереходные глаголы (глаголы, которые не могут иметь прямого дополнения);
- глаголы-связки (*be – быть*, *become – становится*, *look – смотреть*, *feel – чувствовать* и т.д.);
- модальные глаголы (*can/could*, *may/might*, *will/would*, *shall/should*, *must*, *ought to*);
- некоторые переходные глаголы (*to fit – годиться*, *быть в пору*, *to have – иметь*, *to like – любить*, *to suit – годиться*, *подходить* и т.д.).

EXERCISES

1. Choose the correct item A, B, C or D.

1. The last time I was in the city center, the whole area ________.
   a) is renovated
   b) is being renovated
   c) was renovated
   d) was being renovated
2. According to the plan, the old buildings ________ next month.
   a) is going to be knocked down
   b) are going to be knocked down
   c) will be knocked down
   d) are knocked down
3. The painting you're looking at now is quite remarkable. It ________ 5 times!
   a) is stolen
   b) was stolen
   c) has been stolen
   d) has been being stolen

4. – Did you go to the party? – No, ________.
   a) I'm not invited
   b) I wasn't invited
   c) I wasn't being invited
   d) I haven't been invited
5. It's a huge international corporation. Thousands of people ________ there.
   a) were employed
   b) are employed
   c) are being employed
   d) have been employed
6. He ________ three months ago and has been unemployed ever since.
   a) had been fired
   b) has been fired
   c) was fired
   d) is fired
7. I had to spend the night in the airport because my flight ________.
   a) is delayed
   b) was delayed
   c) has been delayed
   d) had been delayed
8. The situation is serious. Something ________ before it's too late.
   a) must be done
   b) can't be done
   c) will be done
   d) has been done
9. Please, go away. I ________ alone.
   a) I'm left
   b) I shouldn't be left
   c) I want to be left
   d) I hate being left
10. There's somebody behind us. I think we ________.
   a) are followed
   b) are being followed
   c) were being followed
   d) have been followed

2. Read the situations and write sentences from the words in brackets.

Example: Dangerous driving causes a lot of accidents.
A lot of accidents _____by dangerous driving.
A lot of accidents ***are caused*** by dangerous driving

1. When we got to the stadium, we found out that they had cancelled the match. When we got to the stadium, we found out that the match _____.
2. They are building a new road around the city. A new road around the city _____.
3. His boss has finally promoted him. He ____ finally_____.
4. How do people learn languages? How languages_____?
5. You need to feed the cat twice a day. The cat _____ twice a day.
6. Nobody told me about the meeting. I _____ about the meeting.
7. We can’t solve the problem. The problem _____.
8. They aren’t going to broadcast Madonna’s concert. Madonna’s concert _____.
9. You must lock the doors at the end of the day. The doors ______at the end of the day.
10. Nobody’s cleaned the windows for several weeks. The windows _____for several weeks.

3. Make up questions in Passive Voice from the words given:

Example: by many tourists/been visited/the National park/has?
Has the National park been visited by many tourists?

1. In China/cars/made/are?
2. The ambulance/to hospital/her/has/taken?
3. In five minutes/can/the potatoes/roasted/be?
4. For the exam/the students/will/prepared/be?
5. Tea/when/served/be/will?
6. Lunch/being/is/today/provided?
7. Broadcasted/the videos/be/may?
8. To them/last week/were/given/laptops?
9. Closed/for repairs/has/the road/been?
10. Asked/by the teacher/was/he/yesterday?

4. Complete the gap by using a form from the list. Remember to use the passive form of the correct tense.

wash – pay – win – accept – rob – clean – not invaded – discover – deliver – teach

1. The bank ____________________ last night.
2. Credit cards ____________________ in this store .
3. This jumper should ____________________ by hand .
4. Your new car ____________________ tomorrow.
5. The first prize ____________________ by a man from Manchester.
6. Penicillin ____________________ by Alexander Fleming.
7. Britain ____________________ since the year 1066.
8. This account must ____________________ within 28 days.
9. The hotel rooms ____________________ every day.
10. Next week your class ____________________ by Mrs Grigson.

5. Put each verb in brackets into a suitable past verb form.

Example: The music at the neighbor's party was very loud and could ____ (to hear) from another side of the street.
The music at the neighbor's party was very loud and ***could be heard*** from another side of the street.

1. He doesn't mind driving, but he prefers to _____ (to drive) by other people.
2. The final decision _____ (to take/not) until the next meeting directors.
3. The injured woman couldn't walk and had to _____ (to carry).
4. That old building is really dangerous. It ought to _____ (to knock) down before it falls down itself.
5. Does he think that less money should _____ (to spend) on country arms?
6. Your luggage may _____ (to check) by a custom officer when you go through customs.
7. The policeman is looking for the missing girl/ she can't ____ (to find) anywhere.
8. The new book will certainly _____ (to translate) into many foreign languages.
9. She told the receptionist he wanted _____ (to wake) up at 7:30.
10. If someone kicks the policeman _____ he (to arrest).

TYPES OF QUESTIONS

В английском языке различают пять типов вопросов:

1. General questions – общий вопрос.
2. Special questions – специальный вопрос.
3. Questions to the subject – вопрос к подлежащему.
4. Tag questions – разделительный вопрос.
5. Alternative questions – альтернативный вопрос.

1. GENERAL QUESTIONS (or YES/NO QUESTIONS)

Общий вопрос ставится ко всему предложению и предполагает ответ «да» или «нет». Порядок слов в общем вопросе:

An auxiliary verb or a modal verb → subject → verb…?

Вспомогательный глагол (или модальный глагол)→подлежащее→смысловой глагол

Выбор вспомогательного глагола обусловлен грамматическим временем глагола.

Примеры вспомогательных глаголов:
am/is/are/was/were/do/does/did/have/has/had/shall/will.

Примеры модальных глаголов
can/could/may/might/must/should/ought.

1. Is he a student? – Yes, he is / No, he isn't.
2. Are they pilots? – Yes, they are / No, they aren't.
3. Was your brother in the cinema yesterday? – Yes, he was / No, he wasn't.
4. Does she know English well? – Yes, she does / No, she doesn't.
5. Do your cats eat a lot? – Yes, they do / No, they don't.

Check yourself

Put the words in the correct order.

1. buy / that / you / did / picture? – Yes, I did / No, I didn't.
2. the / arranged / has / he / yet / party? – Yes, he has / No, he hasn't.
3. number / Claire' s / got / phone / you / have? – Yes, I have / No, I haven't.
4. London / a / they / travelled / before / had / they / visited / lot? – Yes, they had / No, they hadn't.
5. you / me / to / the / show / way / the / will / underground? – Yes, I will / No, I won't.
6. swim / you / can? – Yes, I can / No, I can't.

7. that / you / see / could / ship? – Yes, I could / No, I couldn't.
8. forget / always / he / phone / does / numbers? – Yes, he does / No, he doesn't.
9. your / you / wallet / find / did? – Yes, I did / No, I didn't.
10. like / you / candies / do? – Yes, I do / No, I don't.

2. SPECIAL QUESTIONS (or WH - QUESTIONS)

Специальный вопрос ставится к определенному члену предложения и его задача выяснить определенную информацию. Специальный вопрос требует развернутого, полного ответа. Порядок слов в специальном вопросе:

Wh → an auxiliary verb or a modal verb → subject → verb…?

Вопросительное слово → вспомогательный (или модальный) глагол → подлежащее → смысловой глагол

Вопросительные слова:

Interrogative words	Translation
What…?	Что, какой…?
Where…?	Где, куда…?
When…?	Когда…?
Why…?	Почему, зачем…?
Who…?	Кто…?
Which…?	Который…?
Whose…?	Чей …?
Whom…?	Кого, кому…?
How…?	Как …?

Interrogative combinations	Translation
What kind…?	Какой…?
What time…?	Во сколько …?
How many…?	Сколько…? (с исчисляемыми существительными)
How much…?	Сколько…? (с неисчисляемыми существительными)
How long…?	Как долго…?
How often…?	Как часто…?
How far…?	Как далеко…?
How old…?	Сколько лет…?

Examples of special questions:

1. Where does that lady keep her jewellery?
2. What should you do if you are lost?
3. How is Kevin?
4. When were you born?
5. Whose book is this?

Check yourself

Put the words in the correct order.

1. subject / you / what / do / like?
2. far / the / from / how / you / university / live / do?
3. English / long / been / have / studying / you / how?
4. my / where / key / is?
5. often / how / can / your / you / visit / grandparents?
6. on / does / Jane / what / do / Sundays?
7. are / desk / why / you / at / sitting / my?
8. car / did / he / your / borrow / when?
9. they/ how / bought / pictures / many / have?
10. to / will / how / it / long / you / get / take / there?

3. QUESTIONS TO THE SUBJECT

Вопрос к подлежащему требует отдельного тщательного рассмотрения. В отличие от специального вопроса в вопросе к подлежащему НЕТ вспомогательного глагола. Чтобы образовать вопрос к подлежащему, нужно просто заменить подлежащее на вопросительное слово «Кто?» или «Что?».

Порядок слов в вопросе к подлежащему:

Wh → verb → other parts of the sentence?

Вопросительное слово → сказуемое → другие члены предложения

Следует различать вопрос к подлежащему и специальные вопросы, начинающиеся со слов “What” или “Who”.

Examples of questions to the subject:

1. What happened to you?
2. Who went to the zoo?

Compare with those of special questions:

1. Who are you seeing now?
2. What are you doing?

Check yourself

Put the words in the correct order.

1. Who / about / you / it / ? / told /
2. ? / called / Who / yesterday / her /
3. tell / about / Who / ? him / can / her /
4. yet / hasn't / book / read / this / Who / ? /
5. ? / has / to / What / happened / you /
6. this / is / responsible / who / for/ ?
7. at / you / are / what / looking/ ?
8. will / answer / you / tomorrow / who/ ?
9. today / is / duty / on / who?
10. you / do / think / what / about / him?

4. TAG QUESTIONS (or DISJUNCTIVE QUESTIONS)

Разделительный вопрос состоит из двух частей: первая часть это утверждение или отрицание, а вторая часть – это краткий вопрос, либо утвердительный, либо отрицательный. Вторая часть вопроса отделяется запятой. Данный тип вопросов очень распространен в разговорной английской речи: не спрашивая напрямую, собеседника побуждают к ответу. Вторая часть вопроса обычно переводится на русский язык “не так ли”, “не правда ли”, “да”, “правильно”.

Examples of tag questions:

1. He looks after his sister, doesn't he?
2. A girl fell into the river, didn't she?
3. The guests will come tomorrow, won't they?
4. An army officer must wear a uniform, mustn't he?
5. The secretary has been typing the letters for two hours, hasn't she?

Обратите внимание, что во второй части вопроса повторяется тот вспомогательный (или модальный) глагол, что был использован в первой части вопроса. Если первая часть вопроса – утверждение, то вторая часть будет отрицанием, и наоборот.

Check yourself

Choose the correct letter.

1. The children are happy, …?
   a) aren't they b) don't they c) are they
2. She is your best friend, ... ?
   a) isn't she b) won't she c) doesn't she
3. There are many plates in the cupboard, …?
   a) isn't it b) aren't there c) are there
4. They could read the notice, …?
   a) could they b) couldn't they c) can't they
5. Open the book at page 20, …?
   a) will you b) wasn't he c) didn't you
6. Each parent worries about their children, …?
   a) don't they b) doesn't he c) isn't he
7. She hasn't put an advertisement in a paper, …?
   a) hasn't she b) does she c) has she
8. Many people don't know about this new shop, …?
   a) don't they b) do they c) are they
9. Nobody will come to the beach tomorrow, …?
   a) won't they b) will they c) will he
10. He never wakes up before 10 0'clock, …?
   a) does he b) doesn't c) isn't he

5. ALTERNATIVE QUESTIONS

Альтернативный вопрос предполагает выбор между двумя предметами и т.п. Этот вопрос можно поставить к любому члену предложения. Вопрос состоит из двух частей: первая часть – это общий вопрос, а вторая часть – это союз «или» ("or") и слово-альтернатива.

Examples of alternative questions:

1. Do you live in Tomsk *or Moscow*?
2. Is she a student *or a school girl*?
3. Did you wake up at 6 *or at 7 o'clock*?

Check yourself

Identify the type of questions. Choose the correct letter (A–E).

1. Does she like to ride a bicycle in the evening?
   a) a general question
   b) a special question
   c) a question to the subject
   d) a tag question
   e) an alternative question
2. Who can help us to wash the car?
   a) a general question
   b) a special question
   c) a question to the subject
   d) a tag question
   e) an alternative question
3. This sportsman is very fast, isn't he?
   a) a general question
   b) a special question
   c) a question to the subject
   d) a tag question
   e) an alternative question
4. Do they speak English or German?
   a) a general question
   b) a special question
   c) a question to the subject
   d) a tag question
   e) an alternative question
5. Who are we waiting for?
   a) a general question
   b) a special question
   c) a question to the subject
   d) a tag question
   e) an alternative question
6. Why are you late?
   a) a general question
   b) a special question
   c) a question to the subject
   d) a tag question
   e) an alternative question

7. That house is under construction, isn't it?
   a) a general question
   b) a special question
   c) a question to the subject
   d) a tag question
   e) an alternative question
8. What was the weather like all the time?
   a) a general question
   b) a special question
   c) a question to the subject
   d) a tag question
   e) an alternative question
9. Who doesn't understand the rule?
   a) a general question
   b) a special question
   c) a question to the subject
   d) a tag question
   e) an alternative question
10. Who will meet the foreign delegation?
   a) a general question
   b) a special question
   c) a question to the subject
   d) a tag question
   e) an alternative question

CONDITIONALS

Условные предложения – это предложения, где придаточное предложение начинается со слова «если» (if).

Существует четыре типа условных предложений: **Type 0, Type 1, Type 2 and Type 3.**

Условное предложение **Type 0** используется для выражения общеизвестной истины или научного факта. Союз «*if*» *можно заменить на* «*when*».

If temperature is zero, water freezes. – Если температура равна нулю, вода замерзает. (100 % истина)

Условное предложение Type 1 (real present) употребляется для выражения реального или очень возможного действия (ситуации) в настоящем или будущем. If обозначает возможность того, что что-то произойдет. When употребляется, если действие наверняка, обязательно случится.

If he calls, *I'll tell him the news.* (*but he might not call*)

When he calls, *I'll tell him the news.* (*he will definitely call*)

Type 2 Conditionals (unreal present) требуются, если мы говорим о воображаемой, нереальной ситуации которая относится к настоящему или будущему времени. В придаточных предложениях у глагола be для всех лиц и чисел используется форма ***were***.

If I were you, I would drive more carefully in the rain. – Если бы я был на твоем месте, я бы вел машину аккуратнее во время дождя. (но я не на твоем месте).

Условное предложение Type 3 Conditionals (unreal present) употребляется при обозначении нереального, воображаемого действия в прошлом. Часто предложения такого типа выражают сожаление или критику.

В условных предложениях союз **if** можно заменить словами ***unless*** **(*=if not*)** (Type 1 conditionals), ***providing/provided that*****,** ***so/as long as*****,** ***suppose/supposing*****,** ***on condition that*****,** etc.

TYPES OF CONDITIONALS

Type	If-clause	Main clause
0	**If + Present simple**	**Present simple**
	If *the sun* ***shines****,*	*snow* ***melts****.*
1	**If + Present simple** **Present continuous** **Present perfect** **Present perfect continuous**	**Future** **Imperative** **Modals** **Bare infinitive**
	If *he* ***doesn't pay*** *the fine,* ***If*** *you* ***need help****,* ***If*** *you* ***have finished*** *your work,*	*he* ***will go*** *to prison.* ***come*** *and* ***see*** *me.* *we* ***can have*** *a break.*
2	**If + Past simple or Past Continuous**	**would/could/might + bare infinitive**
	If *I* ***had*** *time,* *(but I don't have time-untrue in the present)* ***If*** *I* ***were*** *you,*	*I* ***would take up*** *a sport.* *I* ***would talk*** *to your parents about it. (giving advice)*
3	**If + Past perfect or Past perfect continuous**	**would/could/might + have + past participle**
	If *she* ***had studied*** *harder,* ***If*** *he* ***hadn't been acting*** *so foolishly,*	*she* ***would have passed*** *the test.* *he* ***wouldn't have been punished***

EXERCISES

1. Use Zero and First Conditional Clauses to complete the sentences.

1. If he _____ (have) got a temperature, _____ (call) the doctor.
2. _____ (take) your umbrella if it _____ (rain).
3. If you _____ (heat) water to 100 ºC, it _____ (boil).
4. _____ (take) a taxi if you _____ (be) in a hurry.
5. If it _____ (be) too late when you get home, _____ (not/wake) me up.
6. If you _____ (put) butter near the fire, it _____ (melt).
7. If you _____ (set) high temperature to the oven, the cake _____ (burn).
8. _____ (not believe) him if he _____ (start) telling his tales again.
9. If Mum ____ (ask), _____always (tell) her the truth.
10. You _____ (fail) you exam if you _____ (be late) with your assignment.

2. Circle the correct answer.

1. If she would live / lived in London, I wouldn't see her very often.
2. If you ate / eat more vegetables, your skin would look better.
3. Will / Would they play with us if we asked them?
4. He wouldn't read / didn't read that book if he didn't have to.
5. If they went to the theatre, will / would they invite you?
6. If she knew / knows how to drive, she would buy a car.
7. If I wouldn't call / didn't call, Mum would be very worried.
8. If we had / would have more pocket money, we'd go to the cinema.
9. He won't be / wouldn't be such a good athlete if he didn't train so hard.
10. If he wouldn't be / weren't so rude, people would like him.

3. Rewrite the sentences. Use the Second Conditional.

1. I haven't got any money, so I won't buy that CD.
2. Pigs haven't got wings, so they don't fly.
3. His marks aren't good because he doesn't work hard.
4. I'm busy, so I won't come with you.
5. They don't know her, so they won't invite her to their party.
6. I won't call him because I haven't got his phone number.
7. She walks to school because she hasn't got a bike.
8. It's cold, so we won't go to the beach.
9. I won't join you because I have to stay at home.
10. He won't lend you his camera because he needs it.

4. Read and write Third Conditional sentences.

Example: Helen forgot to make an appointment at the hairdresser's. She cut her hair herself. She looked awful at the party.

If she hadn't forgotten to make an appointment at the hairdresser's, she wouldn't have cut her hair herself. If she hadn't cut her hair herself, she wouldn't have looked awful at the party.

1. Peter ate three bars of chocolate. He had a terrible stomach ache. He couldn't go to the cinema with Stanley and Leslie.
2. Mary sat in the sun too long. She was red and sore. She didn't enjoy herself at the barbecue that evening.
3. Pauline watched TV until three o'clock in the morning! She was late for the school bus. She missed the school excursion.
4. Mr Davis tried to lift a heavy suitcase. He hurt his back. He couldn't play golf.

5. You dropped the vase because you weren't careful.
6. He didn't pass the exam because he was nervous.
7. We didn't go to the beach because it rained.
8. I had a good time because you were there with me.
9. They didn't get a taxi because they didn't have enough money.
10. We were late because our car broke down.

5. Complete the sentences and decide which type of Conditional Sentence it is.

Example: *If I __had___ (have) lots of money, I would sail round the world.* ***2***

1. If my sister _____ (see) this puppy, she will love it. ____
2. If I ___ (pack) the suitcases myself, I wouldn't have left my swimsuit. ___
3. We _____ (can/sit) in the garden if the weather were nicer. ____
4. _____ (Fred/be) bored if you had taken him to the opera? ____
5. I _____ (wait) for you outside the cinema if I arrive early. ____
6. Val and Cherie would move if they _____ (can/find) a better house. ____
7. I ____ (tell) him my name if he had asked. ____
8. If the children want to go to the zoo, _____ (Dad/take) them? ____
9. If the job _____ (be) interesting, would you work for this company? ____
10. They wouldn't have believed him if he ______ (tell) them the truth. ____

GLOSSARY

Unit 1

branch of engineering	отрасль технических наук
to deal with	иметь дело с
convert	превращать, преобразовывать
raw materials	сырье
valuable	ценный
fuel cells	топливные элементы
applied chemistry	прикладная химия
to solve problems	решать проблемы
mastery	мастерство
to invent smth	изобретать что-либо
cost effective	бюджетный, малозатратный
environmentally friendly	безвредный для окружающей среды
efficient	эффективный
polymer	полимер
fertilizer	удобрение

Unit 2

variety	разнообразие
manufacturing process	технология производства
sophisticated products	сложные изделия
heavy chemicals	продукты основной химической промышленности
fine chemicals	химические продукты тонкого органического синтеза
dyes	красители
drugs	лекарственное сырье
to be consumed	быть потребляемым
high-tech, high-value products	высокотехнологичный дорогостоящий продукт
scientific research	научное исследование
novel marketing techniques	новые методы сбыта продукции
to scale up	увеличивать, расширять
to be absorbed in	быть поглощенным чем-либо
profit margin	общая рентабельность
technical capacity	технические возможности

Unit 3

exemption	послабление, льгота
downstream	перерабатывающий сектор
discharge	сброс, слив
waiver	разрешенное отступление
deleterious impact	отрицательное влияние
designated use (DU) zones	зоны целевого использования вод
contiguous region	смежный регион
underperformance	снижение качества, недовыполнение
sewer	канализационный коллектор, сток
dispersion	рассеивание, разброс
pertain	подходить, относиться
watershed	водосборный, гидрографический бассейн
nonpoint source pollution	рассредоточенный источник загрязнения
wetland protection	защита заболоченных участков
replacement strategy	стратегия замещения

Unit 4

recombinant DNA technology	рекомбинантная ДНК технология
industrial microbiology	промышленная микробиология
novel techniques	новейшие технологии
fermented beverage	напиток полученный при брожении
high yield	высокопродуктивный
large-scale process	крупномасштабный процесс
to be equipped with	быть оснащенным
hazard	опасность
baffle	разделитель
air sparger	воздухораспределитель
to multiply exponentially	увеличиваться в разы
to reach a maximum	достигнуть максимума
biological catalyst	биологический катализатор, фермент
product recovery	извлечение продукта
purification	очистка

Appendix 1

Keys to Grammar exercises

GENERAL QUESTIONS (or YES/NO QUESTIONS)

1. Did you buy that picture? – Yes, I did / No, I didn't.
2. Has he arranged the party yet? – Yes, he has / No, he hasn't.
3. Have you got Claire's phone number? – Yes, I have / No, I haven't.
4. Had they travelled a lot before they visited London? – Yes, they had / No, they hadn't.
5. Will you show me the way to the underground? – Yes, I will / No, I won't.
6. Can you swim? – Yes, I can / No, I can't.
7. Could you see that ship? – Yes, I could / No, I couldn't.
8. Does he always forget phone numbers? – Yes, he does / No, he doesn't.
9. Did you find your wallet? – Yes, I did / No, I didn't.
10. Do you like candies? – Yes, I do / No, I don't.

SPECIAL questions (OR Wh-questions)

1. What subject do you like?
2. How far from the university do you live?
3. How long have you been studying English?
4. How old is your little sister?
5. How often can you visit your grandparents?
6. What does Jane do on Sundays?
7. Why are you sitting at my desk?
8. When did he borrow your car?
9. How many pictures have they bought?
10. How long will it take you to get there?

QUESTIONS TO SUBJECT

1. Who told you about it?
2. Who called her yesterday?
3. Who can tell him about her? Who can tell her about him?
4. Who hasn't read this book yet?
5. What has happened to you?
6. Who is responsible for this?
7. What are you looking at?
8. Who will you answer tomorrow?
9. Who is on duty today?
10. What do you think about him?

TAG QUESTIONS (or disjunctive questions)

1) a; 2) a; 3) b; 4) b; 5) a; 6) b; 7) c; 8) b; 9) b; 10) a.

ALTERNATIVE QUESTIONS

1) a; 2) c; 3) d; 4) e; 5) b; 6) b; 7) d; 8) b; 9) c; 10) c.

CONDITIONALS

Ex. 1
1) has got, call.
2) take, rains.
3) heat, boils.
4) take, are.
5) is, do not wake.
6) put, melts.
7) set, burns.
8) do not believe, starts
9) asks, tell.
10) fail, are late.

Ex. 2
1. If she would live / lived in London, I wouldn't see her very often.
2. If you ate / eat more vegetables, your skin would look better.
3. Will / Would they play with us if we asked them?
4. He wouldn't read / didn't read that book if he didn't have to.
5. If they went to the theatre, will / would they invite you?
6. If she knew / knows how to drive, she would buy a car.
7. If I wouldn't call / didn't call, Mum would be very worried.
8. If we had / would have more pocket money, we'd go to the cinema.
9. He won't be / wouldn't be such a good athlete if he didn't train so hard.
10. If he wouldn't be / weren't so rude, people would like him.

Ex. 3
1. If I had some money I would buy that CD.
2. If pigs had wings they would fly.
3. If he worked hard he would have better marks.
4. If I had free time I would go with you.
5. If they knew her they would invite her to their party.
6. If I had his phone number I would call him.
7. if she had a bike she would not walk to school.

8. if it were not cold e would go to the beach.
9. If I did not have to stay at home I would join you.
10. If he did not need his camera he would lend it to you.

Ex. 4

1. If Peter had not eaten three bars of chocolate he would have go to the cinema with Stanley and Leslie.
2. If Mary had not sat in the sun too long she would have enjoyed herself at the barbecue that evening.
3. If Pauline had not watched TV until three o'clock in the morning she would not have missed the school excursion.
4. If Mr Davis had not tried to lift a heavy suitcase he could have played golf.
5. You would not have dropped the vase if you had been more careful.
6. If he had been so nervous he would have passed his exam.
7. If it had not rained we would have gone to the beach.
8. If you had not been there with me I would not have had a good time.
9. If they had had some money they would have got a taxi.
10. We would not have been late if our car had not broken down.

Ex. 5

1) sees, 1.
2) had packed, 3.
3) could sit, 2.
4) Would Fred have been bored, 3.
5) will wait, 1.
6) could find 2.
7) would have told, 3.
8) will Dad take, 1.
9) were, 2.
10) had told, 3.

Appendix 2

Abstract writing

Рекомендации по написанию аннотации английского текста

Рекомендуемый объем аннотации – 150–200 слов.

Аннотация к тексту включает только самые основные положения и выводы, которые даются в сжатой форме.

Аннотация выполняет следующие функции:

– позволяет определить основное содержание текста (или статьи), его релевантность и решить, следует ли обращаться к полному тексту;

– предоставляет информацию о тексте (статье) и устраняет необходимость чтения его полного текста в случае, если он представляет для читателя второстепенный интерес;

В аннотации не должны повторяться предложения из текста (нельзя брать предложения из текста и переносить их в аннотацию), а также ее название.

В аннотации должны излагаться существенные факты, приведенные в тексте, и не должен содержаться материал, который отсутствует в самом тексте.

В тексте аннотации следует избегать слишком длинных предложений, а также сложных грамматических конструкций. Он должен быть лаконичен и четок.

Аннотация (abstract) состоит из:

1. Вводная часть – главная идея текста и основная информация (Кто? Что? Где? Когда?).
2. Основная часть – перечень затронутых в тексте проблем.
3. Заключительная часть, в которой пишущий высказывает свое мнение.

При написании аннотации следует использовать клишированные вводные слова:

Вводная часть:
The text deals with …
As the title implies the text describes …
The text is concerned with…

Основная часть
It is known that …
It should be noted about/that …

It is spoken in detail about…
It is reported that …
The text gives valuable information on/about…
Much attention is given to…
It is shown that…
The main idea of the text is…
It gives a detailed analysis of…
It draws our attention to…
It is stressed that…

Заключение: оценка:
The following conclusions are drawn…
The text gives valuable information about…
рекомендация:
The main idea of the text is …
The text is of great help to …
The text is of interest to …

Пример составления аннотации:
Subwavelength Plasmonic Waveguides and Plasmonic Materials

This text is concerned with surface plasmon based photonics materials to show possibility of creation such plasmonic device as plasmonic waveguide with new properties.

It should be noted that such process is still kind of obscure and requires precise investigation and research. **It is spoken in detail about** formation of plasmon-polariton metal surface as a result of extreme light irradiation and transmission through these layers. **It is shown that** free-electron model could be used for describing plasmon system inside the glass and light distribution through the plasmonic waveguide made of metal nanolayers.

The main idea of the text is to study surface plasmons and show opportunity to fabricate standalone devices to plasmonics, assisted by advanced simulation and fabrication tools, emphasizes the integration of plasmonic features into subsystems for all sorts of optical communications and information exchange.

This text is of great help to researchers involved into waveguide technologies and plasmonic waveguides devices formation.

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