АНГЛИЙСКИЙ ЯЗЫК
для студентов технических вузов
Основной курс

Допущено Министерством образования
Республики Беларусь
в качестве учебного пособия
для студентов технических специальностей
высших учебных заведений

Под общей редакцией
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Представляет собой базовое учебное пособие для студентов технических вузов. Содержит 13 учебных разделов, материал для повторения, грамматический справочник, активный лексический словарь, материал для дополнительного чтения и перевода, приложение. Каждый раздел включает упражнения для формирования языковых навыков, по обучению чтению и говорению, для активизации речи и по обучению письменной речи. Текстовой материал заимствован из зарубежных источников.

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ПРЕДИСЛОВИЕ

Учебное пособие предназначено для студентов технических специальностей вузов и направлено на развитие языковых и коммуникативных навыков в сферах социально обусловленного и профессионально-ориентированного общения.

Пособие рассчитано на 136 часов учебного времени. Его структуру составляют 13 учебных разделов (Units), материал для повторения (Check Your Progress), представленный после 7, 13 разделов, активный лексический словарь (Active Vocabulary), грамматический справочник (Grammar), материал для дополнительного чтения и перевода (Supplementary Reading) и приложения (Most Frequently Used Abbreviations, Units of Measurement, Conjunctions, Spelling, Word Formation, Most Frequently Used Prepositions, Conjunctions and Adverbs, List of Irregular Verbs).

Каждый раздел (кроме первого) состоит из 2 частей (Sections), каждая включает введение в тему (Lead-in); упражнения, предназначенные для формирования языковых навыков (Language Practice), задания для обучения чтению и говорению (Reading and Speaking), для активизации речи (Activity) и для обучения письменной речи (Writing).

Раздел Further Reading включает два текста для чтения, что позволяет обеспечить индивидуальный и дифференцированный подход к обучению английскому языку в техническом вузе.

Текстовой материал заимствован из зарубежных источников и его тематика определена программой подготовки специалистов технического профиля.

Комплекс заданий основан на функционально-коммуникативном подходе, предполагает взаимосвязанное обучение всем видам речевой деятельности, реализует определенные коммуникативные задачи в ситуациях социально обусловленного и профессионально-ориентированного общения и направлен на формирование коммуникативно-компетентной личности инженера.

Раздел Supplementary Reading с комплексом заданий на предтекстовом и послетекстовом уровнях способствует активизации речемыслительной деятельности студентов и развитию стабильных коммуникативных умений в профессионально ориентированных сферах общения.

Раздел Grammar содержит краткие сведения о грамматическом материале, включенном в учебные тематические циклы, который активизируется комплексом упражнений, представлен в конце книги к каждому учебному разделу.

Учебное пособие может быть рекомендовано для самостоятельного изучения языка.

Авторы выражают искреннюю благодарность рецензентам:

доценту кафедры методики преподавания иностранных языков Минского государственного лингвистического университета кандидату педагогических наук А.П. Пониматко за ценные советы и замечания, которые были учтены при доработке рукописи;

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Авторы

An Engineering Student

Lead-in

I. List the main branches of engineering. Compare your list with that of your groupmates.

II. You are a student at University now. Listen to the dialogues you can hear at University during your first days of studying and learn how to introduce yourself.

A

Teacher: Good morning! Let me **introduce** myself. I am your English teacher. I am here to help you with English. What are you? **What do you do?** Why are you here?
Class: We are students.
Teacher: Are you **first-year students**? Are you **freshmen**?
Class: Yes, we are.
Teacher: Will you introduce yourselves? **Who are you**?
Student: I am Andrew Kolosov. I am here to study English.
Teacher: What is your name?
Student: My name is Kate Gomonova. I am a first-year student. I am here to master my English, too.
Teacher: Thank you. I am glad to meet you.
Students: We are glad to meet you, too.

B

Teacher: Allow me to introduce your supervisor.
Supervisor: How do you do?
Students: How do you do?
Supervisor: You **are eager** to study at our **Technical University** and become good specialists, aren't you?

Students: Yes, of course, we are.
Supervisor: You are lucky to study at our University. I wish you success.
Students: Thank you very much.

C

Teacher: *(in whisper)* Oh, I'm sorry, who is this student?
Monitor: This is Oleg Smirnov.
Teacher: I see. He is 18 years old, isn't he?
Monitor: Yes, he is.
Teacher: Is he from Moscow?
Monitor: No, he isn't. He is **Belarusian**. He is from Grodno, from the Republic of Belarus.
Teacher: OK. Thanks a lot.

D

Oleg: Hello, Kate. How are you?
Kate: Very well, thank you. And how are you?
Oleg: Quite well, thanks. Kate, this is Mike. He is my friend here at University and he was my friend at school.
Kate: Hello, nice to meet you.
Mike: Hi, I'm glad to meet you, too.

III. That's how we greet and introduce each other in English. Study this table.

Good { morning. / afternoon. / evening.	Good { morning. / afternoon. / evening.
Hello.	Hello.
How do you do?	How do you do?
How are you?	I'm fine, thank you.
How are you doing?	I'm OK, thanks.
How are you getting on?	Not bad.
How are things?	Quite well.
Is everything fine?	Excellent, thanks.
Let me introduce myself.	Nice to meet you.
My name is ...	Pleased to meet you.
This is Mr., Mrs., Miss ...	I am ...
	Glad to meet you.

Language Practice

I. Imagine Kate and Mike or other students of the group are talking. Put in *is / am / are* and reproduce the dialogues.

a) *Kate:* Excuse me, are you Paul?
Michael: No, I ... . My name ... Michael.
Kate: Well, Mike, are you tired after your first day at University?
Michael: No, I ..., really. I ... eager to study here.
Kate: Me too. They say the Technical University ... a very exciting University to attend.

b) *Andrew:* I ... Andrew Kovalev. I ... fond of computers. And you?
Alice: I ... Alice. I ... fond of programming as well. And besides, I ... interested in graffiti arts.
Andrew: What is it?

c) *Ann:* Alexey, you ... good at drawing.
Alexey: Really? I ... glad to hear it.

II. Correct mistakes in the passage.

Hello! We am first-year students of the Technical University. Our names is Oleg, Mike and Kate. We is eager to know what it am like to be an American student. We is from Minsk. Minsk am the capital of Belarus. Minsk are about 750 kilometres far from Moscow. The transportation system in Minsk are rather complicated.

The average temperature in Belarus in winter months are about -10°C (14°F) and about +20°C (68°F) in summer months.

III. Study the following expressions in the frame and fill in the gaps.

> to be afraid *of*, to be good/bad ***at***, to be tired *of*,
> to be busy ***with***, to be surprised ***at***, to be impressed ***by***,
> to be bored ***with***, to be fed up ***with***, to be interested ***in***,
> to be fond *of*, to be crazy ***about***, to be proud *of*

1. Tom is impressed ... the design of this tower. 2. They are fond ... geography. 3. I'm fed up ... this task. 4. We are busy ... our home task. 5. He isn't interested ... physics. 6. Our classmates are crazy ... programming.

IV. Make up sentences using the Word Order Rule. Consult Grammar Section.

1. freshmen University at are we.

2. are students technical we.
3. fond of music am I.
4. is interested in he engineering.
5. good at are they programming.
6. never tired of we studying are.

V. Study the names of different professions.

1. He is a student of computer engineering. So he is a **programmer**. 2. He is a student of processing engineering. So he is a **technologist**. 3. He is a student of metrology. So he is a **metrologist**. 4. He is a student of economics. So he is an **economist**. 5. He is a student of construction engineering. So he is a **builder**. 6. He is a student of mechanical engineering. So he is a **mechanical engineer**.

VI. Name the specialists who work in these areas.

physics	– ______	mathematics	– ______
ecology	– ______	metrology	– ______
technology	– ______	programming	– ______
economy	– ______	architecture	– ______

VII. You are probably familiar with the following jobs: *physician, physicist, accountant,* etc. Which description fits which job?

1. physician	a) a student or expert in physics
2. physicist	b) a person whose profession is to keep and examine business accounts
3. accountant	c) a specialist in scientific and industrial fields
4. technician	d) a doctor of medicine or surgery
5. technologist	e) a skilled workman, especially who repairs

VIII. Match the expressions from the columns to form pairs of synonyms. Use the dictionary if necessary.

excellent	a second-year student
a sophomore	terrible
to be interested in	attractive
horrible	a first-year student
beautiful	to be fond of
I'm great	I'm fine
a freshman	brilliant

IX. Fill in the blanks with the following:

a) many, much, a lot of

1. Measure as ... objects as possible. 2. Add ... acid to the mixture. 3. Pour ... liquid into the beaker. 4. Are there ... instruments in the box? 5. There are not ... nuts on the shelf.

b) few, a few, little, a little

1. They have too... time for experiment. 2. There is ... fuel in the tank. We need some more. 3. There are only ... nails on the worktable. 4. There is ... cement in the sack. That is enough. 5. There are ... spare tyres in my garage.

X. Find and correct mistakes in the following sentences.

1. – How are you do? - Quite well, thank you. 2. Let me to introduce myself. My name's Alex Frolov. 3. He is fond in computers. 4. My best friend isn't interested at graffiti arts. 5. He's crazy of programming. 6. I'm really well at Chemistry. 7. Mark is a student of technology. He's a technician. 8. My mother's friend is a doctor. She is a physicist. 9. Who is this man? – He's an engineer. 10. Are these objects have different shapes? 11. How width is the block? 12. The screw is the shortest than the nail. 13. How many motor vehicles there are with mixed fuel engines? 14. Are there some motorcycles with gas engines?

XI. Translate the following sentences into English.

1. Позвольте представиться. Я – мистер Гейтс, ваш преподаватель английского языка.

2. Мы – студенты технического университета.

3. Он – студент первого курса и очень увлекается компьютерами.

4. Он учится на 3-м курсе.

5. – Как вы поживаете? – Спасибо, хорошо.

6. – Откуда Джон? – Джон из Лондона, он англичанин.

7. – Олег, это мой хороший друг Павел. – Добрый день. – Добрый день.

8. – Кто это? – Это Ганс Шмидт. – Кто он? – Он – студент-первокурсник электротехнического факультета. – Кто он по национальности? – Он немец.

9. – Олег из Минска, он белорус.

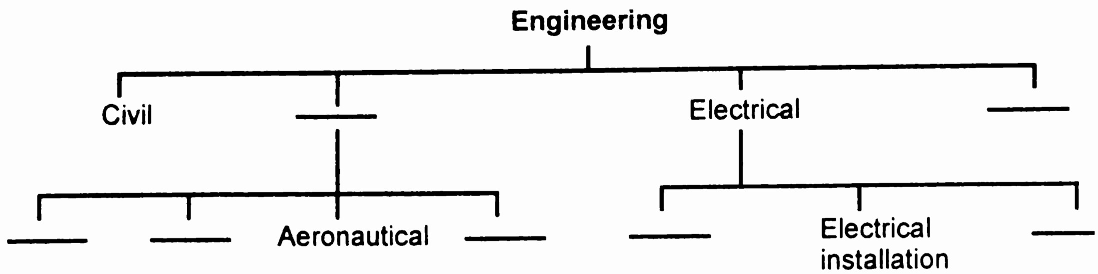
10. Чем занимается твой друг? – Он механик и студент машиностроительного факультета. Он хорошо разбирается в физике.

11. Он женат или холост?

12. Сколько ему лет?

Reading and Speaking

I. a) Fill in the blanks in this diagram with the branches of engineering that you know.



b) Read this text for additional information and complete the diagram.

Engineering is a very practical activity. It is the process of applying the latest achievements of science and technology into practice.

There are a lot of branches in engineering. Mechanical engineers are experts in the design and manufacture of tools and machines. Mechanical engineering has marine, automobile, aeronautical, heating and ventilating branches.

Electrical engineering is about producing and applying electricity in various fields of national economy. It has the following branches: electrical installation, electrical generation, lighting, etc.

Components and equipment for computing and communicating are the product of electronic engineering and bridges, roads and airports are the object of civil engineering.

c) Match each branch of engineering with its products.

1. civil	a) planes
2. electronic	b) ships
3. automobile	c) wire
4. electric	d) roads and bridges
5. heating and ventilating	e) cars and lorries
6. marine	f) air-conditioning
7. aeronautical	g) computers

II. You are a participant at the International Students' Conference in the Netherlands. Your new friends are from Germany, Sweden and Italy. They are all technical students. Make up a conversation with them about your study at University.

Writing

I. This is how we write letters in English. Study this example.

Martha is a German student who studies in Brighton. Read her letter to Gerhard, her friend in Germany.

We begin with *Dear* ... **Address, date**

34 Royal Street
Brighton 17S
25th September

Dear Gerhard,

How's life? I'm well. Now I'm in Brighton. I am a student of the Mechanical Engineering Faculty here at the Polytechnic. There are 12 students in our group. They are from different countries – France, Russia, Turkey, the Ukraine, Syria, Bulgaria, and Belgium. All of them are very friendly. We are happy to study together. And our teachers are brilliant.

My address is at the top of the letter. I live in the hostel on campus. My roommate is a sophomore and we are really good friends. She is fond of physics as well as I am.

I'm really impressed by the size of our University. The buildings are very modern here. The students' canteen is very noisy and always full of hungry students. British food is tasty, but coffee is terrible here.

I'm really eager to study at this University but frankly speaking, I miss home.

Write to me back soon.
Best wishes,
Martha.

Ending (*Regards, Love*)
Signature

II. Write a similar letter to your friend about your first days at University.

III. Translate the following text into Russian. Make sure you know the international words before you start.

Many areas of science are "-ologys". Some of them are *familiar*[1] to you, for example, biology. Some of them are not. Let me tell you about several subjects and professions.

Molecular biology is interested in *cells*[2] and genes. Molecular biologists are good at analysing DNA or fingerprints.

Mineralogists[3] are busy with studying minerals in soils and rocks.

Enzyme technologists[4] are interested in synthesizing new organic molecules or modifying existing molecules *to make*[5] useful medicines and pharmaceuticals.

Geomorphology[6] is busy with protecting water and important river ecosystems.

And *immunologists*[7] are interested in studying different transplants, allergies, HIV and development of vaccines.

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[1]известны, [2]клетки, [3]минерологи, [4]ферментологи, [5]чтобы создать, [6]геоморфология, [7]иммунологи

Unit Two

EXPERIMENTING

Section A. Experimenting with Car Devices

Lead-in

I. Discuss the following questions.

a) Is experimenting important for the development of technology? If so, give your reasons.

b) In what spheres of engineering can people use experiments?

II. Paul and Alex are in the lab now. Listen to their conversation and name the car devices they are working with.

Alex: Hello, Paul! How are you doing?

Paul: Hi, Alex. I'm great, thanks. And you?

Alex: Not bad. What are you doing here?

Paul: Well, I'm studying some car devices. For example, this one is called a **tachometer**.

Alex: A tachometer? And do you know what it is used for?

Paul: Sure, it is used for **indicating** the engine speed. It is called a **revolution counter**. You see, now it is indicating 2,500 rpm. It means that the engine is **turning** over quite fast.

Alex: And what is this instrument? What is it indicating?

Paul: This one is called an ammeter. At the moment it is indicating +10A.

Alex: Well, I see.

Paul: By the way, we are writing a test on car devices tomorrow.

Alex: Really? Then I'm staying with you in the lab.

Paul: OK, then.

III. Complete the dialogues.

A

A: ...
B: I'm fine, thanks ...
A: ...
B: I'm studying the car design.
A: ...

B

A: ...
B: It is called a tachometer.
A: What is it used for?
B: ...
A: I see.

C

A: What is this revolution counter indicating now?
B: ... It means that ...
A: ...
B: And this ammeter is indicating +12A at the moment.
A: I see.

IV. Match a line in A with a line in B.

A	B
1. How are you doing?	a. It is used for indicating the engine speed.
2. What are you doing here?	b. It is a device that is used for measuring current.
3. What is a revolution counter used for?	c. Yes, it is.
4. Are you writing a test tomorrow?	d. We are testing some car devices here.
5. What is an ammeter?	e. I'm excellent, thanks.
6. Is the tachometer indicating 750 rpm now?	f. Yes, that's why I'm staying in the lab.

Language Practice

Vocabulary

I. Match the English words with their Russian equivalents.

1. current, n	a) выполнять
2. perform, v	b) чинить
3. investigate, v	c) скорость
4. charge, v	d) ток
5. speed, n	e) изучать
6. repair, v	f) заряжать

II. Match the words from both columns to make all possible word combinations.

1. car	a) counter
2. instrument	b) panel
3. revolution	c) design
4. mathematical	d) vehicle
5. motor	e) operations

Grammar: Present Progressive Active

III. Write down the *-ing* form of these verbs.

move –	test –
pay –	measure –
perform –	indicate –
do –	work –
put –	study –

IV. Say what is true for you and your groupmates now.

EXAMPLE: *I/ study English.* I am studying English.
They/watch TV. They are not watching TV now.

1. I / listen to the teacher.
2. We / practise a new grammar rule.
3. He / perform mathematical calculations.
4. I / drive a car.
5. We / sit in the class.
6. They / measure the dimensions of this room.

V. You are now at the lab class with your groupmates. Ask each other what they are doing.

EXAMPLE 1: *to study the instrument panel of the car / car design*
A: Are you studying the instrument panel of the car?
B: Yes, I am. I'm studying the instrument panel of the car.
or *B:* No, I am not. I'm studying the car design.

to look at the indications of a speedometer / tachometer
to repair the car / tyre
to test the new device / new engineering materials
to check the volume of the petrol / oil

EXAMPLE 2: *to measure the pressure in the tyre / to change the wheel*

A: Are they measuring the pressure in the tyre?

B: Yes, they are. They are measuring it.

or *B:* No, they aren't. They are changing the wheel.

to drive in nails / to tighten screws
to cut wooden blocks / to cut metal sheets
to use chisels / to use hammers
to shape workpieces / to measure their dimensions

EXAMPLE 3: *to test the new engine*

A: What are you doing? | What is he doing?

B: I am testing the new engine now. | He is testing the new engine now.

To perform mathematical operations; to investigate the properties of copper; to control the quality of engineering materials; to work with wood.

VI. Put all possible questions to the following statements. Consult the table.

		Paul	*is*	*carefully*	*studying*	*a new device*	*in the lab*	*now.*
	Is	Paul		carefully	studying	a new device	in the lab	now?
What	is	Paul		carefully	studying		in the lab	now?
What	is	Paul		carefully	doing		in the lab	now?
Where	is	Paul		carefully	studying	a new device		now?
How	is	Paul			studying	a new device	in the lab	now?
When	is	Paul		carefully	studying	a new device	in the lab?	
Which device	is	Paul		carefully	studying		in the lab	now?
		Who	is	carefully	studying	a new device	in the lab	now?

1. The battery is discharging rapidly. 2. The students are testing the new engineering materials. 3. The driver is measuring the pressure in the wheels. 4. This car is moving at the speed of 70 kph now.

VII. Give your partner more information about what these people are doing.

EXAMPLE: *Oleg – to drive a car – to do it carefully*
A: Oleg is driving a car, isn't he?
B: Yes, that's right. He is driving a car and he is doing this very carefully.

Michael – to increase the speed – to watch the indications of the speedometer;
Andrew – to turn the key clockwise – to start the engine;
Paul – to test the device – to describe the results of the test;
Paul and Alex – to measure the pressure in the wheels – to put air in the tyres;
Ann – to draw different objects – to define their area.

VIII. Make up some questions for the following answers. The answers needn't be true.

1. It is used for indicating current. 2. Right now. 3. Motor Engineering. 4. A new modern car. 5. It's called a speedometer. 6. Yes, they are.

IX. Correct mistakes.

1. The speedometer is indicate 60 kph. 2. We not performing mathematical operations. 3. Are the car moving now? 4. The alternator is not produceing enough current now. 5. Paul, what is you doing here? 6. Ann is driving a new car, is she? 7. The engine not producing any power now. 8. We studying the main components of a motor vehicle.

X. Translate the sentences into English using your active vocabulary.

1. – Что он сейчас делает? – Он изучает приборную панель автомобиля.

2. – Какие приборы находятся на этой панели? – Спидометр, тахометр, амперметр и другие. – Понятно.

3. – А что делают Петр и Анна? – Они наблюдают за показаниями тахометра.

4. – Что сейчас показывает амперметр? – Он показывает +20 А.

5. Генератор переменного тока вырабатывает мощный ток для двигателя.

6. Батарея сейчас разряжается.

7. Так как двигатель сейчас вращается медленно, генератор переменного тока также вращается медленно.

8. Студенты сейчас чертят график.

Reading and Speaking

I. It is impossible to live and work without a car these days. A lot of people drive a car to work or when they travel. Discuss the following questions with your partner.

1. Do you or your parents have a car?
2. Would you like to have a car in the future?
3. Do you think it's necessary to have a car?

II. List as many parts of a car as you can. Compare your list with that of the other groupmates.

III. Now read the text and then answer the questions given after it.

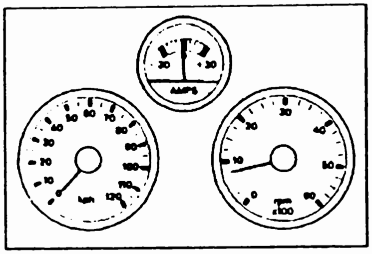

Fig. 1

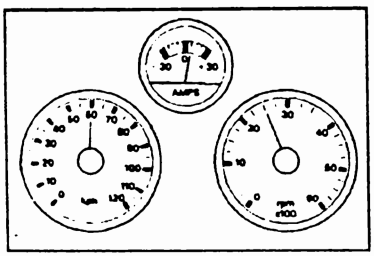

Fig. 2

Look at the picture. There are some instruments for the car panel there. In fig.1 the speedometer is indicating zero kph[1]. The car is not **moving.** The engine is turning at minimum speed (approximately 750 rpm[2]).

As the engine is turning slowly the **alternator** is also turning slowly. It is not producing **enough** current for the engine. The battery is **discharging** and so the ammeter is indicating about -5A[3].

Look at fig.2. The car is now moving at 60 kph. The engine is turning at 2,500 rpm and so the alternator is turning quite fast. It is producing a **strong** current for the engine. The battery is now **recharging** from the alternator and so the ammeter is indicating +10A.

---

[1]kph – kilometers per hour; [2]rpm – revolutions per minute; [3]A – ampere

1. Is the speedometer indicating zero kph in fig. 1?
2. The car is not moving in fig.1, is it?
3. Why is the alternator turning slowly?
4. Is the battery charging or discharging in fig.1?
5. What is the car doing in fig.2?
6. The engine is turning at 2,300 rpm now, isn't it?

7. Is the alternator producing a strong or a weak current for the engine in fig.2?

8. Is the battery recharging now?

IV. Complete the sentences using the wordlist below.

Look at fig.3. The car ... now moving ... 90 ... . The engine is ... at the speed of 4500 rpm. However, the alternator ... not producing any ... . The ammeter ... ... -20 A. In other words, the battery is ... rapidly, ... the engine is ... at a high speed. Therefore, the ... is not producing ... power.

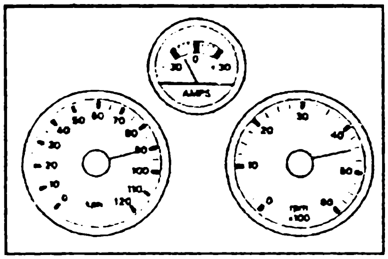

Fig. 3

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is, at, kph, current, turning, is, alternator, although, any, turning, is, indicating, discharging.

V. You are driving a car now. Your friend is sitting next to you. He does not know anything about the car devices. Describe the work of a tachometer, a speedometer or an ammeter to him.

Further Reading

I. Look at the following list of words. They are all from the text below. Check your dictionary to find their meaning.

graph, *n*	evenly, *adv*
variable, *n*	axis, *n* (*pl.* axes)
label, *v*	

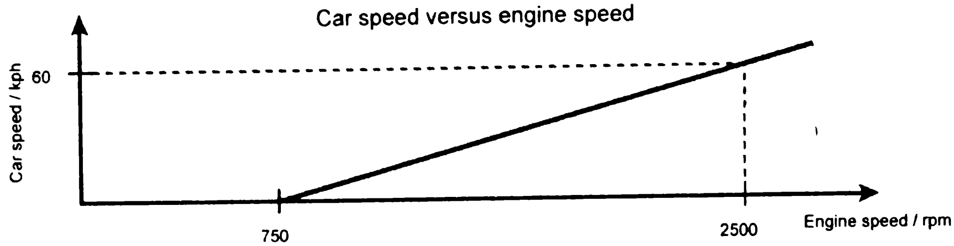
What do you think the text is about?

II. Match the words with their definitions.

1. graph	a. relative size or extent
2. scale	b. a diagram that shows relationship between quantities
3. label	c. to put a note on an object
4. variable	d. something that varies

III. The students of the Technical University are at the practical class now. Read the text and learn how to draw graphs in the correct way.

Graphs are very important for **recording** the results of any experiments. Now the students are **drawing graphs** in their exercise books. First, they are giving the graph a title. Then they are drawing the axes and putting the **independent variable** along the bottom of the graph paper (**the horizontal axis**). The other variable *depends on this one*[1] and the students are drawing it up the side of the paper (**the vertical axis**). It is also called the **dependent variable.** The origin of the graph is usually the point (0,0).



For example, if you are measuring the speed of a car when it is moving, you **choose** the speed of the engine and put it along the horizontal axis (rpm). In this case the speed of the car is on the vertical axis.

Now the students are **choosing** the **scales** *so that*[2] the graph fills most of the paper. After that they are **numbering** the scales **evenly** and **labelling** them (the scales) with the correct **units.** For example, "Speed in kph" or "Speed/kph".

---

[1]зависит от этой переменной; [2]так, чтобы

IV. Study the graph in the text and answer the following questions.

1. What is the title of the graph? 2. Is "engine speed/rpm" the independent or dependent variable? 3. What is the name of the independent variable? 4. What is the origin of the graph?

V. Complete the sentences with the words given below.

Michael is studying how to draw graphs. He is at his class now. First, he is ... the graph a title. After that he is ... the axis and ... the independent ... along the bottom of the graph paper. It is known as the ... . Then Michael is drawing the vertical axis, or the ... variable. Finally he is ... the scales for the graph, he is ... the scales evenly and labelling them with the correct ... .

dependent	giving	drawing
units	putting	horizontal axis
variable	choosing	numbering

Activity

I. Look at the pictures below. Discuss with your fellow student what you see in the picture.

EXAMPLE:

A: Who is that man in the picture?
B: Oh, it's Mr. Kosov.
A: Is he repairing his car?
B: No, he isn't.
A: He is painting his car, isn't he?
B: No, you are wrong.
A: What is he doing there?
B: He is cleaning his car.
A: I see. Is he cleaning it in the garage or in the workshop?
B: In the garage, of course.

a) Mr. Morton is in the car.

to drive the car
to press the pedal
to look at the indications of the car instruments
to watch indications of the tachometer and the ammeter

b) Children are in the classroom.

to make mathematical operations
to solve different problems
to draw different shapes and measure their areas
to measure in cm^2 or in m^2

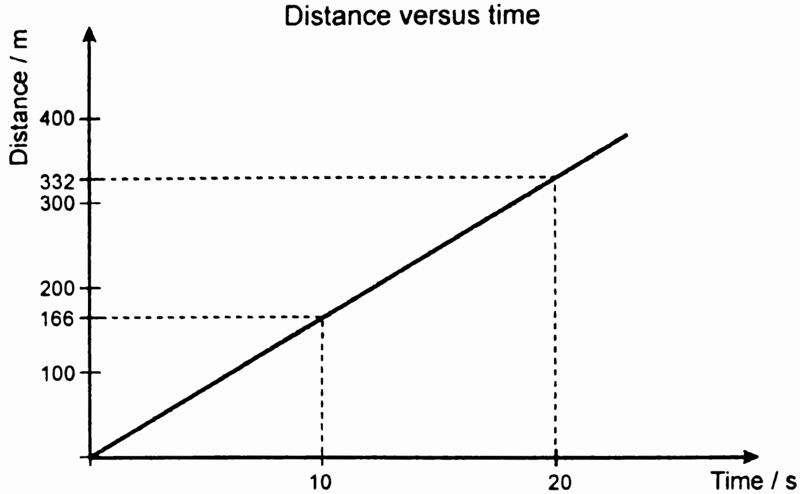
II. Your friend is showing you how to draw a graph. Describe what he is doing step by step. Begin with the words:

First, he is drawing ...	Next ...
Then ...	After that ...

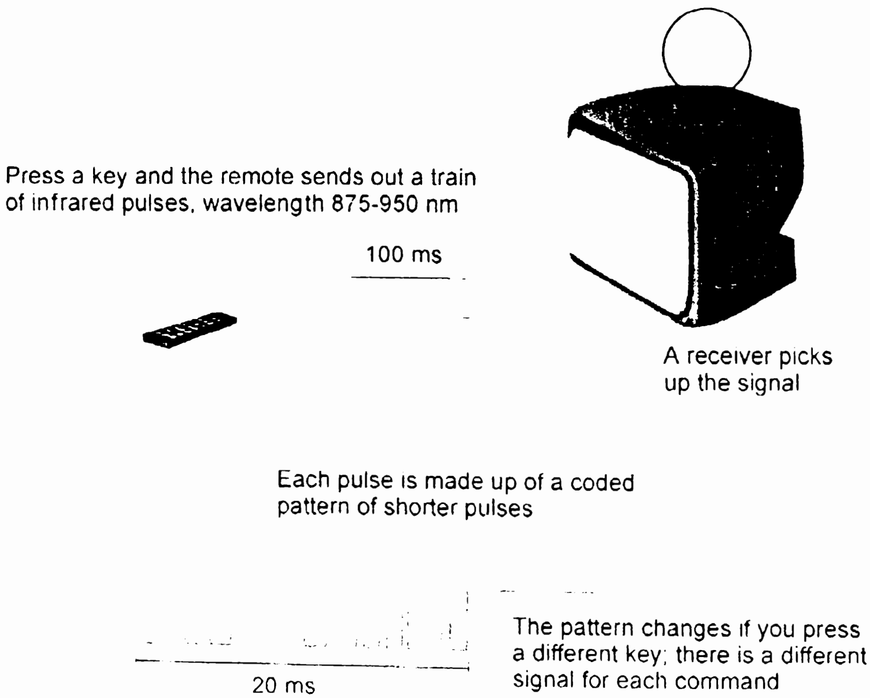
Writing

I. The car is travelling at constant speed. This graph shows the dependence of distance on time. Study this graph and describe it. Can you calculate the speed of the car in kph?

Distance versus time



II. Translate this text into Russian. Try to carry out the same experiment at home with a TV set or radio/CD player.



A student is experimenting with the remote control at the moment. He is putting a piece of white card about 2 cm in front of the control. The control is still operating because the beam is reflecting off the card and then the wall behind.

Now the student is using a piece of black card instead of the white card. This time the signal is not reaching the *receiver*[1]. Why?

Answer: the black surface *absorbs*[2] the *infrared rays*[3] and does not reflect it back into the room.

---

[1]приемник, ресивер; [2]поглощает; [3]инфракрасные лучи

Section B. Electrical Devices

Lead-in

I. Discuss the following questions.

a) Is it important for an engineer to know how to use electrical devices?
b) What electrical devices are there in your lab?

II. Listen to the dialogues and learn how to speak about your past and future activities. Pay attention to the terms of electricity.

A

Peter: Hi, Paul. Glad to see you.

Paul: So am I. Peter, can you tell me what you were doing yesterday from 9 till 11a.m.? I was **looking** for you.

Peter: Well, let me see. A few students and I were **carrying out** some experiments with different **electrical devices**. As for me, I was measuring the **voltage**.

Paul: And what about Alex? Do you happen to know what he was doing?

Peter: As far as I remember, he was measuring the **resistance** of a **lead**.

Paul: Oh, I see. I hope Julia and Michael were helping him.

Peter: Yes, they were. They were connecting leads to the **multimeter**. The **needle** was **indicating** the **value** of the resistance on the **scale**.

B

Alex: Excuse me, Professor.

Professor: Yes, Alex.

Alex: What will you be doing from 9 till 10 tomorrow?
Professor: I'll **probably** be working in the lab. Have you got any problems?
Alex: Oh, yes. I'd like to discuss the plan of the **experiment** with you, if you don't mind.
Professor: Of course, I don't. When are you going to carry out the experiment with a resistor?
Alex: I expect in a week or two.
Professor: OK. I'll be waiting for you at 9 in the lab.
Alex: Thank you ever so much.
Professor: Not at all. See you tomorrow.
Alex: Good-bye.

III. That's how we make predictions about the future in English. Study this table.

MAKING PREDICTIONS ABOUT THE FUTURE

I (don't)	think... expect... suppose... imagine...	I'll ...

I'll probably ...
I probably won't ...

IV. Complete the dialogues using the phrases about the future from the box.

1. *A:* ...
B: So am I. ...
A: I was carrying out an experiment in the lab.
B: ...
2. *A:* Where were you yesterday? I was looking for you.
B: ...
A: And what about your friend Julia?
B: As far as I remember, ...
3. *A:* ...
B: Tomorrow at 7 p.m.? I'll probably be working in my office. Why?
A: ...
B: Of course, I don't.

4. *A:* What time are you going to be free?
B: I expect ...
A: OK. ...
B: Thank you ever so much.
A: ... . See you tomorrow.
B: ...

V. Match a line in A with a line in B.

A	B
1. Hi, Michal.	a. I was preparing for the experiment.
2. I'm glad to see you.	b. Yes, Ann.
3. What were you doing at 9 yesterday evening?	c. So am I.
4. Excuse me, Mr. Kosov.	d. Hello, Helen.
5. I'm going to test a new device.	e. Don't mention it.
6. Thanks a lot.	f. Good luck to you.
7. See you tomorrow.	g. We'll probably be studying electrical devices.
8. What will you be studying at the class tomorrow?	h. See you.

Language Practice

Vocabulary

I. Study the table, then do the exercises that follow.

1. The following suffixes are used to form ***nouns*** from v***erbs***:

-tion, -sion, -ance, -ure, -er/-or

2. The following prefixes are used to give the ***opposite*** meaning to the word:

dis-, in-, im-.

a) Make up all possible nouns of the following verbs:

resist –
differ –
restrict –
press –

depend –
absorb –

product –

b) Give the opposite to:

decrease –
dependent –
different –
charge –

approve –
connect –
possible –

II. Find in B the word close in the meaning to the word in A.

A	B		
1. to carry out	a) to wear	b) to perform	c) to move
2. to operate	a) to investigate	b) to charge	c) to work
3. to apply	a) to use	b) to choose	c) to accelerate
4. to observe	a) to determine	b) to watch	c) to calculate
5. to compile	a) to label	b) to make	c) to increase

Grammar: Past and Future Progressive Active

III. Complete the sentences. Use *was / were* + one of these verbs:

writing, carrying out, drawing, measuring, determining, testing

1. Paul *was testing* a new device from 11 till 12 yesterday. 2. I ... a report on the latest achievements in electricity at 7 o'clock yesterday. 3. Alex ... the current in the circuit at 5.45 yesterday. 4. Yesterday at 11.15 Helen ... graphs at the lesson. 5. The students ... the resistance of new materials from 3 till 10 yesterday. 6. The engineers ... an important experiment at 10 o'clock last Tuesday.

IV. Your friend was looking for you yesterday at 2 p.m., but you weren't at home. Tell him what you were doing at that time.

EXAMPLE 1: *to work in the lab / to work at the workshop*
A: Were you working in the lab from 2 till 4 o'clock yesterday?
B: Yes, I was. I was working in the lab at that time.
or *B:* No, I was not. I was working at the workshop.

To observe changes in the behaviour of the current / to measure the resistance of the lead; to perform mathematical operations / to draw different shapes; to study electrical devices / to watch their indications; to use crocodile clips / to connect two leads.

EXAMPLE 2: *to study electrical devices*
A: What were you doing at 2 o'clock yesterday?
B: I was studying electrical devices.

To connect two leads; to measure the value of the current; to turn on the function selector switch of the multimeter; to study the results of the test.

V. Give short answers to the following questions.

EXAMPLE: – *Will you be working in the workshop in half an hour?*
– Yes, I will.
– No, I won't.

1. Will you be controlling the indications of a multimeter in half an hour? 2. Will you be testing a manometer tomorrow? 3. Will Julia be drawing shapes at 2 o'clock tomorrow? 4. Will your groupmates be experimenting with new devices at 5 tomorrow?

VI. Tell your fellow students what you will be doing in half an hour.

EXAMPLE: *to study the properties of alloys*
A: What will you be doing in half an hour?
B: I'll be studying the properties of alloys.

To measure electrical units with a multimeter; to decrease the voltage in the electrical chain; to study electrical devices; to study the properties of conductors.

VII. Give the opposite of these sentences.

1. The professor will be reporting the results of the tests at the class tomorrow. 2. My groupmates weren't increasing the voltage in the electrical chain in the lab. 3. They won't be studying any electrical instruments. 4. I was checking the battery at 5 o'clock on Thursday.

VIII. Put all possible questions to the following statements. Consult the table.

		a) Alex	*was*	*working*	*in the lab*	*from 5 till 7 yesterday.*
	Was	Alex		working	in the lab	from 5 till 7 yesterday?
What	was	Alex		doing	in the lab	from 5 till 7 yesterday?
Where	was	Alex		working		from 5 till 7 yesterday?
		Who	was	working	in the lab	from 5 till 7 yesterday?

1. I was measuring the value of the resistor from 2 till 3 yesterday.
2. Olga was connecting the leads to the resistor at that moment.
3. The students were investigating superconductors at 10.30.

	b)	*Alex*	*will be*	*working*	*in the lab*	*from 5 till 7 tomorrow.*
	Will	Alex	be	working	in the lab	from 5 till 7 tomorrow?
What	will	Alex	be	doing	in the lab	from 5 till 7 tomorrow?
Where	will	Alex	be	working		from 5 till 7 tomorrow?
Who	will		be	working	in the lab	from 5 till 7 tomorrow?

1. Helen will be studying the properties of copper at 4 tomorrow.
2. Paul will be observing the indications of a multimeter in the lab tomorrow.
3. We will be studying various electrical devices all the morning tomorrow.

IX. Ask your friend about his plans for tomorrow. Pay attention to the expression *to be going to.*

EXAMPLE 1: *to control the lasers / to control the electrical devices*

A: Are you going to control the lasers tomorrow from 5 till 7?
B: Yes, I am. I'm going to control them at that time.
or *B:* No, I'm not. I'm not going to control them, I'm going to control the electrical instruments.

To show the results of the test in the graphic form / in the mathematical form; to check the indications of a tachometer / of an ammeter; to connect leads in the electrical chain / to measure the resistance; to turn the switch to the current range / to the resistor range.

EXAMPLE 2: *to test the voltmeter*

A: What are you going to do in two hours?
B: I am going to test the voltmeter.

To finish the laboratory work; to report the results of the tests; to operate the electrical device; to study the indications of a multimeter.

X. Insert prepositions where necessary.

1. We are writing a test tomorrow. I must prepare ... it. 2. The students are measuring electrical units ... a multimeter now. 3. Where were you at 7 yesterday evening? I was looking ... you. 4. The car is moving ... the speed of 60 kph. 5. We are carrying ... some experiments with different electrical devices at the moment. 6. I will be waiting ... you ... 9 a.m. in my office.

XI. Correct mistakes.

1. We will be study the properties of copper from 5 till 6 tomorrow. 2. I will preparing for my test the whole day yesterday. 3. The students not

were measuring the value of the current at the lesson. 4. I was drawing a graph at the class tomorrow. 5. Will be you carrying out this experiment next time? 6. My friends was finishing the laboratory work at the previous class. 7. The teacher will be not telling the students about electricity at the next lesson.

XII. Translate the sentences into English using your active vocabulary.

1. Вчера мы изучали электронные приборы в лаборатории с 2-х до 4-х часов дня. 2. – Что вы делали? – Мы проверяли приборы, затем измеряли сопротивление разных проводников: медных, алюминиевых, железных. 3. – Что он делал? – Он работал с мультиметром. Он использовал зажимы "крокодил" и соединял провода в цепи. 4. – Ты будешь проводить эксперимент в лаборатории через два часа? – Да, я буду проверять новое оборудование. 5. – Когда ты собираешься продемонстрировать результаты теста? – Я думаю, через два дня.

Reading and Speaking

I. Nataly and Alice were not at home from 4 till 6 o'clock yesterday. They were at University. Read this passage through to find the answers to these questions.

1. What were the girls doing in the lab?
2. Were they using a multimeter or a tachometer?
3. What is a multimeter used for?
4. What are the main parts of a multimeter?
5. What are the students going to do next time?

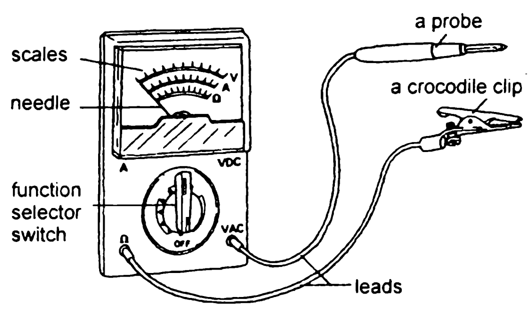


Fig.1

Yesterday from 4 till 6 o'clock Nataly and Alice were working in the laboratory. They were studying different electrical devices and instruments. One of them, a **multimeter**, was on their demonstration table all the time.

The multimeter is used for measuring three types of electrical units, namely: **voltage**, **resistance** and **current**. This device (see fig. 1) has several scales, a **needle**, a **function selector switch**, two **leads**, a **crocodile clip** and a **probe**.

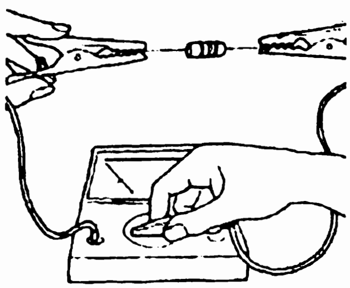


Fig.2

Look at picture 2 – the girls were measuring the **value** of the resistance at that moment. Alice was using two small crocodile clips to make a good connection between the **meter** and the resistor. While she was connecting the two leads to the resistor, Nataly was turning the switch to the **resistance range**.

The needle was indicating the value of the resistance on the ohms scale. Next time they are going to measure the current. They will be using **the same** multimeter.

II. Complete the dialogue. Use the wordlist below.

– Who ... working in the lab yesterday at 11a.m.?
– Alice and Nataly ... working in the lab.
– What were they ... there?
– They were ... different electrical ... .
– What device ... they working ...?
– They were ... with a ... .
– What ... it used ...?
– It is ... for measuring three types of electrical ..., namely: ..., resistance and ... .
– How were the students measuring the ... of the ...?
– Alice was connecting two ... to the resistor ... Nataly was ... the ... switch to the resistance ... .
– What are the students ... to do next time?
– Next time they ... going ... measure the ... . They'll ... using the same ... .

were	value	selector	be
are	were	devices	current
is	turning	for	doing
resistance	studying	voltage	while
units	multimeter	current	with
going	used	meter	working
was	to	leads	range

III. Your friend is interested in what you were doing in the lab yesterday. Describe to him how you were experimenting with a multimeter.

Further Reading

I. a) When you were studying Physics at school, you learnt a lot about electricity. Do you remember any units of electricity? Can you name their English equivalents?

b) Study the pronunciation of the following words.

ampere ['æmpeə]
volt [vəult]
watt [wɒt]
joule [dʒu:l]
pascal ['pæskəl]
coulomb ['ku:ləm]
candela ['kændɪlə]

II. Every day you use different electrical devices. But do you know everything about electricity? Try to answer the following questions.

1. What is current and voltage?
2. Do voltage, current and resistance have any relationship to one another?
3. Can you name the unit of resistance, the unit of power, the unit of force?
4. What is SI?
5. What is a 'derived' unit?
6. What derived units are known to you?

III. Now read the text to check your answers.

The **amount** of **electricity** which is **flowing** (it is called the current) is measured in units called amps. The pressure of electricity, the **voltage**, is measured in volts. A unit of **resistance** is called an ohm.

Current, voltage and resistance have a **definite relationship** to one another. The current and the voltage **determine** the power, the rate at which electrical energy is used. A unit of power is a watt.

In System International (SI) there are seven base units. They are the following:

– the metre (m) as the unit of length;
– the kilogram (kg) as the unit of mass;
– the second (s) as the unit of time;
– the ampere (A) as the unit of electric current;
– the kelvin (K) as the unit of (thermodynamic) temperature difference;
– the mole (mol) as the unit of substance;
– the candela (cd) as the unit of *luminous intensity*[1].

All other SI *units are derived from*[2] the seven base units. They are the joule, the watt, the pascal, the newton and, most interestingly, the unit of charge, the coulomb.

---

[1]сила света; [2] единицы, производные от

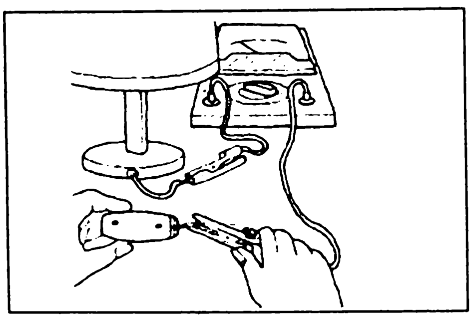
IV. Check if you know the following SI units.

1. The unit of time is ... 2. The unit of substance is ... 3. The unit of electric current is ... 4. The unit of length is ... 5. The unit of luminous intensity is ... 6. The unit of mass is ... 7. The unit of thermodynamic temperature difference is ... 8. The unit of charge is ...

Activity

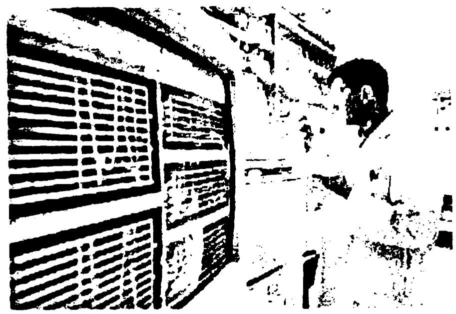
I. Find out what the people in the pictures are going to do. These are possible questions that you can ask.

EXAMPLE: Where is Max?
What is he doing at the moment?
What is he going to do next?
When is he going to finish the work?



Max is at the practical class.

to work with a multimeter
to measure the voltage
to connect the leads
to watch the indications



The engineer is in the lab.

to prepare for the experiment
to study the behaviour of the current
to describe the results in the graphic form
to carry out some tests on the scale

II. Your boyfriend/girlfriend wanted to see you yesterday but he/she couldn't find you. Explain to your friend what you were busy with. Some phrases are already given to you.

A: Well, my dear, can you tell me what you were doing yesterday evening?
B: Well, I was ... .
A: Were you alone in the lab, I wonder ?
B: Er, no. Actually my ... .
A: Your ...?! In what way was he/she helping you, if it's not a secret?
B: Well, ...
A: Really? And can you tell me what you will be doing tomorrow at this time?
B: Well, let me think for a moment. I'll be ... .
A: I see. But dear, ...

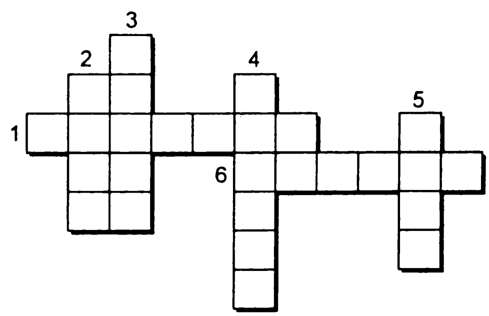
Useful expressions:

to prepare for the experiment / to carry out the experiment
to measure the value of the current / to control voltage in the system
to check the indications of a multimeter / to write a report

III. Do the crossword.

Down:

2. a unit of electromotive force, equal to ampere / ohm
3. a unit of work and energy, equal to newton / metre
4. a unit of electric current, equal to coulomb / second
5. a unit of power, equal to joule / second



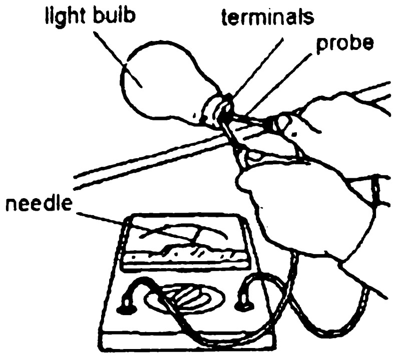
Across:

1. a unit of electric charge, equal to ampere / second
6. a SI unit of pressure equal to newton / square metre

Writing

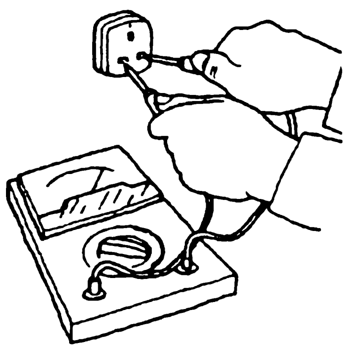
I. Yesterday you were watching how some students were experimenting in the lab. Describe their activities. The words below will help you.

to use
to measure
to hold
to turn



to indicate
the function selector switch
the resistance range
the ohms scale

II. Translate the text into Russian. Use the dictionary if necessary.



The students of the Technical University were carrying out an experiment with a multimeter in the lab last week. They were checking a mains socket in the wall and they were following all the safety instructions. Paul was using two probes that time. While he was inserting them into two terminals of the socket, his groupmate Alex was turning the function selector switch to the VAC (voltage alternating current) range. The needle was indicating the pressure of electricity, i.e. the voltage in the mains. Everybody was watching the indications on the volts scale. It was 220 volts. Next time they are planning to measure the current in a table lamp.

Unit Three

COMPUTING

Section A. Computers Today

Lead-in

I. Is it possible to imagine our life without computers? How useful are they?

II. Alice and Paul are talking in the University coffee-bar. Listen to their conversation and name the advantages of computers.

Alice: Paul, what are you going to do at your laboratory classes today?
Paul: I'm going to work on computer.
Alice: And do you often work at the computer centre?
Paul: Not very often. But I like to work on computer. It does the work of many **human beings** at fantastically high speeds.
Alice: Well, if I'm not mistaken it's **primarily** a **calculating machine**.
Paul: Oh, I believe that it's almost a human machine with **"brains"**. A computer usually **replaces** people in **dull**, routine tasks. It works **according to** the instructions.
Alice: Well, I see. In my opinion, it's a **fascinating** machine.
Paul: Exactly.

III. Complete the dialogues.

1. *A:* ...
   B I'm going to work on my project. What about you?
   A: ...
2. *A:* Do you often work at the Internet centre?
   B: ...
3. *A:* As far as I'm concerned, a computer is almost a human machine!
   B: ...

IV. Match a line in A with a line in B.

A	B
1. What is computer?	a. It's a set of instructions in a special computer language.
2. Do you often work at the computer center?	b. Yes, they do.
3. What is a programme?	c. I think, e-mail.
4. What basic job does computer perform?	d. Well, it's a complex electronic machine.
5. Do modern computers operate quickly?	e. Not very often.
6. What is the most popular Internet service?	f. It receives and processes information.

Language Practice

Vocabulary

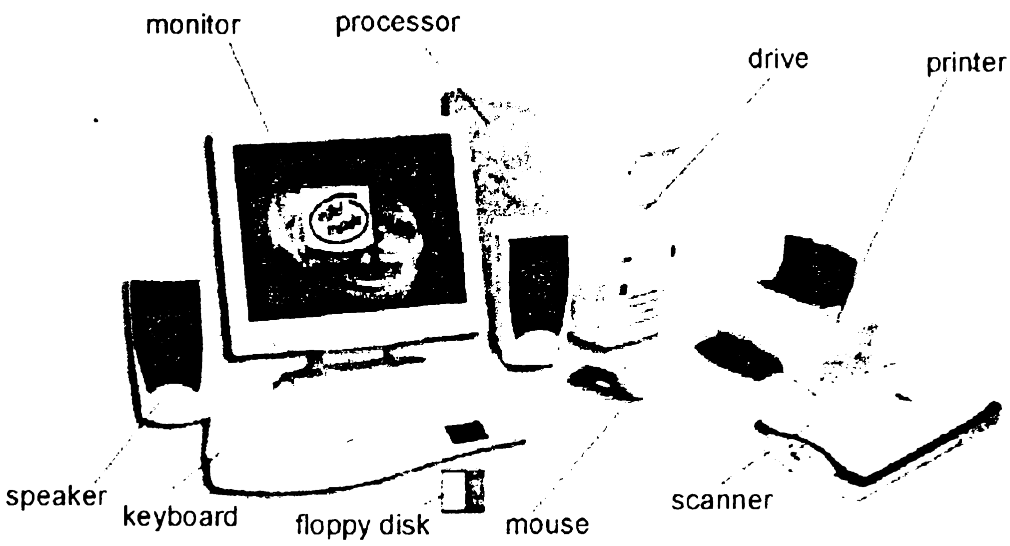
I. Make up all possible nouns of the following verbs.

to decide –	to add –
to instruct –	to operate –
to inform –	to multiply –
to divide –	to subtract –
to employ –	to perform –

II. Find in B the word close in the meaning to the word in A.

A	B		
1. to supply	a) to process	b) to give	c) to accept
2. to employ	a) to define	b) to operate	c) to use
3. to store	a) to keep	b) to perform	c) to carry out
4. network	a) task	b) web	c) circuit
5. to embrace	a) to include	b) to solve	c) to communicate

III. a) Study the picture and learn how to name different computer components.



b) Ask your friend to name these computer components in English.

Клавиатура, процессор, дискета, колонка, дисковод, мышь, сканер, принтер, монитор

Grammar: Present Simple (Active)

IV. Study this chart and make sentences about Michael and Ann, Paul and yourself.

EXAMPLE 1: a. Michael and Ann seldom leave the work half done.
b. Paul always leaves the work half done.
c. I ...

☺ How often do you ... ?	Michael and Ann	Paul	You
1. leave the work half done	seldom	always	?
2. employ minicomputers	frequently	sometimes	?
3. attend classes in programming	usually	seldom	?
4. compile computer programmes	often	never	?
		rarely	
5. use the Internet	regularly	once a month	?
6. work at the Internet centre	every week		?

EXAMPLE 2: 1. Michael and Ann <u>don't test</u> computer programmes every day.
2. Paul <u>doesn't test</u> computer programmes every day.

☺ What do you do every day?	Michael and Ann	Paul	You
1. test computer programmes	–	–	?
2. solve different problems	+	–	?
3. study different programming languages	+	–	?
4. perform arithmetic operations	–	+	?
5. work on computer	–	–	?

V. Give the opposite to the following sentences.

1. The computer doesn't usually make different types of decisions. 2. The computer stores information in its "memory". 3. The new calculating machine does many kinds of calculations. 4. Modern personal computers don't perform work at high speeds. 5. The electronic machines receive and store information.

VI. Answer your partner's questions.

EXAMPLE 1: *to prepare computer programmes*

A: <u>Do</u> you <u>prepare</u> computer programmes?
B: Yes, I <u>do</u>. I often <u>prepare</u> computer programmes.
or *B:* No, I <u>don't</u>. I never <u>prepare</u> computer programmes.

to work at the computer centre
to perform arithmetic operations
to print information on paper
to solve different problems
to use floppy disks
to store information on CDs

EXAMPLE 2: a) *to carry out logical operations*

A: <u>Does</u> the computer usually <u>carry out</u> logical operations?
B: Yes, it <u>does</u>. The computer usually <u>carries out</u> logical operations.

b) *to supply new information*

A: <u>Does</u> the computer <u>supply</u> new information?
B: No, it <u>doesn't</u>. It <u>doesn't supply</u> new information.

to process information	to do the work at high speeds
to increase the labour force	to replace people in dull tasks
to present information	to load digital photos

VII. Put all possible questions to the following statements.

		The computer	*processes*	*information*	*rapidly.*
	Does	the computer	process	information	rapidly?
What	does	the computer	process		rapidly?
How	does	the computer	process	information?	
		What	processes	information	rapidly?

1. Computers control mechanical operations in the car industry. 2. The design of computers changes quickly. 3. Technicians usually install new computers in our laboratory. 4. Computers change the conditions of our work to a great extent.

VIII. Think of some questions for the following answers. The answers needn't be true.

1. Not very often. 2. It is a calculating machine. 3. I don't think so. 4. It usually does. 5. At the computer centre. 6. Yes, it is very important nowadays.

IX. Correct mistakes in the following sentences.

1. He often work on computer. 2. My friends doesn't learn any programming language. 3. What operations a modern computer performs? 4. Do you often employ minicomputers? – No, we doesn't. 5. Alex have a new computer – notebook. 6. Always computers help people solve difficult tasks.

X. Translate the sentences into English using your active vocabulary.

1. Какие операции выполняет компьютер?

2. Компьютер не думает, не так ли?

3. Компьютер выполняет многие виды расчетов быстро и точно.

4. Студенты технических вузов часто выполняют математические операции при помощи компьютера.

5. Компьютер получает, хранит и обрабатывает информацию.

6. В своей работе мы используем различные виды компьютеров, не так ли?

7. Компьютеры состоят из программного и аппаратного обеспечения.

Reading and Speaking

I. A lot of people have computers nowadays.

What do you know about computers?
What basic jobs does the computer perform?

II. List as many computer components as you can. Compare your list with that of your groupmates.

III. Match the component with the function. Look through the text to check your answers.

A component	A function
1. Storage device	a. It displays the processed data.
2. Input device	b. It holds the programmes and data, which the processor uses.
3. Output device	c. It does all the processing and controls the peripherals.
4. Main memory	d. It provides permanent storage.
5. Processor	e. It enters data.

IV. Read the text attentively and find the answers to the following questions.

1. What are computers?
2. What operations do computers perform?
3. The computer doesn't think, does it?
4. Is the computer a simple electronic machine? Why / why not?

Computers are electronic machines. They **communicate** with the **user**, perform different kinds of arithmetic operations, such as **addition, subtraction, division and multiplication,** solve a series of logical problems and make thousands of logical **decisions**. Modern computers operate quickly and **accurately**. However, they don't think.

Every computer **consists of** software and hardware. Information in the form of programmes and **data** is called **software**, but the pieces of equipment that **make up** the computer system are known as **hardware**.

The most important item of hardware is the **CPU (Central Processing Unit)**. This is the electronic unit at the centre of the computer system. The brain of the computer is the **processor**. It does all the processing and controls all the devices in the computer system. The **main memory stores** all the programmes and data used by the processor.

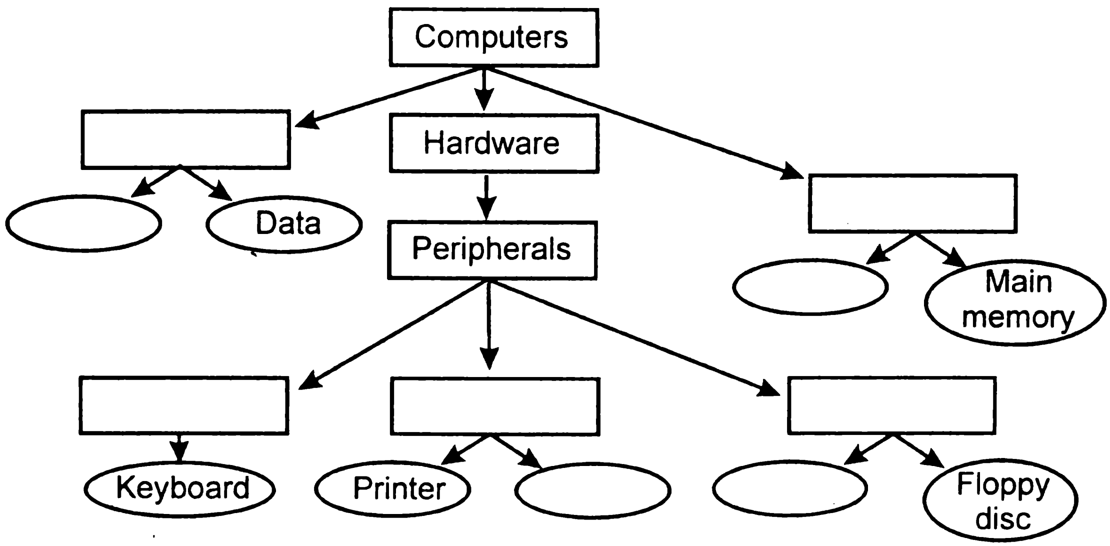
All the other devices in the computer system are known as **peripherals**. These include input devices, output devices and storage devices. An

input device supplies information into the computer. The most commonly used input device is a **keyboard**. An **output device** such as a monitor or a printer **displays** the processed data. A **storage device** is used for the **permanent** storage of information on **floppy discs** or CD-ROM discs.

V. Cross out the odd word.

a) processor, main memory, software
b) input device, data, storage device
c) monitor, floppy disc, printer
d) hardware, programme, data

VI. Fill in the missing information in this diagram.



VII. This is a summary of the lecture on computers that was taken from a student's notebook. But the teacher was speaking too fast and the student couldn't follow him. Help him restore the necessary information.

Computers are complex electronic machines. They perform arithmetic ... such as ..., ..., ..., ... and make thousands of logical ... . All modern computers ... quickly and ... .

Computers consist of software and ... . Software includes ... and data. Hardware contains the Central ... Unit and the peripherals.

The processor is the ... of the computer. It ... all the processing. The ... memory ... all the programmes and data used by the ...

An input device ... information into the ... .
An output device the processed data.
A ... device is used for the ... storage of information.

VIII. One of you is a teacher of Computer Science. The other is a student. The student is taking a test on computer components and functions. The teacher is asking questions and checking if everything is correct. Reproduce this conversation. Work in pairs.

Useful phrases:

What is this device called?	Excellent! Well done!
What is its function?	If I'm not mistaken, ...
Try again.	As far as I know, ...

Further Reading

I. Before reading the text answer the following questions.

1. How many people use the Internet these days? 2. What popular Internet services do you know? 3. Do you often use the Internet? What for?

II. Now read the text about the Internet service.

The Internet

The Internet is a global computer **network** that **embraces** millions of users all over the world. It dates back to 1969 when it *began*[1] as a military experiment. Information that people send over the Internet takes the shortest path available from one computer to another. Because of this, any two computers on the Internet stay in touch with each other as long as there is a single route between them. This technology is called *packet switching network*[2]. **Owing to** this technology, if some computers on the network fail, the information just routes around them.

One of the most popular Internet services is e-mail. Most of the people, who **have access** to the Internet, use the network only for sending and receiving e-mail messages. However, other popular services are available on the Internet: reading USENET News, using the World-Wide Web and Intranet.

However, some problems remain. The most important is security. When you send an e-mail message to somebody, this message travels through many different networks and computers. Special computers that are called *routers*[3] direct the data towards its destination. That is why it becomes possible to get into any of computers along the route and even change the data that we send over the Internet. This happens because the Internet **transmits** nearly all the information, which we send without any form of **encoding**.

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[1]начался; [2]сеть коммутации пакетов; [3]маршрутизаторы

III. Say whether the following sentences are true or false. Correct the false sentences.

1. Only one million people use the Internet. 2. The most popular Internet service is e-mail. 3. People use the Internet only for sending and receiving e-mail messages. 4. It is impossible to get into any of computers along the route. 5. There is a special form of encoding with the help of which the Internet transmits nearly all the information.

IV. Read the translation of the 1st paragraph. Compare it with the original and say if everything is right.

Глобальная компьютерная сеть Интернет включает миллионы пользователей во всем мире. Информация, которую отправляют по Интернету, проходит самый короткий путь от одного компьютера к другому. Поэтому любые два компьютера в сети Интернет связаны друг с другом до тех пор, пока они находятся в локальной сети.

Activity

I. Mr Brains is an excellent specialist in computer technology. Read the following sentences about him and say if they are true to you. Pay attention to the ways of expressing surprise.

EXAMPLE 1: *A:* He compiles computer programmes.
B: Does he? *So do I.* I compile them, too.

EXAMPLE 2: *A:* He doesn't do millions of calculations per second.
B: Doesn't he? *Neither do I. / Nor do I. / I do not, either.*

1. He prepares complicated programmes.
2. He doesn't obtain negative results in his research.
3. He has a logical mind.
4. He doesn't have access to the Internet.
5. He understands the basic concepts in computer science.
6. He doesn't study a new programming language.

II. More and more people use computers in their work. It is impossible to imagine our life without this invention of the 20th century. Are computers the greatest or the most dangerous invention? Do you use computers in your studies or do you simply play computer games?

a) Read the following arguments. Add your own ones.

Computers are the greatest invention	*Computers are the most dangerous invention*
1. They save a lot of time.	1. They are dangerous for your health.
2. They help you to process information.	2. Some people live in the virtual reality not in the real world.
3. They operate quickly and solve problems accurately.	3. They are machines and it's easy to break them.
4. They replace people in dull and boring tasks.	4. They don't think.
5. ...	5. ...

b) Discuss the problem in groups of 3–5 students in order to make a decision.

Writing

I. Write two paragraphs, one about the advantages and the other about the disadvantages of computers.

II. Translate the text into Russian.

Computer is a complex electronic machine. Its basic job is the processing of information. For this reason, computers are known as devices, which accept 2 kinds of information in the form of instructions. The former is called programmes and the latter is known as data.

A modern computer today performs millions of logical operations and it doesn't get tired. Sometimes it seems that computer operates like a mechanical "brain". However, it cannot do anything *unless*[1] a person tells it what to do and gives it the *appropriate*[2] information. Computers replace people in dull, routine tasks, but they will not replace human beings in every sphere of life. *Though*[3] nowadays scientists are trying to devise the "Intelligent Computer".

[1]пока ... не; [2]необходимый; [3]хотя

Section B. From the History of Computers

Lead-in

I. Discuss these questions.

a) How many calculating devices can you name? What were the first calculating devices?
b) When and where did the first computer appear?

II. Alice and Dima are studying in different groups. Now they are discussing their laboratory classes. Listen to their conversations and say what they are talking about.

A. *Alice:* What did you do at your laboratory classes yesterday?
Dima: I **observed** a very interesting experiment with **superconductors.** And what about you?
Alice: As for me, I made a new programme for the microcomputer.
Dima: Well, two years ago computer systems **interested** me, too. Yesterday I read a very interesting book on the history of computers by Norma D. Miller. Did you read it?
Alice: I don't think I did. What does it **deal with**?
Dima: It deals with many **remarkable powers** of computers and their **basic capabilities**.

B. *Alice:* What will you do at your laboratory classes tomorrow?
Dima: I expect I'll study changes in the properties of substances under different conditions.
Alice: You will use superconductors, won't you?
Dima: Yes, I will. And what are you going to do?
Alice: I think I'll study commercial **applications** of minicomputers.
Dima: You are interested in computer systems, aren't you?
Alice: Yes, I am.
Dima: Will you explain some **computer concepts** to me then?
Alice: Certainly.

II. Complete the dialogues.

1. *A:* What did you do at your lab class on Monday?
B: ... And what about you?
A: Well, ...

2. *A:* ...
B: It deals with powers of computers and their basic capabilities.
A: ...

3. *A:* ...
B: I expect I will do some experiments with new substances. And what are you going to do?
A: ...
B: ...
A: Yes, I am.

III. Match a line in A with a line in B.

A

1. What are you interested in?
2. What did he do yesterday?
3. Will you study the commercial applications of minicomputers at your lab class tomorrow?
4. Will you explain some computer concepts to me, please?
5. When did you begin to study computer science?

B

a. Certainly, with pleasure!
b. Long time ago.
c. I'm interested in computer systems.
d. He made a new programme for the microcomputer.
e. I expect so.

Language Practice

Vocabulary

I. Complete the list of derivatives. Use your dictionary if necessary.

Verb	*Noun*	*Adjective*
1. ...	1. invention	1. ...
2. calculate	2.	2. ...
3.	3.	3. devisable
4.	4. production	4. ...
5.	5.	5. independent
6.	6. experiment	6. ...
7. ...	7.	7. reduced/ reducible
8. compute	8. ...	8. ...

II. Find in B the correct translation to the word in A.

A	B		
1. изобретать	a) to reduce	b) to invent	c) to employ
2. считать	a) to count	b) to operate	c) to communicate
3. продолжать	a) to produce	b) to embrace	c) to go on
4. разрабатывать	a) to work	b) to devise	c) to divide
5. много	a) a great deal of	b) a few	c) several
6. зависеть	a) to reduce	b) to define	c) to depend
7. счёты	a) counter	b) abacus	c) device

III. Match the words from both columns to make all possible word combinations.

1. calculating	a. network
2. wide	b. tables
3. easy	d. mathematics
4. logarithm	e. device
5. branch of	e. disc
6. global	f. way
7. floppy	g. application

Grammar: Past, Future Simple Active

IV. Give the Past Simple of the following verbs. Pay attention to irregular verbs. See Appendix 4.

to break	to understand	to change
to compile	to express	to be
to try	to break	to give
to read	to perform	to process
to think	to take	to drive
to find	to write	to know

V. Use one of the given verbs below to fill each gap. Put the verb in the Past Simple.

test read understand study solve

1. Andrew *compiled* a new programme yesterday.
2. I ... a book on the history of computers a week ago.
3. The students ... a calculating machine at the laboratory class last month.

4. All the students ... the basic concepts in computer science.
5. Julia ... a complicated problem at the lesson of Mathematics.
6. We ... scientific application of computers last week.

VI. Make the following sentences negative.

EXAMPLE:	*Computers*	***reduced***	*manpower.*
	Computers	**didn't reduce**	manpower.

1. The computer processed a lot of information. 2. First computers solved problems slower than a human being. 3. The computer changed my lifestyle to a great extent. 4. Mechanical devices increased labour productivity in industry. 5. The new computer stored data with high accuracy.

VII. Tell your friend when you did these things.

EXAMPLE: *to work on computer*
A: When did you work on computer?
B: I worked on computer at the computer centre yesterday.

to study different kinds of computers	*yesterday*
to calculate complex mathematical equations	*last week (month)*
to study the advantages of minicomputers	*two days ago*
to prepare complicated programmes	*the day before yesterday*

VIII. Put all possible questions to the following statements.

		The first	*computers*	*came out*	*in the USA*	*in 1946.*
	Did	the first	computers	come out	in the USA	in 1946?
When	did	the first	computers	come out	in the USA?	
Where	did	the first	computers	come out		in 1946?
		What		came out	in the USA	in 1946?

1. Engineers designed computers for particular purposes. 2. My groupmate studied the application of minicomputers last term. 3. The book on the history of computers dealt with basic capabilities of computers. 4. Computers changed the conditions of our work and life to a great extent.

IX. Choose the correct verb form.

1. The engineers discussed /were discussing new computer technology at 4 o'clock yesterday. 2. He explained / was explaining basic computer terms to us two days ago. 3. I was testing / tested a new device when you called me.

4. I was writing down / wrote down the results of the experiment from 9 to 10 a.m yesterday. 5. Helen learned / was learning two computer languages when she was studying at University.

X. You are discussing computers of the future with your groupmates. Say what the computers will look like.

The computer of the future	**will perform**	operations faster.
	will not (won't) be	very big.

To process data at higher speeds; to change the conditions of our work to a great extent; to differ from the computers in use today; to use tiny integrated circuits; to resemble a human being; to replace a person in every sphere of life

XI. Your friend studies computer science. Ask your friend when he will do these things.

EXAMPLE: *to work on microcomputer*
A: When will you work on microcomputer?
B: I will work on microcomputer tomorrow.

to study the capabilities and limitations of a new computer	*tomorrow*
to discuss advantages and disadvantages of PC	*in a day (three days)*
to study the minicomputer technology	*the day after tomorrow*
to check the main components of computer	*next Monday (week, month)*

XII. Put all possible questions to the following statements.

		They	*will*	*discuss*	*experimental*	*data*	*in a week.*
	Will	they		discuss	experimental	data	in a week?
What	will	they		discuss			in a week?
When	will	they		discuss	experimental	data?	
		Who	will	discuss	experimental	data	in a week?

1. Our industry will introduce complex robots with minicomputers into production in the future. 2. Computers will find wide applications in differ-

ent branches of engineering soon. 3. The students will compile new programmes in a month. 4. We will discuss all advantages and disadvantages of the Internet at tomorrow's conference.

XIII. Insert the necessary prepositions.

1. Students at the Technical University often carry ... different experiments. 2. Although Ivan gets very tired he always goes ... working. 3. A lot depends ... computers today. 4. Minicomputers save a great deal .... time. 5. All the students of our University have access ... the Internet. 6. This new device will find wide application ... many branches of industry.

XIV. Correct mistakes.

1. I studied the capabilities of a new computer tomorrow. 2. The first-generation computers will come out in 1950. 3. During the 18th century many people try to find easy ways of calculating. 4. The first calculating machine don't perform operations at high speeds. 5. Modern computers will to save a great deal of time. 6. Henry Briggs didn't invented calculus. 7. Soon a new generation of computers will appears. 8. The third-generation computers did appear in 1965.

XV. Translate the sentences into English using your active vocabulary.

1. Через несколько лет компьютеры станут меньше и более мощными. 2. Эти роботы будут использовать микрокомпьютеры. 3. Первые вычислительные машины появились в 1820 г. 4. Вы сравнили возможности двух видов компьютеров? 5. Они сделают программу для компьютера через неделю? 6. Наш профессор разработал новое устройство для вычислений. 7. Новое поколение компьютеров будет выполнять миллиард операций в секунду. 8. Компьютеры второго поколения выполняли работу в 10 раз быстрее, чем компьютеры первого поколения.

Reading and Speaking

I. Learn to read these words properly. Do you know their Russian equivalents? If not, consult the dictionary.

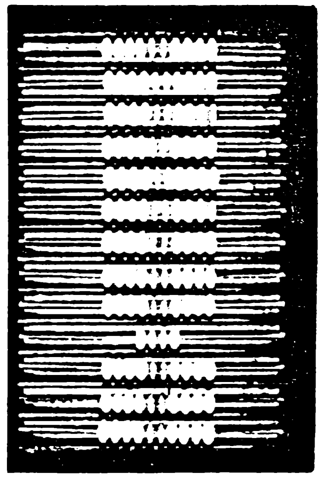
abacus [ˈæbəkəs]	gear [gɪə]
bead [bi:d]	binary [ˈbaɪnərɪ]
logarithm [ˈlɒgərɪðəm]	

II. Before reading the text try to answer the following questions.

1. What was the first calculating device? 2. What is the abacus? Do people still use it nowadays? 3. Who invented calculus? 4. When did the first real calculating machine appear? 5. What is Charles Babbage famous for?

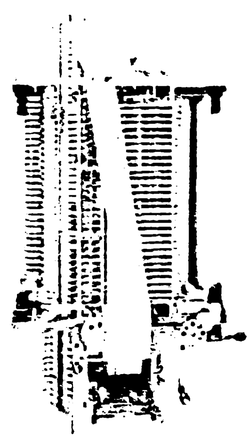
III. Now read the text about the history of computer systems and check your answers.

History of Computer Systems



The very first calculating device was the ten fingers of a man's hand. This, in fact, is why today we still **count** in tens and multiples of tens. Then people **invented** the abacus, a bead **frame** in which the beads move from left to right. People **went on** using some form of abacus well into the 16th century, and it is used in some parts of the world because it's not necessary to know how to read in order to use it.

During the 17th and 18th centuries, many people tried to find easy ways of calculating. The French **scientist** Blaise Pascal invented the first adding machine in 1642. His machine was mechanical in nature and it used gears to store numbers. John Napier, a Scotsman, **devised** a mechanical way of multiplying and dividing. He also **produced** the first logarithms. All mathematicians today use logarithm tables. Leibnitz, a German mathematician, **developed** the binary system of mathematics in the 1600s. Binary mathematics uses only the 0 and the 1, and arranges them to represent all numbers.



The first real calculating machine appeared in 1820 as the result of several people's experiments. This type of machine, which **saved** a great deal of time and **reduced** the possibility of mistakes, **depended on** a series of *gear wheels*[1] and used "punched cards". In 1830 Charles Babbage, an Englishman, began to design a machine that was later called the "*Analytical Engine*"[2]. Babbage showed this machine at the Paris Exhibition in 1855. It **contained** all of the basic elements of an automatic computer – storage, working memory and input device. Many of his ideas were the basis for building today's computers.

---

[1]зубчатые колеса; [2]аналитическая машина

IV. Arrange the following calculating devices according to the time of their invention.

the first adding machine	the "Analytical Engine"	the abacus
the first multiplying and dividing device	the modern calculator	the computer

V. Match these people with the country of their origin. Say what you know about each of them.

1. John Napier	a) England
2. Charles Babbage	b) Germany
3. Wilhelm Leibnitz	c) France
4. Blaise Pascal	d) Scotland
5. Bill Gates	e) Russia
6. Albert Popkov	f) the USA

VI. How are the following ideas expressed in the text?

1. Then people <u>created</u> the abacus. 2. People <u>continued to use</u> some form of abacus well into the 16th century. 3. J. Napier <u>invented</u> a mechanical way of multiplying and dividing. 4. This machine saves <u>a lot of</u> time. 5. This type of machine <u>is based on</u> a series of gear wheels.

VII. Work in pairs. In the Technical University tomorrow there will be an exhibition "A long way to computers".

Student A: The Dean of your Department has asked you to be a guide at this exhibition and describe to the visitors all the calculating devices displayed. Ask a specialist on computer history to find out as much information as possible about these devices. They are: *picture of man's two hands, an abacus, logarithm tables, the first adding machine, the Analytical Engine.*

Student B: You are a specialist on computer history. Answer the guide's questions about different calculating devices.

<u>You may start like this:</u>

Student A: Dear Mr Kosov, I would like to ask you several questions about some calculating devices.

Student B: Yes, what devices are you interested in?

A: Well, what was the very first calculating device?

B:

A:

Further Reading

I. Are you good at computers? Try to answer the following questions to check your knowledge. Is there anybody in your group who knows all the answers?

1. When did the first generation of computers appear?
2. The first-generation computers used vacuum tubes, didn't they?
3. What did the second-generation computers use instead of vacuum tubes?
4. How did the computers of the third generation differ from those of the first and the second generations?
5. Do we have computers that complete millions of operations per second?
6. What was the first PC called?

II. Read the text and check your answers.

Let's have a look at the history of computers. The first **general-purpose** electronic digital computer **came out** in the USA in 1946. It was called ENIAC (Electronic Numerical Integrator And Computer). ENIAC contained about 18,000 vacuum tubes, weighed more than 30 tons, **occupied** more than 1,500 square feet of floor space, and **consumed** 150 kilowatts of electricity during operation. The **first-generation** computer performed about 5,000 additions and 1,000 multiplications per second and was slow **in comparison with** modern machines. In the late 1950s the second generation of computers appeared and these performed work ten times faster than the first computers. The reason for this extra speed was the use of transistors instead of vacuum tubes. The third-generation computers appeared in 1965. They performed a million calculations per second, which was 1,000 times as many as first-generation computers. Now tiny integrated circuits controlled computers.

By the late 1960s many large businesses depended on computers. Many companies **linked** their computers into networks and that made it possible for different offices to share information. During this time computer technology **improved** rapidly. In the 1970s there appeared a microprocessor. And in 1975 American engineers devised the first personal computer, Altair. Millions of individuals, families and schools began to use PCs.

Present-day computers complete millions of instructions per second. Some experts predict that a new generation of **intelligent** machines will process data with the help of beams of laser light, rather than electric current. They say that these computers will store data on individual molecules and that virtual reality will play a large role in education.

III. Complete the sentences.

1. The first-... computers ... 5,000 ... and 1,000 ... . 2. The ...-generation ... performed ... ten times faster than the ...-generation .... 3. The second-generation computers used ... instead of ... . 4. Many companies ... their computers into ... . 5. Future computers ... probably ... data with the help of ... of laser light. 6. Some experts predict that ... ... will ... a large role in education.

IV. Expand these sentences with the information from the text.

1. The first-generation computers were slow. 2. The second-generation computers used transistors. 3. There were many improvements in the third generation of computers. 4. People became dependent on computers. 5. Computers of the future will be better.

V. Give a title to the text.

Activity

I. Play a guessing game.

Student A: Choose one of the calculating devices given below. Student B will have to guess what device it is. Answer his questions (<u>no more than five!</u>).
the Analytical Engine, the abacus, the ENIAC
the calculator, the Altair, the modern computer

Student B: Ask no more than five <u>general</u> questions to guess what calculating device Student A has chosen.

II. You and your friend are preparing for the exam in Computer Studies. Ask each other different questions to check your knowledge of the subject.

<u>These are possible questions:</u>

1. When and where did the first calculating machine appear?
2. What calculating machines do you know?
3. What is ENIAC?
4. I wonder how many calculations the first-generation computer performed per srcond?
5. The second generation of computers workcd faster than the first computers, didn't it?
6. ...

I. Describe the computer you would like to have in the future.

II. Do you know what computers of the future will look like? Translate the text into Russian to find it out.

Computers of the Future

In the 1980s some scientists predicted: "By the year 2000 we will have a network planet. In offices, shops, factories and homes there will be small machines that will help us communicate with distant computers. We will ask them questions, perform calculations and enter data that computers will store, process and act upon. Probably all the professions will have their own data banks. People will use home terminals for education, planning vocation and sheer entertainment. They will buy theatre tickets, airline tickets, and manage their bank accounts with the help of the Internet".

All this is reality nowadays. But the potential uses of computers are still endless. Today scientists predict that we will have machines that are as intelligent as we are. Here are some of their predictions:

- cars will report good and safe driving;
- a TV set will choose programmes that the viewer enjoys. Better yet, it will not repeat annoying commercials;
- a house will sense the mood of its owner: the coffee machine will kick in (=start working) when it's needed.

Unit Four

ROBOTICS

Section A. Robots Components

Lead-in

I. Discuss these questions.

a) Can you imagine the present life without robots?
b) What is a robot? Do we depend on robots a lot today? Give your reasons.

II. Peter worked at the Motor Plant. He hasn't seen his friend Nick for a long time. Listen to their dialogue and say what operations robots perform.

Peter: Hello, Nick.
Nick: Hello, Peter. I haven't seen you for ages. Where have you been?
Peter: I have been to the **Motor Plant**. I've studied the **industrial** applications of robots there.
Nick: You have learned a lot of interesting things, haven't you?
Peter: Oh, definitely. I have seen various types of robots in operation.
Nick: Have you? And what operations do they perform?
Peter: Well, they **pick up** and **place** different objects, **carry** the objects from one place to another, in short they replace men in all kinds of jobs.
Nick: Have you got any useful **experience** for your future career?
Peter: Sure, and I'm going to make a diploma project on industrial robots.
Nick: I see. Well, good luck to you then.
Peter: Thanks.

III. Complete the dialogues.

a) *A:* ...
B: I've been to the Steel Works.
A: ...
B: Yes, I have.

b) *A:* What operations do robots perform?
B: ...

A: ...

B: Certainly, I have. And I would like to carry out research on industrial robots.

A: ...

B: Thanks a lot.

IV. Match a line in A with a line in B.

A	B
1. Where have you been?	a. It's a special device that does the mechanical work and resembles a human arm.
2. What has Alex done?	b. Yes, I have.
3. What has the engineer devised?	c. It's a machine that performs certain tasks.
4. What is a robot?	d. A new type of a robot.
5. What is a manipulator?	e. I've been to the plant.
6. Have you studied industrial applications of robots?	f. He has just finished his work.

Language Practice

Vocabulary

I. Here are some suffixes to make an adjective. Translate them into Russian.

1. Verb + **-able, -ible**

reproduce (*воспроизводить*) reproducible (*то, что можно воспроизвести, воспроизводимый*)

programme (...) programmable (...)
read (...) readable (...)
repair (...) repairable (...)
interchange (...) interchangeable (...)
break (...) breakable (...)

2. Verb + **-ant, -ent**

differ (*различаться*) different (*различный*)
depend (...) dependent (...)
insist (...) insistent (...)
resist (...) resistant (...)
signify (...) significant (...)

3. Noun + **-al**

centre (*центр*)	central (*центральный*)
culture (...)	cultural (...)
mechanic (...)	mechanical (...)
technology (...)	technological (...)
magic (...)	magical (...)
globe (...)	global (...)

II. What is special about the nouns and verbs of the following words?

bend spring change advance finish cause start

III. Match the words with the opposite meaning.

1. increase	a. rest
2. bend	b. start
3. motion	c. shorten
4. switch on	d. disadvantage
5. finish	e. straighten
6. advantage	f. reduce
7. widen	g. switch off

IV. Find in B the correct translation of the word in A.

A	B		
1. улучшение	a) advantage	b) advance	c) spring
2. важный	a) capable	b) available	c) essential
3. пружина	a) spring	b) capacity	c) actuator
4. даже	a) although	b) even	c) recently
5. растягивать	a) to straighten	b) to extend	c) to cause
6. приводить в действие	a) to manipulate	b) to switch on	c) to actuate

Grammar: Present Perfect (Active)

V. Give Participle II of the following verbs.

go	become	bring
learn	put	throw
apply	study	cut
know	choose	build
make	pay	invent
begin	drive	find

VI. Say what these people have done.

EXAMPLE: Professor Frolov works at the Technical University.
invent / a new calculating method / recently
He has invented a new calculating method recently.

1. Andrew is a student of Robot Engineering.
   study / robot components / recently
2. Helen is at the laboratory class.
   carry out / an experiment with a robot / just
3. Professor Kosov is a famous engineer.
   develop / a new design of a robot / lately
4. Paul is checking robot components.
   check / the robot programme / already
5. The student is in the Demonstration Hall now.
   observe / the robot in operation / just

VII. Give the opposite to the following sentences.

1. Scientists haven't made any important developments in technology over the last 10 years.
2. The Professor has described achievements in robotics to his students.
3. I have never been to the Museum of Technology in Amsterdam.
4. He has already studied robot history.
5. The laboratory has recently recieved a new model of a robot.

VIII. Ask your fellow student if he has already done these things.

EXAMPLE: *to make a discovery – yet*
A: Have you made a discovery yet?
B: Yes, I (we, they) have. I (we, they) have already made a discovery.
or
B: No, I (we, they) haven't. I(we, they) haven't made a discovery yet.

to learn interesting facts about robots	*yet*
to develop a new technology	*just*
to design a modern robot	*recently*
to invent a new robot component	*yet*
to learn about robot's abilities	*this week*
to visit the exhibition of new robots	*lately*

IX. Put all possible questions to the following statements. Consult the table.

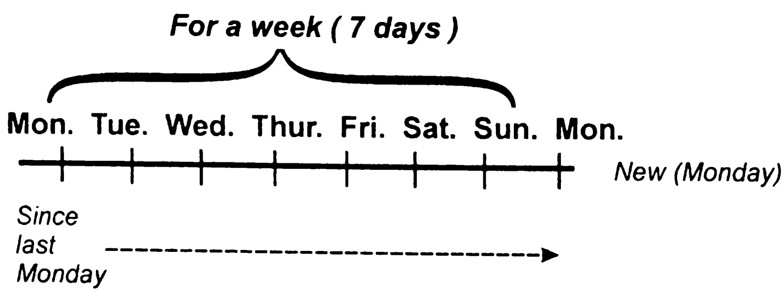
		They	*have*	*just*	*tested*	*the new equipment*	*in the lab.*
	Have	they		just	tested	the new equipment	in the lab?
What	have	they		just	tested		in the lab?
Where	have	they		just	tested	the new equipment?	
What equipment	have	they		just	tested		in the lab?
		Who	has	just	tested	the new equipment	in the lab?

1. The operator has already changed the direction of the robot manipulator. 2. She has become famous for her invention. 3. We have studied the robot's application at the class today. 4. Our engineers have just completed the description of the system in operation.

X. Make up some questions for the following answers. The answers needn't be true.

1. Yes, I have. 2. I've been to London. 3. I've observed the new industrial robot. 4. Unfortunately, not yet. 5. I've seen him recently. 6. He has already finished the experiment.

XI. Put *for* or *since* into each gap.



1. I haven't seen Paul ... January. 2. He has worked for this company ... 2 years. 3. The students have studied the robot's application ... a month. 4. Alex has been at the laboratory class ... this morning. 5. We have known about this achievement ... a long time. 6. A group of students has worked on this project ... the beginning of the term.

XII. Choose the correct verb form.

1. A group of engineers has applied / applied the new technology recently. 2. Our teacher described / has described the manipulator at the lesson yes-

terday. 3. When did you change / have you changed the robot programme? 4. I have never tested / never tested the new equipment. 5. Did you ever study / Have you ever studied the robot history? 6. Andrew has changed / changed the robot application two days ago.

XIII. Insert the necessary prepositions.

1. I often go ... the Museum of Science. 2. I've learned a lot ... engineering history. 3. The principles of robot technology stretch ... thousands of years. 4. There are numerous advances ... the field of robot technology. 5. Only ... the 1950s engineers managed to build the first generation of computers. 6. Modern robots are capable ... many life-like actions.

XIV. Correct mistakes.

1. The design and materials for robots has changed over the years. 2. Professor Levashov developed new moving devices lately. 3. I know Dr. Kosov from the Department of Mechanical Engineering since 1999. 4. Did you have carried out your research work yet? 5. Where you have been? I worried about you. 6. Michal not has checked the programme.

XV. Translate the sentences into English using your active vocabulary.

1. Недавно белорусские ученые изобрели новую технологию. 2. Им стали известны некоторые интересные факты из истории роботов. 3. Они только что продемонстрировали возможности робота. 4. Она в лаборатории с 9 часов. 5. Он стал известным благодаря своему изобретению. 6. Мы еще не создали новый привод. 7. Студенты уже изменили программу робота. 8. Они уже установили манипулятор в новый робот.

Reading and Speaking

I. The 20th century has produced many important achievements in science and technology. Robots are one of them. In groups list as many spheres of robot application as possible. Compare your list with those of other groups.

II. These words are from the text below. Consult your dictionary to check their meaning.

cog, *n*	touch, *n*
throughout, *adv*	appearance, *n*
sophisticated, *adj*	

What do you think the text is about?

III. Read this text attentively and learn some facts from robot history.

Although the development of robots seems a very modern idea, the principles behind this new technology were known thousands of years ago. Even ancient Greeks and Romans used mechanical cogs and **gears** which are now an **essential** part of robot technology. In the Middle Ages there was a real breakthrough in the development of **robot engineering**. At that time many types of mechanical devices **appeared.** At the end of the 17th century engineers already knew about most of the mechanical components that make up a modern robot.

Throughout history inventors have produced a variety of seemingly magical mechanical devices capable of quite life-like actions. These devices were not programmable, they were simply performing a set of operations. Different scientists and engineers have **applied** many **advances in** this **field** since that time.

Today's robot is a very **complex** structure. A metal or plastic frame serves for a skeleton, and a variety of **actuators provide muscle** power. But the new humanoids are not just bodies, they are also sophisticated sensing machines with cameras, microphones, even specific sensors that imitate the sense of touch. And then there are the brains. Nowadays scientists haven't yet **created** such a robot that can think. But who knows, maybe in the future it will not only resemble a human being in appearance but will also have the **capacity** to think and feel.

IV. Answer the questions.

1. When did people learn the main principles of robot technology?
2. Did ancient Greeks and Romans know anything about robots?
3. When did engineers learn about most of the mechanical components of a robot?
4. Is today's robot a simple structure?
5. Would you like to have a robot friend?

V. Complete the sentences.

1. Today the students ... some facts about ... history. 2. Ancient Greeks and Romans used ... cogs and gears which are now an ... part of ... . 3. At the end of the 17th century engineers already knew about most of the ... that ... a modern robot.4. Throughout history ... have ... a variety of seemingly magical ... devices. 5. These devices were simply ... a ... of operations. 7. A robot consists of a metal or plastic ... and a variety of ... provide muscle ... . 8. Today's robots are sophisticated ... machines that have ..., microphones and specific ... that imitate the ... of ... .

VI. Expand these sentences with the facts from the text.

1. The basic principles of robot technology were known thousands of years ago. 2. The Middle Ages produced advances in robot technology. 3. There were many mechanical devices in the past. 4. A modern robot is a complex engineering structure. 5. It's difficult to predict what the robots of the future will look like.

VII. You have just listened to the lecture on the history of robot technology. You still have ten minutes before the break and the teacher has asked you to tell him what new facts you have learnt. Make a short report.

Further Reading

I. There's a great number of new words and phrases in the following text. Study their meanings.

shake, *v*	трясти, пожимать
shake hands with smb	пожать руку кому-л.
clamp, *n*	зажим; захват
jaw, *n*	тиски
rigid, *adj*	неподвижно закрепленный
ridged, *adj*	хребтообразный
deflect, *v*	прогибать(ся), сгибать(ся), отклонять(ся)
grip, *v*	хватать, сжимать, брать
elephant, *n*	слон
trunk, *n*	хобот
hose, *n*	шланг

II. Read the title of the text and look at the pictures. What do you think the text is about? Would you like to shake hands with such a robot?

III. In the previous text you have learned some facts about the history of robots. Now read about the latest achievements in robot engineering.

Shake Hands with a Robot

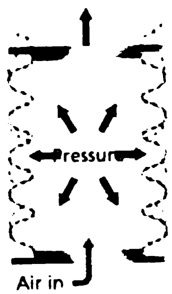
Shake hands with Vorscht – that's what engineers at University in Edinburgh are saying. Recently they have devised this brand new robot. Vorscht's handshake is not the metallic, jaw-like clamp of the robots that are used on **production lines** in industry. It's a softer, gentler grasp, like gripping the trunk of an elephant, or **even** shaking hands with another person.

Take a rigid plastic tube, rather like a vacuum cleaner hose. Close one end, and blow air in the other. The tube **stretches** slightly (see Box 1). The increased pressure inside the tube **causes** it to **extend**.

Take three of these tubes and **mount** them side by side to form an assembly called an actuator. Increase the pressure in two of the tubes, and the actuator **bends** (see Box 2). **Reduce** the pressure and it **straightens up** again. That's how the fingers on Vorscht's hands bend when they grip your hand.

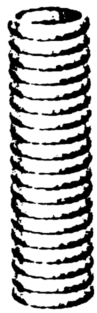
BOX 1

An individual element is a plastic tube with ridged sides, like bellows.



Increasing the pressure inside the tube causes it to extend.

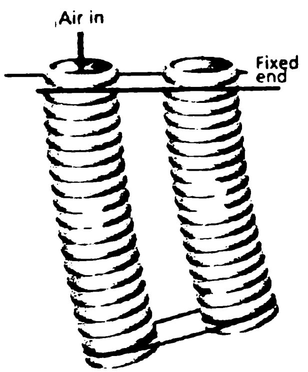
The sides of the tube are like a spring — reduce the pressure and it springs back to its original length. This occurs because of the elasticity of the material, like that of an elastic band.



BOX 2

With two elements, the actuator can move from side to side. Greater pressure in element 1 makes it bend to the right.

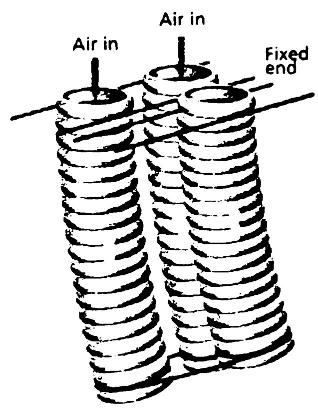
This is called bending in a plane.



Pressure 1 > pressure 2

With three elements, the actuator can be made to bend in any direction.

The greater the differences in pressure, the more the tip of the actuator is deflected.



Pressure 1 = 2 > 3

IV. Say if the following sentences are true or false. Correct the false ones.

1. Vorscht is the name of the company that produces robots. 2. When you shake hands with Vorscht you feel metallic jaw-like clamp. 3. The ridged plastic tubes that the robot consists of look like a vacuum cleaner hose. 4. When you increase pressure inside a ridged tube the tube springs back to its original length. 5. The tubes are made of elastic material. 6. When an actuator consists of three tubes it can't bend in any direction.

V. Explain to your groupmates how this robot works.

1. Take a tube, ... 2. ... one end, ... in the other. 3. The tube ... 4. The increased ... causes it to extend. 5. If you increase the pressure in two of the tubes, the ... 6. If you reduce ..., the actuator ... again.

VI. You have just studied the work of different types of actuators at the practical class. Now explain to your friend the main differences between them. Consult the boxes above.

VII. Make a list of different applications of such a robot as Vorscht.

Activity

I. Work in pairs. Ask your partner if he has been to these places.

EXAMPLE 1. *A:* Have you ever been to the automobile works?
B: I have never been to the automobile works?
A: *Neither have I.* But I don't mind going there.

EXAMPLE 2. *A:* Have you ever been to the tractor works?
B: I've never been there, but I've been to the machine-building works.
A: *So have I.*

Phrases to use:

Japanese Electronic Company
the Watch Factory
Oxford University
British Steel Works
Belarusian-German Joint Venture
the Ball-bearing Works in Minsk

II. Group work. A very rich businessman wants to buy a robot to help his wife about the house. He has asked a prosperous engineering company to devise such a robot for him.

a) Engineers: Divide into small groups and design such a robot. When designing consider the following:
– its functions (ability to cook, clean, wash, perform different instructions)
– its cost
Present your project to the businessman.

b) Businessman: Listen to the presentation of each group and ask questions about these robots. Choose the robot you liked most.

Writing

I. Expand the text about robots with the information given below. Use *such as, for example, that ...* .

You can begin like this:

Many of the robots today perform different jobs **that** are especially difficult for human workers, **for example**, they move heavy things and fix electronic parts. Robots are used in various branches of industry, **such as** automanufacturing and instrument making. ...

Robots

Many of the robots today perform different jobs. Robots are used in various branches of industry. A modern robot is a complex structure with a number of components. Each of them performs a certain task. Scientists have recently developed new models of robots. Such robots are used for various purposes.

Add this information:

1. Some jobs are especially difficult for human workers.
2. Robots move heavy things and fix electronic parts.
3. Robots are used in automanufacturing and instrument making industries.
4. Manipulators do all the mechanical work.
5. Sensors detect heat, size and sound.
6. New models of robots imitate human beings.
7. These robots paint automobiles inside, help patients in hospital, carry fragile objects.

II. This is an extract from a scientific journal. Read and translate it into Russian.

Man-made Man

In the past few years, we have seen important advances in computer science, biomechanics and material science, which have caused great changes in robot engineering.

Today a robot is not just a metal structure. It is already capable of expressing different emotions and imitating simple operations. Engineers and scientists have written a lot of complicated programmes for robots but it is still very difficult to make a thinking machine. Chess, for example, involves a great deal of human brainpower, but for robots playing chess is a simpler task than, say, making soup. A chess player needs only information and logic but what about making soup? You cut some vegetables, boil some bones, add some spices. But what vegetables and how many? How to distinguish potatoes from chicken? And, by the way, whose bones to put? And how can a robot possibly add salt with no sense of what "saltness" means?

So you see that in order to have human-like machines that will work in real-world situations scientists still have a lot of work to do.

Section B. Robots in Operation

Lead-in

I. Have you ever seen how a robot works? Where did you see it and what operations did it perform?

II. Mr. Kosov, a reporter from the University newspaper, is talking to Paul, one of the students at this University. Listen to their dialogue and learn what the students do at the practical classes in Robotics.

Mr. Kosov: Paul, I'd like to talk to you. I'm interested in your practical classes in Robotics. Will you tell me about them?

Paul: Certainly. Yesterday we watched how a robot worked.

Mr. Kosov: Really? Had you seen robots before that?

Paul: Well, yes, I had, but only on TV. In reality it's an impressive sight.

Mr. Kosov: What had you done before you **started** your work?

Paul: Before that we had **prepared** all the necessary workpieces and tools in our laboratory.

Mr. Kosov: That's very clever of you and in general do you like your practical classes in Robotics?

Paul: Oh, yes. We learn a lot of interesting information about robot engineering and at these lessons we can **carry out** different experiments ourselves. For example, last time our teacher gave us a task to perform a series of experiments with a **gripping device**.

Mr. Kosov: It sounds interesting. Have you **finished** your work yet?

Paul: Unfortunately, not yet.

Mr. Kosov: By what time will you have finished it?

Paul: I hope we'll have finished it by 4 o'clock today.

Mr. Kosov: Well, thank you very much. And good luck with your studies.

Paul: Thanks.

III. Complete the dialogues.

1. *A:* I'd like to talk to you about robot engineering. ...
   B: ...
   A: Really?
   B: ... but only on TV.
2. *A:* Do you like your practical classes in Robotics?
   B: ...
   A: It sounds interesting.
3. *A:* ...
   B: Unfortunately, not yet.
   A: ...
   B: ... by 2 pm tomorrow.

IV. Match a line in A with a line in B.

A

1. Can you tell me about new achievements in Robotics?
2. We checked a new device yesterday.
3. What had you done before Alex came?
4. Are you interested in Robotics?
5. Have you prepared all the devices for the experiment?
6. Good luck with your exams.
7. By what time will you have improved the gripping device?

B

a. I had finished the test.
b. Thanks.
c. Oh, yes, I am.
d. Unfortunately, not yet.
e. I'll have done it by next week.
f. Certainly, with pleasure.
g. Did you?

Language Practice

Vocabulary

I. Match the English words with their Russian equivalents.

1. research	a) движение
2. effector	b) возможность
3. force	c) оборудование
4. pressure	d) исследование
5. motion	e) опасный

6. equipment — f) давление
7. possibility — g) исполнительный орган
8. hazardous — h) сила

II. Make up all possible word combinations from both columns.

1. to widen	a) information
2. to switch off	b) one's possibilities
3. to install	c) an experiment
4. to perform	d) equipment
5. to provide	e) an electric device

Grammar: Past and Future Perfect (Active)

III. Complete these sentences using the verbs in brackets.

EXAMPLE: Alex had prepared everything for the experiment by the beginning of the lesson. (*to prepare*)

1. I ... the switches on the control panel when the Instructor came. (*to check*). 2. The students ... a series of exercises by the end of the week. (*to perform*). 3. Paul ... the necessary measuring devices before the classes began. (*to prepare*). 4. The scientist ... already ... a new model of a robot before he became famous. (*to develop*)

IV. You are now at the practical class in Robotics.

a) Ask your friend if he had done the following things by certain time in the past.

EXAMPLE: *to prepare everything by 5 o'clock*
A: Had you prepared everything by 5 o'clock yesterday?
B: Yes, I had. I had prepared everything by 5 o'clock yesterday.
or *B:* No, I hadn't. I had not prepared everything by 5 o'clock yesterday

to develop a new robot power system	*by that time*
to invent a new gripping device	*by the end of the week*
to widen the robot's abilities	*by 8 o'clock yesterday*
to increase product quality	

b) Ask your friend what he will have done by certain time in the future.

EXAMPLE: *to finish one's work by 5 o'clock*
A: Will you have finished your work by 5 o'clock?

B: Yes, I will. I will have finished my work by 5 o'clock.
or *B* No, I won't. I will not have finished my work by 5 o'clock.

to mount a new gripping device	*by 4 o'clock*
to finish the test with a new robot	*by that time*
to develop a new type of an actuator	*by the end of the month*
to design a new type of a robot	

V. Ask your groupmates what will have happened to these substances under different conditions.

EXAMPLE: *lead – to heat to 1,000 °C – to melt*
A: What will have happened to lead when you heat it to 1,000°C?
B: It will have melted.

liquid	– to cool to -40 °C	– to freeze
gas	– to compress	– to explode
water	– to heat to 800 °C	– to evaporate
mercury	– to heat to 100 °C	– to expand

VI. Give the opposite to the following sentences.

1. By that time the students had already completed their research. 2. The students of our department will have passed all the exams by the end of May. 3. When the teacher entered the lab the mobile robot had already performed many different tasks. 4. When you come to see me I will have already finished to test a new industrial robot. 5. My assistant had done all the preparatory work by the time I came to the research room. 6. I will have already studied the new unit by 7 p.m.

VII. Put all possible questions to the following statements. Consult the tables.

a)		*He*	*had*	*checked*	*a gripping device*	*by 5 yesterday.*
	Had	he		checked	a gripping device	by 5 yesterday?
What	had	he		checked		by 5 yesterday?
By what time	had	he		checked	a gripping device?	
		Who	had	checked	a gripping device	by 5 yesterday?

1. He had already become a famous scientist by that time.

2. The engineers had designed first robot systems by the end of the 19th century.

3. The engineers had equipped the robot with new sensors before they put it into operation.

b)		*She*	*will*	*have developed*	*a new method*	*by 5 tomorrow.*
	Will	she		have developed	a new method	by 5 tomorrow?
What	will	she		have developed		by 5 tomorrow?
By what time	will	she		have developed	a new method?	
		Who	will	have developed	a new method	by 5 tomorrow?

1. The engineers will have constructed a new moving device by the end of May.

2. The students will have completed an experiment before the class begins.

3. The robot designers will have developed a new model of a robot by the beginning of June.

VIII. Insert the necessary prepositions.

1. When people invented the robot they relieved themselves ... difficult work. 2. I have never seen a robot ... action. 3. I need necessary information ... the robot's motions. 4. When you complete the work put all the devices ... storage. 5. The robot operates very accurately ... the help of a special device. 6. After the engineer had switched ... the device it began to work.

IX. Correct mistakes.

1. My brother had never study robot engineering before. 2. The teacher will has explain the new material by the time you come to the lecture. 3. Will have the engineers improved the electrical system by the beginning of September? 4. People invented mechanical devices long before the first robot was designed. 5. The students didn't have finished the experiment by the end of the lecture.

X. Translate the sentences into English using your active vocabulary.

1. – Что вы сделали до того, как начался эксперимент? – До того, как начался эксперимент, мы проверили все оборудование и подготовили необходимые материалы. 2. После того, как оператор включил не-

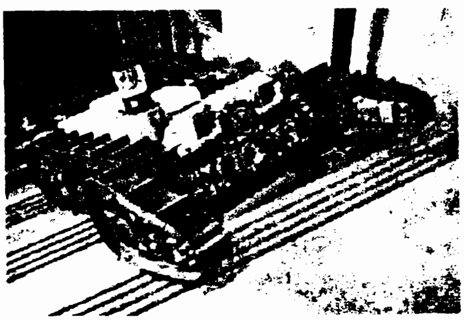
обходимые приборы, робот начал выполнять ряд операций. 3. После того, как человек придумал робота, он освободил себя от монотонной и опасной работы. 4. Робот закончил все операции к шести часам. 5. – Вы завершите эксперимент к семи часам? – К сожалению, нет. Думаю, что мы выполним его к восьми часам.

Reading and Speaking

I. In the text below you will find a word combination "feedback device". Can you guess what its function is? Scan the text to check your answer.

II. Yesterday the students of Robot Engineering had a practical class in Robotics. Look at these questions and read the text to find the answers.

1. How did the invention of the robot affect the man?
2. What system directs the manipulator's actions?
3. What did the robot do after the manipulator had finished all the operations?
4. Did the students enjoy the work of the robot?
5. What will the students have learned by the end of the term?



Man **widened** his **possibilities** and **relieved** himself from **monotonous** and **hazardous** tasks after he had invented the robot. Nowadays there's an endless variety of robots in the size, shape and jobs they perform. Scientists and engineers devise robots both for industry and homes. Some of the robots are experimental and look more like living creatures. Many people are working today in the field of **robotics** and they are trying to find new applications for robots in the future.

Now let's have a look at some students of the Technical University that study Robotics. Yesterday they saw a robot in operation. They had never seen a robot before. After the operator had **pushed** some buttons the robot began to perform a **sequence** of operations. By the time the manipulator performed some actions, feedback devices had provided the necessary information about the robot's motions and positions.

The control system directed the manipulator's actions. After the manipulator had completed all the operations, it put all the workpieces into storage. With the help of a gripping device, the robot operated very accurately and precisely. When the robot completed all the actions the operator **switched it**

off. By the end of the term the students will have learned everything about robot design, i.e. the body structure, the power system, the control system and various sensors, actuators and manipulators.

III. What expressions with these words can you find in the text?

Robot, tasks, operations, device, actions, information; to relieve, to perform, to provide.

IV. Complete the sentences.

The students ... never ... a robot before then. After man had ... the robot, he ... his possibilities and ... himself from monotonous and ... tasks. ... the time the manipulator ... some actions, feedback devices had ... the necessary ... about the robot's motions. By the end of the ... the students will ... ... everything about robot ..., i.e. ... system, actuators, ... and ... systems.

V. Your friend and you carried out the first experiment with a robot yesterday. Tell your scientific supervisor what actions you both performed and what results you obtained.

Further Reading

I. When you read the text about the robot called Vorscht you learned the word "actuator". Do you remember what it means? Do the quiz to check your memory.

An actuator is ...

a) a device that analyses and stores information.
b) a device that is always active.
c) a device which puts a machine into motion or mechanical action.

II. Look at the picture in the text. What do you think the text is about? Skim it quickly to check your answer.

III. Read the text attentively to learn how the most common manufacturing robot works.

When engineers devised a steam engine in the 18th century, some people said that they had already invented everything possible. However, our mankind has produced a great number of other inventions since that time. Robots are one of them.

Nowadays people use 90% of robots for heavy, **repetitive** manufacturing work. These robots **handle** tasks that are difficult, dangerous or boring to human beings.

The most common manufacturing robot is the **robotic arm**. It typically **consists of** seven metal segments. Tiny motors or actuators put them into operation when a special computer gives them **certain** instructions.

An industrial robotic arm with six joints closely resembles a human arm – it has the equivalent of a shoulder, an elbow and a wrist. This type of robot has six **degrees of freedom**, i.e. it can turn in six different ways. A human arm, by comparison, has seven degrees of freedom. Your arm moves your hand from place to place. Similarly, the robotic arm moves an **end effector** from place to place. You can supply robotic arms with all sorts of end effectors, which will perform a certain task, for example it will grasp and carry different objects. Robotic hands often have built-in **pressure sensors** that tell the computer how hard the robot is **gripping** a particular object. That's why the robot doesn't **drop** or break whatever it's carrying. Robots do their work more **efficiently** than human beings because they are so precise. They always drill in the exactly the same place, and they always tighten bolts with the same amount of **force**, no matter how many hours they've been in operation.

IV. Say whether these statements are true or false. Correct the false ones.

1. When engineers created a robot some people said that they had already created everything possible. 2. Engineers build 90% of robots for entertainment nowadays. 3. The most widely-spread manufacturing robot is the robotic arm. 4. You can supply the robotic arm with various actuators. 5. A special programme in the computer tells the robot not to drop the object it is carrying. 6. Robots are more efficient in their work than human beings because they are smarter.

V. Expand these sentences with the facts from the text.

1. People use robots in industry for various reasons. 2. The robotic arm resembles a human arm. 3. The end-effectors in the robotic arm perform different tasks. 4. Robotic hands often have built-in pressure sensors. 5. Robots are very precise in their work.

VI. You have just come back from the Motor Works where you watched the work of various robotic arms. Tell your friends about the structure of the robotic arm and the basic principles of its operation.

VII. Think of a good title to the text.

Activity

I. Michael didn't attend the practical class yesterday because he was ill. But now he wants to know what his groupmates did at the class. Make up dialogues using the following model.

EXAMPLE: *Michael:* Did you control the gripping device yesterday?
Alex: No, I didn't. Paul had already done it.
Michael: When did he do it?
Alex: He did it the day before yesterday.

to test the new device yesterday / on Monday;
to measure the dimensions of the workpieces yesterday / two days ago;
to check the power system of the robot yesterday / long ago;
to control the quality of workpieces yesterday / last week;
to investigate the properties of engineering materials / the day before yesterday.

II. Discussion. It was long time ago when people devised the first prototype of a robot. Nowadays we are close to making humanlike machines. Will these robots improve our life or will they make it worse?

a) Read the following arguments and think of your own.

For creating humanlike robots	*Against creating humanlike robots*
1. They will save us.	1. They will destroy us.
2. They help us in dangerous and routine tasks.	2. They can't work without constant supply of energy.
3. They never have any problems and never complain.	3. They can go out of control.
4.	4. ... .

b) Discuss the problem in groups of 3–5 students and try to reach an agreement.

Writing

I. Study the picture below and describe the operations of this industrial robot. The words provided will help you.

a robotic arm, an end-effector, degree of freedom, built-in pressure sensors, actuators;

to pick up, to place, to grip, to carry, to pivot

II. Translate the text into Russian. Use the dictionary if necessary.

Different companies all over the world are trying to improve robots. The engineers and scientists at the Technical University in Eindhoven reported that they had created a new mobile robot. Let's have a look at their "beautiful creature".

Hydraulic pistons move the robot legs back and forth. The pistons are attached to different leg segments just like muscles are attached to different bones. Engineers said it had been really difficult to make all these pistons work together properly. The robot figures out the right combination of piston movements in walking and it programs this information into the robot's computer. This mobile robot has a built-in balance system that tells the computer when it needs to correct its movements.

The engineers from this University are working at another type of a mobile robot now and they will have built a more stable robot walker by the end of the year. It will have six legs like insects because of their exceptionally good balance and the ability to adapt well to a wide variety of unfamiliar environments.

Unit Five

AUTOMOTIVE ENGINEERING

Section A. Some Car Systems

Lead-in

I. a) List as many car systems as possible. Compare your list with the rest of the group. Who's got the longest list?

b) What is the fuel system used for?

II. Philip, a student of Automotive Engineering, has met his friend Alex in the laboratory testing. Listen to their dialogue and learn the basic principle of the carburettor operation.

Philip: Hello, Alex! What are you doing?

Alex: Well, I'm studying the **fuel system** of this car. Now I can tell you a lot about the basic principles of its operation.

Philip: Really? O.K. Let me see. Do you know the name of that little device near the engine?

Alex: Sure, it's called a **carburettor**.

Philip: And what is it used for?

Alex: Well, it measures out a precise **amount** of fuel that is **mixed** with the correct amount of air.

Philip: And do you know the principle of the carburettor operation?

Alex: Oh, that's easy. First, air is **drawn** down the **air intake** (it is located directly above the carburettor) into a **venturi** where its pressure is lowered. That's why, the fuel will **flow** into the venturi.

Philip: Will it flow because of the low pressure of the air?

Alex: Right you are. Then the air is mixed with the fuel before this mixture is taken into the cylinder **combustion chamber**.

Philip: Is it really? And what happens with this fuel mixture in the cylinder combustion chamber?

Alex: It is **ignited** there and is drawn into the engine afterwards.

Philip: I see.

III. Complete the dialogues.

1. *A:* What are you doing now?
   B: ...
   A: Can you tell me anything about it?
   B:
2. *A:* ...
   B: Oh, it's called a carburettor.
   A: And what is it used for?
   B: ...
   A: ...
   B: That's easy. First air is drawn down the air intake into a venturi.
   A: Where is the air intake located?
   B: ...
   A: And what happens next?
   B: ...
   A: I see.

IV. Match a line in A with a line in B.

A

1. Where were you yesterday?
2. What were you studying in the lab?
3. Where is the fuel mixed with the air?
4. What is a venturi?
5. What happens in the combustion chamber?
6. What is a carburettor used for?

B

a. It's a special tube in the carburettor.
b. It's used for mixing fuel with air.
c. The fuel system of a car.
d. The fuel mixture is ignited.
e. In the lab.
f. In the carburettor.

Language Practice

Vocabulary

I. Match the English words with their Russian equivalents.

a. steering	привод
b. accelerator	двигатель внутреннего сгорания
c. advantage	независимая подвеска

d. independent suspension	бак
e. internal combustion engine	топливная система
f. drive	ускоритель
g. fuel system	рулевое управление
h. tank	достоинство

II. Fill in the table with the missing forms of the following words. Use your dictionary if necessary.

Verb	*Noun*	*Adjective*
1.	safety	
2.		separate
3. cool	...	...
4.	power	...
5. compress		
6. detect		...
7. ...	...	adaptive
8. ...	improvement	...

III. Analyse the word combinations in the table and translate the following combinations into Russian.

Артикль	Существительное в роли определения	Определяемое существительное	Перевод
the	steam	engine	паровой двигатель
the	steam engine	cylinder	цилиндр парового двигателя
the	steam engine cylinder	improvement	усовершенствование цилиндра парового двигателя

the land transport
the land transport problem

the internal combustion engine
the internal combustion engine improvement
the vehicle motion
the vehicle motion control
the control device
the control device application

Grammar: Present Simple Passive

IV. Change the following sentences so as to use Present Simple Passive. Follow the model.

EXAMPLE: *A: We obtain petrol from petroleum.*
B: Petrol is obtained from petroleum.

1. The engine produces power. 2. We usually use oil in different branches of industry. 3. They provide us with the necessary equipment. 4. The engineer controls the fuel systems. 5. Nowadays they make pistons from plastics.

V. Give the opposite to the following sentences.

1. This mechanism is used in the engine. 2. Power is not produced by the engine. 3. Fuel is burnt in the engine to produce power. 4. Fuel and air are not mixed in the carburettor.

VI. Your partner wants to check your knowledge of automotive engineering. Answer his questions. Use different adverbs of frequency such as *always, never, sometimes, often, seldom, usually.*

EXAMPLE: *a) Oil is used in diesel engines.*
A: Is oil always used in diesel engines?
B: Yes, it is.

b) Sulphur is used in petrol fuel.
A: Is sulphur always used in petrol fuel?
B: No, it isn't. It's never used in petrol fuel.

1. Diesel fuel is used in different engines.
2. Gas is kept in a special tank.
3. Petroleum is needed in all branches of industry.
4. Fuel is carried by the fuel pipe.
5. Fuel is mixed with air in the carburettor.

VII. Ask all possible questions. Consult the table below.

		Fuel	*is*	*usually*	*stored*	*in a fuel tank.*
Where	is	fuel		usually	stored?	
Why	is	fuel		usually	stored	in a fuel tank?
When	is	fuel		usually	stored	in a fuel tank?
		What	is	usually	stored	in a fuel tank?

1. This fuel is used in all types of engines.
2. Fuel and air are compressed by the piston.
3. The body of the car is supported on the frame.
4. Gases are expelled from the cylinder.

VIII. Make up some questions for the following answers. The answers needn't be true.

1. In the carburettor. 2. It is equipped with a new control system. 3. Engineers. 4. Petroleum. 5. The inventor himself. 6. In the fuel tank.

IX. Choose the right form of the verb.

1. This data is calculated / calculates by that electronic device. 2. Students are always solved/always solve complicated problems with the help of logarithm tables. 3. Our workshops are equipped / equip with automatic machinery. 4. A robot packs / is packed the necessary instruments for the experiment. 5. Useful information is provided / provides for the engineers.

X. Make up short dialogues. Pay attention to the place of the preposition of the passive construction.

EXAMPLE: *A:* As far as I know ***they speak*** a lot about this problem.
B: Yes, you are right. This problem ***is*** much ***spoken about***.

To refer to the theory (seldom); to rely upon this method (usually); to deal with a new scientific problem (sometimes); to send for the mechanic (never); to think of the results of the experiment (always).

XI. Correct mistakes.

1. This car be powered by the energy of the Sun. 2. Machines are not maked of wood. 3. This car are equipped with the experimental fuel system. 4. To this theory is often referred in scientific literature. 5. Is our engineer invite to the scientific conference in Denmark? 6. How different fuels to be produced?

XII. Translate the sentences into English using your active vocabulary.

1. Из нефти вырабатываются разные виды топлива. 2. Топливный насос связан с карбюратором. 3. Топливо и воздух сжимаются порш-

нем. 4. – Что хранится в топливном баке? – Топливо. 5. – Где смешиваются воздух и топливо? – В карбюраторе. 6. Система охлаждения контролируется инженером. 7. Газ обычно хранится в специальной емкости.

Reading and Speaking

I. List all possible components of the fuel system in the car.

II. Now learn to pronounce the words which will help you describe a car.

lubrication [ˌlu:brɪˈkeɪʃən] *n*
pump [pʌmp] *n*
carburettor [ˌkɑ:bəˈretə] *n*
piston [ˈpɪstən] *n*
separate [ˈsepərɪt] *adj*

III. How many word combinations can you form with the noun fuel? Scan the text to check which of them are mentioned there.

IV. Now read the text attentively and learn about different mechanisms in a car.

A motor vehicle is a complex engineering construction. It is **composed** of several thousand parts. The smaller parts are joined together and form larger components, or units. One of the main components of any vehicle is, of course, the engine.

In addition to the engine itself, there are four **separate** mechanisms, which are used to **feed** the engine. These mechanisms are the **fuel system**, the **lubrication system**, the electrical system and the **cooling system**.

The fuel system is a separate mechanism that is used for feeding the engine. The fuel system consists of a **tank**, a fuel line or a pipe, a pump and a **carburettor**. The engine produces power when air and fuel are **mixed** and **burnt**.

So let's have a look at the fuel system operation. The fuel is stored in a fuel tank. The fuel tank is connected to a fuel pipe. The fuel pipe carries the fuel to the fuel pump. This pump can be either electric or mechanic in operation. Electric pumps are generally **situated** near the fuel tank whereas a mechanical pump is generally **located** beside the engine. It is **driven** by the camshaft. The fuel pump is connected to the carburettor. In the carburettor the fuel is mixed with air. It is important to have the right ratio of air to fuel. For example, the optimum ratio of air to petrol in the fuel mixture is 15 parts of air to 1 part of petrol. The fuel and the air are drawn into the combustion chamber, where they are **compressed** by the piston. In the engine the fuel and air are burnt and they produce power.

V. Answer the following questions.

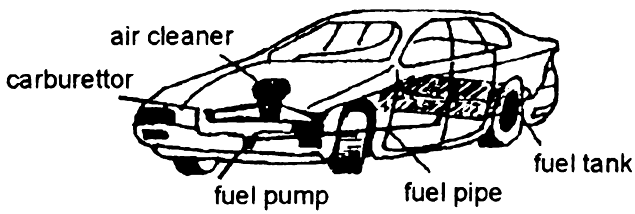
1. How many mechanisms are there in addition to the engine itself? What are they? 2. When does an engine produce power? 3. Where is fuel stored? 4. The fuel pump is connected to the carburettor, isn't it? 5. Does the fuel pump carry the fuel into the carburettor or into the fuel tank? 6. Where is the fuel mixed with air?

VI. Complete the sentences.

1. There are ... mechanisms which ... for feeding the engine. 2. The ... is a separate mechanism which is ... to feed the .... 3. Air and fuel ... mixed and .... 4. The fuel ... in a fuel tank. 5. The fuel pump ... to the carburettor. 6. In the carburettor the fuel is ... with .... 7. The ... and air are ... into the engine.

VII. Now study this picture and describe how different mechanisms feed the engine.

Fuel system



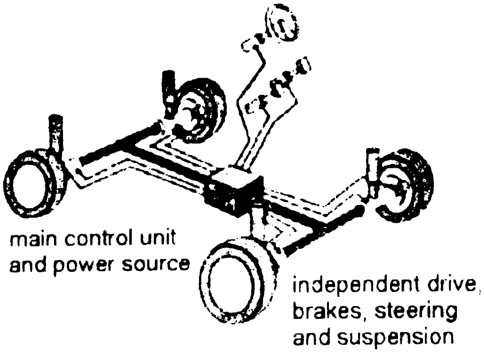
Further Reading

I. Cars play a very important role in the modern world. In our everyday life we use cars probably more than any other means of land transport. But it's not very safe to drive a car today. What would you like to improve in a car? Discuss this problem with your partner.

II. Analyse the following compound nouns and translate them into Russian.

the automatic vehicle control
the microprocessor controller
the sensor information
the drive subsystem
the steering wheel
the steering device
the wheel motion system

III. Nowadays car technology is constantly improving. Read the text about such improvements and be ready to answer the questions that follow.



The basic elements that control vehicle motion have changed little in their concept over the past few decades. Vehicles are still driven by an **internal combustion engine**, **steering** is achieved by driving a mechanical **gear** and **brakes** are actuated by physically pumping hydraulic pistons. All these actions are carried out by the driver.

The status quo is ready for change. Under development are fast-reacting, intelligent systems that increase the possibility of automatic vehicle control.

In such vehicles the steering, **accelerator** and brake devices are connected to a sensor that monitors their position. The sensor passes this information as an electrical signal to the microprocessor controller.

The sensor information is processed and the actions for the steering, brakes and drive subsystems are calculated.

The picture shows the outline of an automotive chassis. This differs from a conventional **chassis** as motion of each wheel is achieved by **independent suspension**, **drive**, brake and steering. The main control unit receives electrical signals from the steering wheel and pedals, and produces electrical signals that actuate the wheel motion systems.

In this design there is a possibility to modify the steering, brake and accelerator device. All these could be integrated into a single joystick. This possibility is a major advantage when we want to modify cars for *the physically challenged*[1].

---

[1]страдающие каким-либо физическим недостатком

1. Have the basic elements that control vehicle motion changed a lot over the past few decades? 2. What are vehicles driven by? 3. Who carries out all these actions? 4. What is under development now? 5. Do you think it's a good idea to develop automatic vehicle control?

IV. Arrange the operation stages of a typical automatic vehicle control.

a) The sensor information is processed by this controller.

b) A special sensor in the car monitors the position of the steering, accelerator and brake input devices.

c) The actions for the steering, brakes and drive subsystems are calculated.

d) This information is passed by the sensor as an electrical signal to the microprocessor controller.

V. Think of a title to the text.

Activity

I. At the Motor Show in Minsk last week, you saw a totally new design of a car. It was equipped with "an intelligent vehicle motion control". You told your father about this innovation but he doesn't believe in all these improvements. Describe him how this system works and speak about its advantages. Are there any disadvantages? Work in pairs.

II. The first cars appeared at the end of the 19th century. Nowadays we can't imagine our life without a car. At the same time cars cause a lot of problems. So, is a car our friend or enemy?

a) Read the following statements. Think of some more.

Reasons to have a car	*Reasons not to have a car*
1. It saves our time.	1. It is very noisy.
2. It carries heavy materials.	2. It pollutes air.
3. It's very comfortable.	3. Many people are killed or injured in car accidents.
4. It gives a chance to travel whenever	4. It does harm to your health, because you don't walk.
5. It brings quick help (police, ambulance).	5. It causes traffic jams.
6. ...	6. ...

b) Discuss the problem in pairs and try to reach an agreement.

Writing

I. Write a paragraph about the fuel system operation. The words below will help you.

a fuel tank, a fuel pipe, a fuel pump, a carburettor, a piston;
to mix, to burn, to compress, to consist of, to produce

II. Translate the text into Russian.

A driver's response time is very slow in comparison to that of electronic systems. A quick human response is around 0.5 seconds, and some responses are as slow as 1 to 2 seconds. Let's consider a driver who is travelling at 40 mph and has a response time of 1 second. A simple calculation (distance = = speed x time) shows that the car will travel 17.9 m before the vehicle motion is changed. In comparison, electronic systems operate at a tenth of a second and have the potential to operate in milliseconds. In severe maneuvers, the car stability is increased by this quicker response and people's life is saved.

Section B. Designing Cars

Lead-in

I. Discuss the following questions.

a) Why are there so many models of cars today?
b) How does the car design influence your choice of cars?
c) A car designer is a very prestigious profession nowadays. Can you explain why?

II. Some students are at the exhibition "History of Cars". Listen to their conversation with the guide and learn how the first automobiles looked like.

Guide: ...If you look to the right you will see the first self-propelled steam-driven vehicle.
Alex: Who was it **designed** by?
Guide: It was designed by the French military engineer Cugnot in 1763. You see, it had three wheels and could carry only two **passengers**.
Helen: What was the maximum speed of this vehicle?
Guide: Four miles per hour. And it stopped every 15 minutes in order to make more **steam**.
Alex: Oh, that's not very **comfortable**.
Guide: Definitely not. But new motor cars with **gasoline** and diesel engines were **introduced** at the end of the 19th century. Look at that small car without a roof. It was **constructed** in 1893.
Alex: And where was the engine **placed**?
Guide: Right under the seat. The drivers always carried large cans of fuel and some spare tyres with them because there were no repair stations to serve them.

Paul: Unbelievable. I wouldn't like to be in these drivers' place. And what about that beautiful car? It seems pretty modern, doesn't it?

Guide: Well, that one is a famous Volkswagen Beetle, one of the world's most loved cars.

Alex: And why has it become so popular?

Guide: I think, mostly because of its **design** and low cost.

Helen: These cars are still in operation, aren't they?

Guide: Yes, they are. I'm sure they will be produced even in greater numbers in the future.

III. Complete the dialogues.

1. *A:* – ...?
 B: – It was designed by Cugnot.
 A: – When was it designed?
 B: – ...
 A: – ...?
 B: – Well, the maximum speed was ... .
2. *A:* – This small car was constructed in 1893.
 B: – ...?
 A: – It was placed under the seat. ...
 B: – Why?
 A: –..., because at that time there were no repair stations.
 B: –...?
 A: – That is a famous Volkswagen Beetle.
 B: –...?
 A: – Yes, they are. And they will be produced in the future.

IV. Match a line in A with a line in B.

A	B
1. Who was the Volkswagen Beetle designed by?	a) It was designed by Rudolf Diesel.
2. Where was the first steam engine produced?	b) I think, because of its attractive design.
3. Why is this car so popular?	c) Let's hope for the best.
4. When will new cars be designed?	d) I think in a couple of years.
5. I hope your Mercedes will be repaired soon.	e) By Ferdinand Porsche.
6. Who invented a new internal combustion engine?	f) In France.

Language Practice

Vocabulary

I. Here are some more suffixes to make an adjective. Translate them into Russian.

Noun + **-ful** – Adjective (*наличие качества*)
Noun + **-less** – Adjective (*отсутствие качества)*

1. use – польза	useful – полезный useless – бесполезный
2. power – мощь	powerless – powerful –
3. care – забота	careful – careless –
4. help – помощь	helpful – helpless –
5. hope – надежда	hopeful – hopeless –
6. colour – цвет	colourful – colourless –

II. Match the words with their definitions.

1. to adjust	a) smth which is used to carry people or goods from one place to another
2. to arise	b) to regulate for proper use
3. to reduce	c) to start or originate
4. to detect	d) a public road that is wide, well-paved and direct
5. to respond	e) to react, to answer
6. highway	f) to make or become smaller or less
7. vehicle	g) to discover the presence

III. Match the words with the similar meaning.

1. feature	a) provide
2. respond	b) help
3. monitor	c) device
4. detect	d) characteristic
5. improve	e) answer
6. feed	f) find
7. appliance	g) make better
8. assist	h) control

IV. Change the following sentences so as to use Past and Future Simple Passive.

EXAMPLE 1: *I saw her in the workshop.*
She was seen in the workshop.

1. They sold the cars all over Europe. 2. They measured the temperature of water 5 minutes ago. 3. He increased the volume of liquid an hour ago. 4. We repaired the car yesterday. 5. They used this fuel for different engines.

EXAMPLE 2: *They will solve the problem tomorrow.*
The problem will be solved tomorrow.

1. He will publish the results of the experiment next month. 2. I will control the work of this device. 3. We will explain the work of the carburettor next time. 4. They will improve the car design. 5. The new device will reduce the time of the operation.

V. Ask an engineer about the advances in car design.

EXAMPLE 1: *the gearbox / to improve*
– Was the gearbox improved?
– Yes, it was.

the size of the car / to reduce
the car design / to improve
wheels / to modify
mini motor cars / to design
new types of fuel / to use

EXAMPLE 2. *the new models of cars / to build*
– Will the new models of cars be built in our country?
– I think, they will.

the cars / to power by the energy of the Sun
the vehicles / to operate automatically
the driver workload / to reduce
the safety of motion / to improve
the brakes / to apply.

VI. Ask your friend if he did these things himself.

EXAMPLE: *A: Did you repair this mechanism? (the mechanic)*
B: No, it was repaired by the mechanic.

1. Did you check this device? (the engineer) 2. Did you improve the work of the fuel pump? (the mechanic) 3. Did you connect these pipes yourself? (the instructor) 4. Did you control the cooling system? (the engineer) 5. Did you repair the car yourself? (the workers)

VII. Explain to your friend:

a) why these things will not be done.

EXAMPLE: *A: This device will not be tested.*
B: Why won't it be tested?
A: Because it's broken.

1. This fuel will not be burnt completely. 2. The power will not be switched on. 3. The work will not be finished. 4. The car will not be sent abroad. 5. The fuel will not be used for all engines.

b) when these things will be done. Use different adverbs of time.

EXAMPLE: *A: The work was not finished yesterday.*
B: When will it be finished?
A: It will be finished tomorrow.

1. This equipment was not installed in time. 2. Mini motor cars were not sold in Belarus last year. 3. This work was not completed properly yesterday. 4. The fuel system was not checked last time. 5. The tractors were not exported abroad a year ago.

VIII. These two sentences have a different structure but the same meaning. Change the structure of the sentences below so as to keep their meaning unchanged. Pay attention to the place of prepositions in the sentence.

EXAMPLE: *We listened to his lecture with great pleasure.*
His lecture was listened to with great pleasure.

1. We sent for the mechanic two hours ago. 2. People spoke much about the new invention. 3. We will take care of the new equipment. 4. Teachers will refer to the results of this experiment. 5. The Professor paid attention to the work of this student.

IX. Insert necessary prepositions.

1. Michael is preparing ... his examination now. 2. I've heard a lot ... the advantages ... electric cars. 3. People need petroleum ... all branches of industry. 4. The fuel is stored ... a fuel tank. 5. Vehicles are driven ... a combustion engine. 6. Automotive chassis differ a lot ... conventional chassis. 7. The cars

of the future will run ... solar energy. 8. The lecturer paid attention ... the design of a new minicar.

X. Correct mistakes.

1. The Belarusian National Technical University was not found in 1935. 2. An interesting problem will to be discussed at the lecture tomorrow. 3. When Belarusian State University was founded? 4. All the work was did by automatic machinery. 5. The Nobel prize be given to our outstanding scientist. 6. The testing of a new vehicle will be not completed by the end of the week. 7. The electric lamp was invented with Yablochkov. 8. To the work of this engineer was paid attention.

XI. Translate the sentences into English using your active vocabulary.

1. Этот автомобиль будет отремонтирован своевременно. 2. Почему это топливо не будет использоваться в автомобиле? 3. Большинство этих машин было сконструировано в Великобритании, не так ли? 4. Эксперименты проводились в лаборатории. 5. Вчера на нашем экспериментальном автомобиле была установлена первая система автоматического управления движением. 6. Новые заводы строились и будут строиться в нашем регионе.

Reading and Speaking

I. There exist different types of cars and a mini motor car is one of them.

1. What do you know about this vehicle?
2. Have you ever seen or driven it?
3. Why is it called "mini"?
4. Are they widely used nowadays?

II. Scan the text quickly and say what it is about.

III. Now read the text attentively to learn more about mini motor cars.

Mini motor cars are sold all over Europe. The first Mini was produced in Britain in 1959 and it has become Britain's most popular and **successful** car since that time.

In the late 1950s, BMC, the British Motor Corporation, wanted to build a car that was different from other cars. They wanted a small, cheap and economical car – a family car that was big enough to carry four **passengers**. In the 1950s it was a difficult problem. At that time a typical family car was quite long, about three and a half meters. It had large wheels and large **space**

for the engine. So there wasn't much **room** for the passengers. Besides that, it was very expensive to make.

The Mini was **designed** by Alec Issigonis. His **design** was revolutionary. First, the car was made half a meter shorter. Next, the wheels were made much smaller and they were put right at the four corners of the car. Then the engine was turned sideways and the **gearbox** was put underneath. And there was still enough room for four passengers.

Today nearly every small car is based on the design of the Mini. So why is the Mini so popular? The answer is simple: it is well designed, very economical, it is easy to drive around the city and easy to park!

IV. Answer these questions.

1. When was the first Mini produced? 2. Who was this car designed by? 3. How did a typical family car look like in the 1950s? 4. What changes did Alec Issigonis make in a new car, called the Mini? 5. What are the advantages of the Mini? 6. Do you think that the Mini is a good car? Why? / Why not? 7. Would you like to drive such a car yourself?

V. Complete the sentences.

1. Mini motor cars are ... all over Europe. 2. The Mini has become Britain's most ... and ... car. 3. In the 1950s BMC wanted to build a ... and ... car. 4. The Mini ... by Alec Issigonis. 5. The car ... half a meter ... . 6. The wheels were made ... . 7. The engine ... sideways and the ... was put underneath. 8. Today almost every car is ... on the ... of the ... .

VI. A students' conference called "Small cars – a myth or reality?" will be held at the Technical University tomorrow. Make a short report on mini cars.

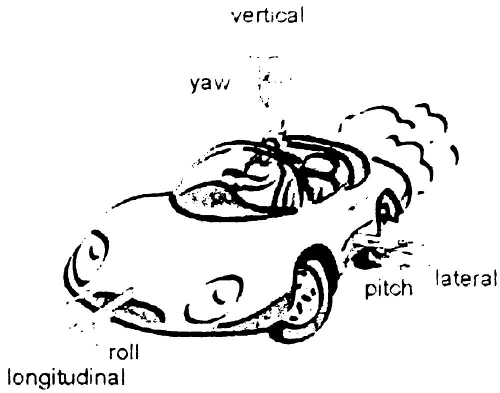
Further Reading

I. These words are from the text below. Study their meanings.

adaptive cruise control	автоматическое управление движением
longitudinal	продольный
lateral	поперечный, горизонтальный
steer-by-wire system	система с кабельным управлением

II. Look at the picture below and try to guess what this text deals with.

III. This is an extract from an article published in one of the British journals. Read it attentively and learn how some engineers imagine the future of the car.



The vehicle of the future will be designed in a different way. These will be automatic vehicles with ACC or adaptive cruise control. The principle is that the car automatically **adjusts** its speed relative to its **distance** from and the speed of another vehicle. This removes the need for the driver to control the accelerator and thus the driver **workload** will be reduced **considerably**. ACC is a part of the longitudinal control of the vehicle.

The next step in automating the longitudinal control is automatic braking systems (ABS) Here, the driver will be informed by these systems that a dangerous situation can **arise unless** action is taken. If the driver fails to **respond**, the brakes will be automatically applied and vehicle **stability** and driver safety will be maintained.

Laser and vision technologies are used to **detect** objects and **ensure** lateral control of the vehicle. The first systems will assist the driver through warnings; more advanced systems will use steer-by-wire systems to adjust the vehicle heading automatically.

The combination of lateral and longitudinal control of the vehicle motion is a new **feature** of the vehicle which will be used in an **automated highway** system.

IV. Answer these questions.

1. Will the vehicle of the future be the same as nowadays?
2. What kind of car will we have?
3. What is ABS?
4. What is used to detect objects around a vehicle?
5. Would you like to have such an automatic vehicle with ACC and ABS? Give your reasons.

V. Give a title to this article.

Activity

I. Your brother started working in a prosperous engineering company last year and he has saved enough money for a small, cheap car. Discuss advantages and disadvantages of buying a small car and give your brother a piece of advice.

II. Science and new technology are gradually changing everything in our life. Can you imagine how a car of the future will look like? Look at these statements and express your opinion on them. Give some other ideas of your own. Start with the phrases from the box.

EXPRESSING CERTAINTY AND DOUBT:

I'm (not)	certain	(that)...
(quite)	sure	
	convinced	
	positive	

There's no doubt that...

I doubt that/if...

1. All the cars will be of one colour, yellow.
2. The cars will not run on petrol.
3. There will be a lot of electric cars.
4. Some cars will run on solar energy.
5. Every car will have an air bag in front of the driver.
6. A driver will not have to drive a car because it will be automatic.
7. ...

Writing

I. How do you imagine the car of the future? Write a short description of it.

II. Translate this text into Russian.

What Is Mechatronics?

The word *mechatronics* was first used in 1969 to describe the integration of *precision mechanical engineering*[1] with electronic and computer control systems in order to make intelligent machines. Scientists wanted to bring together branches of engineering that are normally studied in isolation, in the hope that the design solutions will benefit both electrical and mechanical disciplines.

The range of applications of mechatronics is enormous and includes domestic appliances, automated assembly lines, computer peripherals and so on. Some specialists predict that mechatronic systems will be widely used in cars of the future. Mechanical devices will be controlled by the computer systems and thus the car's stability will be increased. On the whole a car will become a more efficient means of transport. All the mechatronic systems will operate independently and will help the driver control the motion of the vehicle.

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[1] точная механика

Unit Six

ENGINEERING DESIGN

Section A. Tractor Technology

Lead-in

I. Discuss the following questions.

a) Where are cars used? What cars are used on farms?

b) Have you ever been to Minsk Tractor Works? What production is it famous for?

II. Oleg hasn't seen his friend Paul for a long time. Listen to the dialogue to find out where he has been and what he has been busy with.

Paul: Hello, Oleg! How are you?

Oleg: Fine, thanks, Paul. What about you?

Paul: Very well, thank you.

Oleg: Where have you been? I haven't seen you for ages.

Paul: Oh, I have been really busy this week. You know, we have been shown an experimental tractor with a 6-cylinder engine at Minsk **Tractor works**.

Oleg: How interesting! And why are there so many cylinders in the engine?

Paul: Well, this engine has been designed to provide precisely the right combination of power and **torque** for each job. So it's very efficient. And besides we have tested new **oil filters**. They have been designed according to new tractor **specifications**.

Oleg: And what are the advantages of these filters?

Paul: Well, the main advantage is that they help to **maintain** internal cleanliness of the engine and **protect against wear** and corrosion much better than the old ones.

Oleg: That sounds good. By the way, where have these oil filters been tested?

Paul: In the testing field. Their work has been watched by the engineers. Soon these oil filters will be used in different types of tractors in our country.

Oleg: I see.

III. Complete the dialogues.

1. *A:* ...
   B: Not bad, thanks. And what about you?
   A: ...
2. *A:* I haven't seen you for ages! What happened to you?
   B: ...
   A: That's very interesting!
3. *A:* ...
   B: They have been tested in our laboratory. Soon ...
   A: ...

IV. Match a line in A with a line in B.

A	B
1. Where have you been, I wonder?	a. It's been equipped with a new acoustical system.
2. What have you seen at the Works?	b. A 6-cylinder engine.
3. What has this tractor been equipped with?	c. Because of its outstanding performance.
4. What type of tractor is it?	d. I've been to the Tractor Works.
5. What engine has been installed in this vehicle?	e. An experimental tractor.
6. Why is this tractor so popular among farmers?	f. It's a general-purpose wheeled tractor.

Language Practice

Vocabulary

I. Match the English words with their Russian definitions.

1. environment	a) работать
2. to supply	b) цель
3. performance	c) качество
4. efficient	d) успех
5. to operate	e) снабжать
6. purpose	f) эксплуатационные качества
7. quality	g) окружающая среда

8. to demand — h) усовершенствование
9. refinement — i) требовать
10. success — j) эффективный

II. Match the words with the similar meaning.

1. mount	a) improve
2. require	b) production
3. equip	c) refinement
4. enhance	d) install
5. manufacture	e) demand
6. improvement	f) supply

III. Make up all possible derivatives from the following words and translate them into Russian.

Verb	*Noun*	*Adjective*
1. manufacture	manufacture	manufacturing
2. ...	manufacturer	manufacturable
3. produce	...	
4.	introduction	...
5.	...	comfortable
6. ...	improvement	
7. install		
8.	reduction	
9. adjust		
10. ...	...	reliable

Grammar: Present Perfect (Passive)

IV. Change the following sentences so as to use Present Perfect Passive.

EXAMPLE: *A: They have equipped Ford tractors with climate control filters, haven't they?*
B: Yes, Ford tractors have been equipped with climate control filters.

1. They have already cleaned the oil filter, haven't they? 2. You have repaired your tractor already, haven't you? 3. The engineers have provided these tractors with new equipment, haven't they? 4. They have modified

shock absorbers, haven't they? 5. Our young engineer has improved the acoustical system in this tractor, hasn't he?

V. Change the statements so as to use the passive form of the verb. Mind the negative meaning of the sentence.

EXAMPLE: *to lock – to unlock*
A: It was long ago that the workshop was locked.
B: It has never been unlocked since.

1. to lose – to find
   This instrument was lost long ago.
2. to break – to repair
   The brake system was broken last month.
3. to switch off – to switch on
   The engine was switched off several hours ago.
4. to open – to close
   The valve in this pipe was opened in the morning.
5. to increase – to reduce
   The pressure in the system was increased yesterday.

VI. Answer your friend's questions about the following actions.

EXAMPLE: *A: Has the application of filters been explained by the teacher?*
B: Yes, it has been explained already.
or No, it hasn't. It hasn't been explained yet.

1. Have the new trucks been chosen by the customers? 2. Has the air cleaner been widely used since its invention? 3. Have oil filters been improved during the field testing? 4. Have Ford tractors been trusted by many farmers? 5. Has the new tractor been equipped with climate control filters?

VII. Make up all possible questions. Consult the table.

		A new device	*has*	*been installed*	*in the tractor*	*recently.*
	Has	a new device		been installed	in the tractor	recently?
Where	has	a new device		been installed		recently?
		What	has	been installed	in the tractor	recently?

1. Transmission controls have been mounted on the flat floor recently.
2. The climate control system has been inspected by the engineer.
3. He has been asked many questions about the performance characteristics of the new tractor.
4. The Ford Company has been deeply involved in the development of tractor technology.

VIII. Make up some questions for the following answers. The answers needn't be true.

1. In the testing field. 2. Very soon. 3. At the Motor Plant. 4. Yes, it has. 5. New transmission controls. 6. They have been equipped with a hydraulic system.

IX. Choose the right verb form.

1. They *(have already increased, have already been increased)* the efficiency of a new tractor. 2. The oil filters in this vehicle *(have replaced, have been replaced)* recently. 3. This engine *(has just been tested, has just tested)* by our mechanic. 4. New refinements *(have introduced, have been introduced)* into this type of tractors. 5. The engineers *(have manufactured, have been manufactured)* the new acoustic system.

X. Correct mistakes in the following sentences.

1. The transmission control has been imrove recently. 2. All these machines have been maked of metal. 3. Have been the new achievements in tractor engineering shown to young specialists? 4. A new model of a tractor has be delivered to the farm. 5. The driver's seat has provided with different comfort adjustments.

XI. Translate the sentences into English using your active vocabulary.

1. Этот трактор только что отремонтировали. 2. Сегодня в нашу мастерскую были доставлены важные детали. 3. В ходе эксперимента ими были получены интересные результаты. 4. Уровень шума внутри кабины был значительно уменьшен современными акустическими системами. 5. Была ли проиллюстрирована на схемах работа топливной системы? 6. Почему задали много вопросов? 7. Когда была проконтролирована очистка масляного фильтра? 8. За последнее время были усовершенствованы многие механизмы тракторов.

Reading and Speaking

I. Nowadays there exist a lot of car companies all over the world. Some of them are very old some of them have just appeared on the market.

1. What famous car companies do you know?
2. Are there any famous corporations in your country?
3. Do they produce only cars?

II. All these words are from the text below. Learn how to pronounce them properly. Do you know their Russian equivalents?

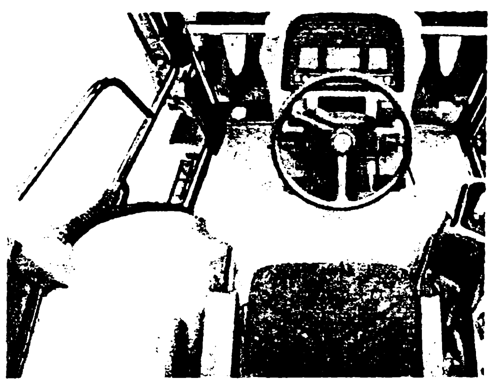
enable [ɪ'neɪbl] *v*
efficiently [ɪ'fɪʃəntlɪ] *adv*
acoustical [ə'ku:stɪkəl] *adj*
absorber [əb'sɔ:bə] *n*
halogen ['hæləd3ən] *n*
unique [ju:'ni:k] *adj*
reliability [,rɪlaɪə'bɪlɪtɪ] *n*

Can you guess what the text is about?

III. The Ford Company is one of the most famous manufacturers of cars. Read the text to learn what other vehicles it produces.

Farming today **demands** constant gains in **productivity**. That's why the Ford Company research and **improvement** programmes never cease.

The Ford Company is known as a technologically advanced manufacturer of vehicles. For many years the Ford Company has been deeply involved in the **manufacture** of tractors, cars and **trucks**. Ford tractors **enable** farmers to work quickly and efficiently. The **cab** is a comfortable and efficient workplace. Modern **acoustic systems** have greatly reduced noise **levels** inside the cab. **Transmission** controls have been **mounted** on the **flat** floor. The driver's seat has been equipped with pneumatic suspension and it turns easily and gives the driver a more comfortable view. Air filtration, efficient heating and ventilation with air-conditioning further **enhance** comfort and the driver's efficiency. There's more. Individually adjustable halogen **work lights** have been **installed** into the cab roof.



These tractors have also been equipped with **climate control filters** and anti-burst door locks. Ford tractors are famous for their unique combination of **outstanding performance**, high **reliability** and cost efficiency.

They have been continually improved since their introduction. Dozens of features and **refinements** have been added during recent years. Ford tractors have been **trusted** by generations of farmers **due to** their high **quality**.

IV. Answer the following questions.

1. What does farming demand today? 2. Why do the Ford Company research and improvement programmes never cease? 3. What is the Ford Company famous for? 4. Has the Ford Company been deeply involved in the manufacture of tractors, cars and trucks? 5. Ford tractors have everything to work quickly and efficiently, don't they? 6. What have these tractors been equipped with? 7. Why have Ford tractors been trusted by generations of farmers?

V. Complete the sentences. Choose the suitable words from the list below.

The Ford Company produces not only cars, but also 1 ... and 2 ... . Ford tractors are known all over the world for their high 3 ... and 4 ... and the Ford Company is always improving them. In a modern tractor you will see that 5 ... controls have been mounted on the flat floor and six halogen work-lights have 6 ... ... into the cab 7 ... . Besides that, modern 8 ... systems have greatly 9 ... noise levels inside the cab. The tractors have also been 10 ... with 11 ... ... filters and anti-burst 12 ... .

reliability	door locks	tractors	quality
been installed	trucks	equipped	transmission
acoustical	roof	climate control	reduced

VI. Do our farmers need to operate such tractors? Will they make agricultural production more efficient?

VII. Work in pairs. You are Sales Manager at the Ford Company. Several farmers are looking for high-quality tractors and they have chosen your company. Try to persuade them to buy a Ford tractor.

Further Reading

I. What types of tractors do you know? Look through the text to check your answers.

II. This extract is taken from a lecture on farm machinery. Read it attentively to learn about the latest improvements in tractor technology.

Needless to say, one of the most important industrial achievements for farmers today is the introduction of agricultural tractors in their work. Horses and men have been almost entirely replaced by tractors in many heavy and **time-consuming** tasks that are carried out on the land. A tractor performs the work of numerous horses and, what is of greater importance, it doesn't need any rest in order to recover from fatigue. If necessary attention is paid to its lubrication and it's constantly supplied with fuel, it will work on indefinitely.

During the years since its introduction, a huge progress has been made in developing a more efficient machine. Modern tractors have been constructed to **meet all requirements** of space, comfort, vision and safety. Many devices have been **incorporated** in the mechanisms of the tractor for this **purpose**. The 6-cylinder engines have been installed in them for improved productivity and reliability. Some tractors have been equipped with a hydraulic system, which gives the driver the choice of the right power for every operation.

Nowadays there **exists** a wide range of different types of tractors. Let's say, the most common type today is the general-purpose wheeled tractor that is used on most farms and has an engine of up to 100 h.p. On the other hand if you need to carry out heavy cultivation on farms, you can use either track-laying tractors with a large horse-power (up to 500 h.p.) or heavy-wheeled tractors. Most present-day tractors are powered by internal combustion engines, which operate on the same basic principles.

III. Say if these statements are true or false. Correct the false ones.

1. The tractors are used instead of horses in many heavy tasks. 2. A tractor performs the work of one horse. 3. A tractor needs some time to recover from fatigue. 4. If the tractor's lubrication system is maintained in good condition, the tractor will work for a long time. 5. Nowadays there exist two types of tractors: the general-purpose wheeled tractor and track-laying tractor. 6. The hydraulic system in the tractor enhances the driver's safety.

IV. Find in the text the information about the following:

a) an important industrial achievement for farmers;
b) tractors after their introducion;
c) a general-purpose wheeled tractor;
d) a track-laying tractor;
e) a heavy-wheeled tractor.

V. Give a title to the text.

Activity

I. Several groups of engineers at Minsk Tractor Works have been given the task to improve the tractor "Belarus". Discuss the possible design of this tractor in your groups.

II. Several farmers from Russia have arrived at Minsk Tractor Works in order to buy tractors. Present your project to these farmers and convince them to order your model of a tractor.

Writing

I. Complete this paragraph about Ford tractors. Use the linking words from the box.

EXPRESSING ADDITION
moreover, in addition to, besides, as well as, also, furthermore

Ford tractors are famous for high reliability and cost efficiency. They have been designed to provide a comfortable and efficient workplace. Climate control filters have been installed in the cab. Moreover, ...

Use some of these ideas:

1. acoustical systems – to reduce noise levels in the cab
2. transmission controls – to mount on the flat floor
3. the driver's seat – to equip with pneumatic suspension
4. halogen work lights – to install into the cab roof
5. ...

II. Translate this text into Russian.

Minsk Tractor Works is the world's leading manufacturer of agricultural equipment. Since 1953 thousands of universal wheeled tractors under the manufacturer's brand "Belarus" have been produced.

The well-known advantages of these tractors are their low fuel consumption, long service life, simplicity and convenience of maintenance. The modern tractors have been fitted with six-cylinder diesel engines. Thus they can develop sufficient horsepower under most unfavourable conditions and show high efficiency. The nine-speed gearbox provides a wide range of speed for performance of all types of farm operations. A comfortable, safe and noise-proof cab provides excellent visibility and together with an adjustable soft seat, tinted glass, cab air filtering and a heating device ensures comfort for the driver throughout the whole working day.

All the features of "Belarus" tractors meet international standard specifications.

Section B. Machinery Engineering

Lead-in

I. Engineers make use of machine tools in all their activities. List as many applications of machine tools as possible. Compare your list with that of your groupmates.

II. Paul, a student of Mechanical Engineering, has visited the exhibition "Advances in Machinery Engineering" and now he is telling his friend Alex about it. Listen to their dialogue and learn how to name different machine tools.

Alex: Hello, Paul! Glad to see you. Where have you been? I was looking for you all day yesterday. But unfortunately, I didn't find you.

Paul: You know, our lessons had been finished by five o'clock yesterday and I went to our Exhibition Hall and saw different types of **machine tools** there, such as **lathes**, **milling machines** and **grinding machines**.

Alex: That sounds interesting. It's impossible to imagine a workshop today that is not equipped with **multi-purpose** machine **tools**.

Paul: I can't but agree with you. People have already fully automated all transportation operations.

Alex: And were there any interesting types of machine tools at the Exhibition, I wonder?

Paul: Oh, definitely, the latest developments in the design of machine tools were well represented there. And as far as I know, some of these types will have been put into operation by the end of the next year.

Alex: And what impressed you most of all at the Exhibition?

Paul: Well, you know, there was one fantastic machine known as the **"machining centre"**. This machine performs about a hundred different operations **simultaneously**.

III. Complete the dialogues.

1. *A:* ...
   B: Well, you see, I had finished the test by 2 o'clock yesterday and I went to the Machine Tool Works.
   A: ...
2. *A:* What types of machine tools did you see at the Exhibition?
   B: ...
   A: Which one did you like most?
   B: ...

A: Will any of these new machine tools have been put into operation by the end of the year?

B: ...

IV. Match a line in A with a line in B.

A	B
1. Where were you yesterday?	a. A microprocessor.
2. Has the new lathe been tested yet?	b. By 10 May.
3. What is the oldest tool that is known to the mankind?	c. John Wilkinson.
4. Who was the first machine tool invented by?	d. The engineers said that it had already been tested.
5. What has been incorporated in this machine tool?	e. I was at the Machine Tool Works.
6. By what time will the machine tool have been delivered?	f. I don't know, I'm afraid.

Language Practice

Vocabulary

I. Match the words with the opposite meaning.

1. hand tool	a. unimportant
2. advantage	b. automatic
3. accurate	c. single-purpose machine
4. give	d. disadvantage
5. important	e. inaccurate
6. multi-purpose machine	f. receive
7. manual	g. machine tool
8. simple	h. complex

II. Match the word with its definition.

1. tool	a. to take away, to get rid of
2. workshop	b. a thing with the help of which an operation is carried out
3. to shape	
4. to cut	c. to turn in a new direction

5. to remove
6. workpiece
7. to bend

d. a room in which manufacture is carried out
e. to separate into slices or pieces
f. to form, to make
g. a piece of metal/substance for work.

III. Match the English word combinations with their Russian equivalents.

1. a lathe
2. a milling machine
3. a drilling machine
4. numerical control
5. a cutting tool
6. a grinding machine

a) фрезерный станок
b) сверлильный станок
c) шлифовальный станок
d) токарный станок
e) режущий станок
f) числовое программное управление, ЧПУ

IV. Write down all possible derivatives of the following words.

Verbs	*Nouns*	*Adjectives*	*Adverbs*
to vary			
to conduct			
to resist			
to act			
to remove			

Grammar: Past and Future Perfect (Passive)

V. Find the verb in Perfect Passive in every line.

1. a) are delivering b) delivered c) had been delivered
2. a) had received b) is receiving c) had been received
3. a) reduce b) will have been reduced c) will be reduced
4. a) will predict b) had been predicted c) had predicted
5. a) will be given b) will have been given c) are given
6. a) will have removed b) was removed c) had been removed

7. a) will have been adjusted b) has adjusted c) will have adjusted
8. a) had been repaired b) will be repaired c) was repaired

VI. Change the following sentences so as to use passive form of the verb underlined.

EXAMPLE 1: *A*: *They had finished the experiment before the lesson was over.*
B: The experiment had been finished before the lesson was over.

1. He had completed the chemical reaction when the teacher came. 2. We had published the results of our work by the end of the year. 3. They had dried the sample before the experiment started. 4. They had begun the experiment before the assistant came. 5. They had obtained all the necessary data by the time the experiment began.

EXAMPLE 2: *A*: *We will have published the article by the beginning of the conference.*
B: The article will have been published by the beginning of the conference.

1. By the end of the next month he will have repaired his car. 2. They will have brought the necessary tools by the beginning of the work. 3. We will have improved this tool by the end of the year. 4. They will have delivered new books to the library by the end of the week. 5. They will have installed new equipment in the laboratory by the beginning of a new academic year.

VII. You completed your practical work at the Machine-building Plant last week.

a) Say what work had been done by the end of your practice.

EXAMPLE: *to perform a lot of different operations*
A lot of different operations had been performed by the end of the practice.

To study the operation of the milling machine; to deliver a new model of a lathe; to instruct the students properly; to investigate the advantages of machine tools; to obtain valuable practical experience.

b) Say what work will have been done by the end of this term.

EXAMPLE: *to write the course project*
The course project will have been written by the end of the year.

To carry out the research on machine tools; to repair the old cutting tool to demonstrate the work of metal-cutting machines; to perform various operations on the drilling machine; to experiment with metal-forming machines.

VIII. Ask all possible questions. Consult the tables below.

		The device	*had been repaired*	*in our lab*	*by the end of the day.*
	Had	the device	been repaired	in our lab	by the end of the day?
By what time	had	the device	been repaired?		
Where	had	the device	been repaired?		
	What		had been repaired	in our lab	by the end of the day?

1. A new machine tool had been devised by the end of the week.
2. The experiment had been finished in our laboratory before the lesson was over.
3. The engineers had improved the design of this machining centre before the plant began to produce it.

		The workpiece	*will have been cut*	*by 2 o'clock.*
	Will	the workpiece	have been cut	by 2 o'clock?
By what time	will	the workpiece	have been cut?	
		What	will have been cut	by 2 o'clock?
		What	will have been done	by 2 o'clock?

1. A new milling machine will have been introduced in this plant by the beginning of May.
2. A new cutting tool will have been put into operation by the time our workshop opens.
3. The research will have been completed by a group of engineers by the time you arrive.

IX. Correct mistakes in the following sentences.

1. New safety rules have been established by the end of the last year. 2. A new device will be designed by next week. 3. Will have the design of the tool been improved by the end of September? 4. The necessary tools were

brought into the laboratory by the beginning of the experiment. 5. These new properties of the substance had predicted by the scientists before the experiment began. 6. The construction of the workshop will have be completed by next year.

X. Translate the sentences into English using your active vocabulary.

1. Они выполнили ряд операций на токарном станке до того, как закончились лабораторные занятия. 2. Вчера к 5 часам вечера фрезерный станок был отремонтирован. 3. Образцы многоцелевых станков были изготовлены до того, как начался эксперимент. 4. Статья будет опубликована до начала конференции. 5. Один станок с централизованным программным управлением контролирует работу более ста различных режущих инструментов. 6. Коробки передач изготавливаются на призматических станках.

Reading and Speaking

I. Learn to read the following words. Say which of them are international.

component [kəm'pəʊnənt]
category ['kætɪgərɪ]
prismatic [prɪz'mætɪk]
hollow ['hɒləʊ]
casing ['keɪsɪŋ]

II. Analyse the following word combinations and translate them into Russian.

machine tools
machine tool types
mechanical engineering workshop
metal-cutting machines

III. What is the difference between a hand tool and a machine tool? Look through the first passage of the text to find it out.

IV. There exists a great number of machine tools that can be used by engineers in their work. Read the text about different types of machine tools for more information.

Scientists consider that the oldest tools that are known to the mankind are 2,600,000 years old. They were used by people in manual operations and that is why they were called **hand tools**. By the beginning of the Industrial Revolution, people had already devised simple hand tools for cutting and shaping different materials. But in the 18th century there appeared **machine tools** that made mass production a reality in the 19th century. A machine tool is a power-driven machine that is used to perform different operations with metal or other material. Basic machine tools use mechanical power to bend, cut, drill, grind and hammer metal into desired shapes. More advanced machine tools use such power sources as electrical or chemical energy, heat, magnetism and ultrasound.

Nowadays machine tools play an important role in the manufacture of almost all metal products. Machinists (people who operate machine tools) use them in making automobiles, radios, refrigerators, television sets and so on. Every mechanical engineering workshop is equipped with machine tools. They are the main source for the manufacture of component parts of all machines and mechanical devices.

There are about 500 kinds of machine tools. Some perform a single operation, such as grinding or drilling. Others, called **machining centres**, carry out several kinds of tasks. These numerous machine tool types fall into two categories. The first group is called "**metal-cutting**". The machine tools of this group **remove** some material from the workpiece and they are much stronger than the workpiece itself. The examples of metal-cutting machines are **lathes**, drill presses, milling and shaping machines.

The second group is called "**metal-forming**". They **shape** the workpiece without the removal of any material from it. For metal-forming operations we use a wide range of *forging machines*[1], presses and *press brakes*[2].

---

[1]ковочная машина; [2]прессовые тормоза

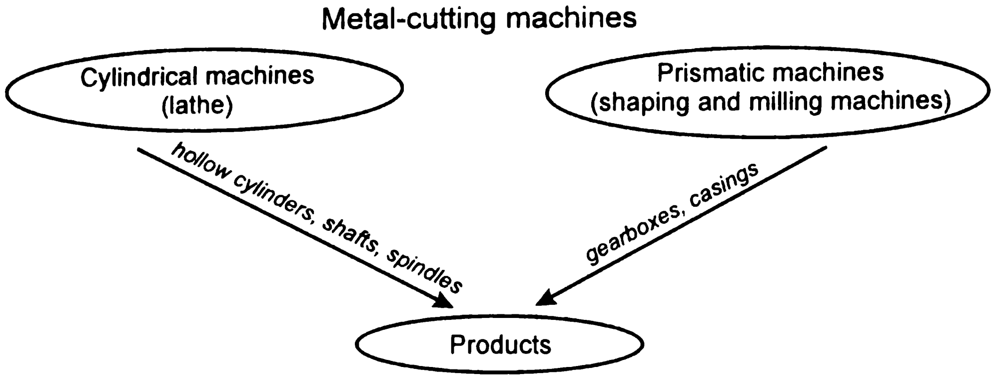
V. Answer the following questions.

1. What is a machine tool?
2. Where do we use machine tools?
3. How many machine tools are used in industry nowadays?
4. What are the two main types of machine tools?
5. Is there any difference between the first and the second group of machine tools?

VI. Say if the following sentences are true or false. Correct the false ones.

1. The first hand tool was used during the Industrial Revolution of the 18th century.
2. Machine tools never use such power sources as heat and chemical energy.
3. Machinists are the people who operate machine tools.
4. Machining centres perform a single operation, for example, drilling.
5. A lathe is an example of metal-forming machines.
6. The machine tools of the first group remove some material from the workpiece.

VII. Complete the text using the diagram.



This diagram shows the subdivision of metal-cutting machines. This subdivision may be made between ... and ... machines. Cylindrical machines produce ..., ..., ... and ... may be said as the best-known machine tools of this type. Prismatic machines produce ... and ... and ... machines may be said as the best-known machine tools of this type.

VIII. a) You are going to deliver a lecture to the students of metallurgy on different types of machine tools. Make an outline of your lecture (maximum 10 sentences)

b) Give the lecture to the students. Be ready to answer their questions.

Further Reading

I. Learn how to read the following words.

precise [prɪ'saɪz] fixture ['fɪkstʃə]
particular [pə'tɪkjʊlə] numerous ['nju:merəs]

II. What do these abbreviations stand for? Look through the text to find it out.

CNC, NC, DNC

III. Where can numerical control systems be used? Read the text to learn more about NC systems.

In 1775 John Wilkinson, an English ironmaker, invented the first modern machine tool. It was a **boring machine** that enabled the workers to drill precise holes in metal. Many refinements have been incorporated in machine tools since that time.

By the middle of the 20th century some machine tools had been linked together in series for use in mass production. And in the 1950s the first machines with numerical control were introduced.

Numerical control, commonly called NC, is a system of automating machine tools. Let's have a look at some examples of NC systems application.

The system known as **computer numerical control** (CNC) has a number of machine tools, each of which is directed by its own computer. So when you want to adapt a CNC machine tool to a different job you just change the control programme, or software of the computer. They are very easy in operation, their programming is simple and you can always test it. Moreover, they are cheaper to maintain and are generally more accurate in comparison with standard machine tools. CNC systems are used with a wide range of machine tools such as milling machines and lathes. Many are equipped with graphic displays that show the shapes of the workpiece and can even produce three-dimensional views of the components.

When several CNC machine tools receive instructions from a large central computer that stores and processes operational procedures, we can speak about a **direct numerical control** (DNC). This single computer controls more than 100 machine tools.

A further development in the automation of machine tools is the "**machining centre**". This machine has automatic tool **changers** and performs a lot of machining operations on a workpiece with the help of more than 100 different cutting tools. One machining centre can do the work of eight or more standard machines. They are particularly useful when you need to produce large and complex components with the high degree of accuracy.

In general, all machine tools that are equipped with NC systems have a lot of advantages. One of the most important advantages is the absence of necessity to design, build and store the numerous **fixtures**.

IV. Answer the following questions.

1. What is the main advantage of CNC machines?
2. What is the difference between CNC and DNC machines?
3. How many tools may a DNC machine contain?
4. What is the main principle of work of machining centres?
5. If you were Director of a large plant, would you install machine tools with NC systems there ?

V. Say if the following sentences are true or false. Correct the false sentences.

1. John Wilkinson invented the first modern NC machine tool. 2. Nowadays NC systems are hardly ever used in industry. 3. CNC machine tools are more accurate in comparison with standard machine tools. 4. One machin-

ing centre may perform the work of 100 standard machines. 5. If a worker wants to produce a complex component with high degree of accuracy he should use one of the NC machine tools.

VI. Read the following summary of the previous text and fill in the missing information with the words given below.

Automation of machine tools began in the 20th century. In the 1950s the first machines with ... were ... .

Numerical ... is a system of automating machine ... .

Computer ... control machine tool is directed by a ... . CNC machines are easy in ... and they are ... to maintain.

In ... system a single computer may ... more than 100 machine tools.

Machining centres may ... a lot of machining ... on a ... at a time. One machining centre may do the work of eight ... machines.

... NC systems have ... advantages.

computer	in general	introduced	tools	perform
a lot of	numerical control	operation	numerical	operations
control	direct numerical control	standard	cheaper	workpiece

VII. Give a title to the text.

Activity

I. You've just visited the Belarusian Historical Museum. There was an excellent exhibition of different kinds of tools from the oldest to the most modern ones. Share your impressions with your friends.

<u>Some of the tools at the exhibition were:</u>
hand tools made of wood, stone and copper;
the first cutting machine tools;
a modern lathe and a drilling machine; a machining centre.

II. A group of students has come to the Steel Works where you work. Show them around and tell them about different machine tools that you have at the works.

III. Discussion. It's impossible to imagine present-day manufacturing process without machine tools. They bring a great number of benefits but do they possibly have any disadvantages?

a) Read the following arguments. Think of your own ones.

For	*Against*
1. They make people's work easier.	1. They are dangerous in operation.
2. They perform numerous operations simultaneously.	2. If the computer programme fails, the production stops.
3. They are fast and accurate.	3. It's difficult to repair them.
4. They don't get tired.	4. They require regular maintenance.
5. ...	5. ...

b) Discuss the problem in groups and try to reach an agreement.

Writing

I. Write two paragraphs, one about advantages and the other about possible disadvantages of machine tools.

II. Translate the text into Russian. Use your technical dictionary.

By the beginning of the new millenium a great number of complex machine tools had been designed to speed up production. Although these tools include features of the basic machine tools and perform the same operations, they incorporate design modifications that let them perform complex operational sequences quicker. Furthermore, after the production machine has been set up by a skilled worker or machinist, a less skilled operator also can produce parts accurately and quickly.

There's one more improvement that had already been incorporated in machine tools by the 21st century. This is a highly automated machining system, called adaptive control that involves the use of a microprocessor. A microprocessor is a tiny electronic device that performs the work of computer. The microprocessor regulates variables in the machining process such as the speed of the spindle. That makes the process very efficient. It also receives information from sensors that measure force, temperature, and other variables. It uses the information to operate the system at the level that is safe for the machine tool and the workpiece. Specialists predict that by the year 2015 all major industrial works in Belarus will have been equipped with such machining centres.

Unit Seven

MATERIALS SCIENCE

Section A. Copper

Lead-in

I. Discuss the following questions.

a) How much do you know about copper?

b) Where is copper used today? Make a list of possible applications of copper. Compare it with that of your groupmates.

c) Do you know any copper alloys? What are their constituents?

II. The students are at the seminar on metals technology. Listen to their discussion and learn what properties copper has and where it can be used.

Teacher: Dear students, today we're going to discuss the main properties and applications of copper. So far, what can you say about this metal?

Andrew: If I'm not mistaken, copper is a non-ferrous metal. And it can be found in a free state in nature.

Alice: And as far as I remember, people were able to **extract** this metal in prehistoric times. Various things such as weapons, tools and **decorations** could be made of it.

Teacher: Very good. Were those copper tools very reliable?

Andrew: I think not. **Pure** copper is a soft **ductile** metal. Strong cutting tools could be made only of copper alloys such as **bronze**.

Teacher: OK. What are the present applications of copper?

Alice: Well, they are numerous. Copper metals can be used in most **domestic appliances**. Electrical industry is impossible without copper wiring as it is a very good conductor of electricity. Also, copper is corrosion resistant which makes it valuable for marine industry. Besides, this metal is even used in making money!

Teacher: You are quite right. Tomorrow we will **be able to** study the valuable properties of copper in the practical class.

III. Complete the dialogue.

A: – Are we going ... today?
B: – ... . Let's remember what ...
A: – I know that copper ...
B: – Very well, and when ...?
A: – ...
B: – What applications ...?
A: – ...
B: – Why did bronze become so ...?
A: – ...
B: – Can you prove that copper ... today?
A: – ...
B: – What valuable properties ...?
A: – Well, ...
B: – Excellent! I see you know a lot about copper.

IV. Match a line in A with a line in B.

A

1. Copper was discovered long ago.
2. Is copper used in automobile industry?
3. Bronze was first produced in Asia and Africa.
4. Why is copper so widely used today?
5. Electric wiring is made of pure copper, isn't it?
6. Thank you very much.

B

a. Yes, it is.
b. Where exactly?
c. You are welcome.
d. You are quite right.
e. Because of its valuable properties.
f. Certainly.

Language Practice

Vocabulary

I. Learn how to read these words.

ductile [ˈdʌktaɪl]
reliable [rɪˈlaɪəbl]
decorative [ˈdekərətɪv]
recycling [rɪˈsaɪklɪŋ]
plumbing [ˈplʌmɪŋ]

II. Match the Russian words with their English equivalents.

1. оценивать	a. qualities
2. извлекать	b. conductor
3. проводник	c. purpose
4. домашний	d. to extract
5. вязкий (эластичный)	e. ductile
6. нержавеющий	f. domestic
7. качества	g. to estimate
8. цель	h. corrosion resistant

III. Match the words with the opposite meaning.

A	B
1. useful	a. varied
2. ability	b. decorative
3. functional	c. tremendous
4. magnetic	d. unnecessary
5. present	e. useless
6. small	f. inability
7. necessary	g. ancient
8. uniform	h. nonmagnetic

Grammar: Modal Verbs "can, could, be able to"

IV. Say what these people could do in the past.

EXAMPLE: I *can't use* the new apparatus now but I could use it yesterday at the lesson.

1. He can't do research on copper alloys this term but he ... it last term. 2. We can't compare the properties of these substances now but we ... them during our previous experiment. 3. They can't study aluminium bronze at the lesson now but they ... it in the lab yesterday. 4. We can't extract copper with the help of stone and bone tools but ancient people ... it in this way thousands of years ago. 5. I can't describe the results of his experiment today but he ... them yesterday.

V. Use the following statements in the past and future.

EXAMPLE: He **can** drive well.
He **could** drive well 10 years ago.
He **will be able** *to* drive well in a month.

1. He can continue his studies at the Mechanical Engineering faculty. 2. Our engineers can extract copper in several ways. 3. I can visit the Bingham Canyon copper mine. 4. This new car can move without a driver. 5. The scientists can use the samples of this substance in the test.

VI. Ask your scientific supervisor to explain what can happen to these engineering materials.

EXAMPLE: *copper / to be alloyed with iron*

A: Can copper be alloyed with iron?

B: Certainly it can. Copper can be alloyed with iron.

or I'm afraid it can't. Copper can't be alloyed with iron.

a ductile metal / to be worked into a new shape
copper / to be used as a conductor of electricity
tin / to be alloyed with copper
brass / to be used in bearings and gears
copper / to be recycled several times

VII. Put these statements into Present, Past and Future using the modal expression *to be able to (not to be able to)* instead of *can (can't)*.

EXAMPLE:

+	–
I can study materials science.	He can't complete this work himself.
I **am able to** study materials science.	He **is not able to** complete this work himself.
I **was able to** study materials science.	He **was not able** to complete this work himself.
I **will be able to** study materials science.	He **will not be able to** complete this work himself.

1. We can alloy copper with aluminium. 2. The engineers can use copper for electrical conductors. 3. I can do research on phosphor bronze now. 4. She cannot explain the properties of this group of alloys. 5. This student cannot explain the difference between brass and bronze. 6. They cannot evaluate the results of the first series of experiments.

VIII. Correct mistakes in the following sentences.

1. We didn't can work in the laboratory on Sunday. 2. Will be you able to make a report on your scientific research? 3. He could to use the old equipment in his experiment. 4. The teacher can explains this rule again. 5. You will able to cut soft metal with greater speed than hard metal. 6. Engineers will be not able to use this new alloy in industry, I'm afraid. 7. The student not able to determine the nickel content of this copper alloy. 8. Can this technology to make the extraction of copper easier?

IX. Translate the sentences into English using your active vocabulary.

1. В качестве электрического проводника мы можем использовать медь. 2. Он способен объяснить, как добывают медь в промышленных целях. 3. Мы смогли изучить свойства алюминиевой бронзы на практических занятиях. 4. Бронза может оказывать сопротивление коррозии. 5. Преимущество меди в том, что ее можно перерабатывать несколько раз. 6. Медные сплавы могут быть использованы в разных отраслях промышленности.

Reading and Speaking

I. These words are taken from the text. Use the dictionary to find out their meaning.

rather, *adv*
circulation, *n*
vital, *adj*
junked, *adj*
remainder, *n*
throughout, *prep*
discarded, *adj*
demand, *n*

II. Skim the text to find answers to these questions.

1. Is copper the oldest metal that is known to man? 2. What properties does copper possess? 3. What is bronze? 4. When, where and why did bronze appear? 5. What are the applications of copper and its alloys? 6. Why aren't we afraid of working out the resources of copper?

III. Read the text attentively for more information about copper.

Copper is man's oldest metal as people could **extract** it more than 10,000 years ago. As it is rather soft and ductile, copper is **alloyed** with other elements. There is **evidence** that the first copper alloy – **bronze** (90% copper, 10% **tin**) – was produced around 2800 BC in countries such as India, Egypt and Mesopotamia. Bronze was harder and could be used for making reliable cutting tools. Its use characterizes the Bronze Age.

The **workability** and the **ability** for corrosion resistance made copper, bronze and **brass** the most important **functional** as well as **decorative** materials from the Middle Ages and on till the present day. With the beginning of the Electrical Age the demand for copper increased **tremendously** because it is an unusually good conductor of electricity and **heat**. Today more than 5 million tons of copper are produced **annually** and the copper metals are playing an increasingly vital part in all branches of modern technology.

The good news is that we will not **run out of** copper. The worldwide **resources** of this important and valuable metal can be **estimated at** nearly 5.8 trillion pounds of which only about 0.7 trillion (12%) have been **mined** throughout history. Besides, nearly all of 700 billion pounds is still in circulation because copper's **recycling rate** is higher than that of any other engineering metal. Each year nearly as much copper is **recovered** from recycled material as is obtained from newly mined **ore**. Almost half of all recycled copper **scrap** is old post-consumer scrap, such as discarded electric cable, junked automobile radiators and air conditioners, or even ancient Egyptian **plumbing!** The remainder is new scrap, such as chips and **turnings** from screw machine production. Engineers hope that we will be able to use copper for centuries on.

IV. Say if the following statements are true or false. Correct the false statements.

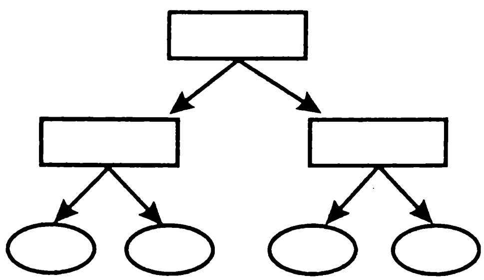
1. Copper was extracted by man more than 10,000 years ago. 2. Copper alloys appeared because there was the shortage of pure copper. 3. Copper metals are important functional and decorative materials today. 4. In the 19th century the demand for copper greatly decreased. 5. The resources of copper will be worked out in the near future. 6. If Egyptian plumbing is recycled a lot of copper can be obtained.

V. Agree or disagree with these statements. Give reasons for your answer.

1. Copper metals possess valuable properties. 2. Technological progress increases the demand for copper. 3. There is no need to save copper resources. 4. Copper can and should be recycled.

VI. Complete the diagram that classifies the following engineering materials. The diagram should have three levels.

alloys	metals
copper	bronze
brass	tin
pure metals	



VII. Give a title to the text.

Further Reading

I. These words are taken from the text. Use the dictionary to find out their meaning.

weathering, *n*
clad, *v*
serviceable, *adj*
cookware, *n*
jet plane, *n*
nuclear, *adj*
nonsparking, *adj*
explosion, *n*
remain, *v*
undamaged, *adj*

II. Do you know any interesting facts about copper? Share the interesting information with your groupmates.

III. Read the text to learn more about properties and applications of copper.

Do you know that...

...copper is essential to our health as an important **constituent** of skin, bones and blood. It is also biostatic – bacteria cannot grow on its **surface**. High-tech doctors save lives with the help of copper-clad scalpels.

...a copper **plumbing** system from the Pyramid of Cheops in Egypt is still in a serviceable condition after more than 5,000 years.

...copper has always been part of metal money.

...chefs around the world prefer copper cookware due to its properties of high heat transfer plus **uniform** heating (no hot spots).

...copper is the standard for electrical conductivity. It conducts electrical current better than any other metal **except** silver.

...IBM is replacing aluminium with copper in computer chips – up to 200 million transistors can be packed onto such a chip. The result is much faster operating speeds.

...about 2% (9,000 pounds) of the total weight of a Boeing 747–200 jet plane is copper. A typical diesel-electric locomotive uses about 11,000 pounds of copper while a Triton-class nuclear submarine uses about 200,000 pounds of copper.

...yellow brass (Copper Alloy 360) is so easy to machine, that it is the standard for metals machinability.

...high-strength, nonmagnetic and corrosion-resistant copper alloy tools are also nonsparking, which is valuable in situations where explosions are feared.

...designers look at copper and brass as metals of quality, comfort and beauty.

...through one hundred years of sea winds, rains and sun, the copper skin of the Statue of Liberty not only has become more beautiful but also has remained virtually undamaged. Closer analysis shows that weathering and oxidation of the copper skin has come to just 0.005 of an inch in a century.

...copper clearly was a good idea a hundred years ago. With technological advances, copper is still a great idea today.

IV. Explain why ...

1) copper is important to our health,
2) copper is widely used in medicine,
3) the ancient Egyptian plumbing system is still in a serviceable condition,
4) copper cookware is preferred by cooks worldwide,
5) copper is the standard for electrical conductivity,
6) aluminium is being replaced with copper in computer chips,
7) transport means need copper,
8) copper alloy tools are used in situations where explosions are feared,
9) copper metals are popular as a decorative material,
10) the Statue of Liberty needed little restoration.

V. Comment on the following statement. Give reasons for your answer.

Copper metals are used for an infinite variety of applications that range from small mass-produced parts in free-machining brass to equipment for the 'space-age' industries of rocket production and atomic energy.

VI. Can you suggest another title for the text?

Activity

I. a) Divide into groups and fill in the table using the information from the text and your background knowledge.

Copper Metals

Area of Application	*Example*	*Necessary Properties*
Medical Engineering		biostatic, corrosion-resistant
...	...	...

b) Compare your results. Which group has the longest list?

II. You have been invited to a conference on the advances in Materials Science. Prepare a report on the topic "Present-day application of copper" and deliver it in class. Choose the most interesting one.

Writing

I. Study the table given below and write a paragraph about the applications and properties of various copper alloys.

Name	*Metals present*	*Uses*
Aluminium bronze	Copper, aluminium	High tensile strength, can be cold-worked or cast, resistant to corrosion
Bell metal	Copper, tin (30%), lead	Casting bells
Brass	Copper, zinc	Cast and cold-worked in gears
Bronze	Copper, tin	general
Cupro-nickel	Copper, nickel (15–30%)	Very ductile, doesn't lose strength or crack when its shape is changed
Gunmetal	Copper, tin, zinc	Cast into gears, bearings
Phosphor bronze	Copper, tin, phosphorus (not a metal)	Cast to form gears and bearings where resistance to corrosion and wear is needed, as in sea water

II. Translate the passage into Russian. Use the dictionary if necessary.

Aluminium bronze is among the most varied and metallurgically interesting copper alloys. This metal is the first choice – and sometimes the only logical choice – for demanding applications owing to the exceptional mechanical and chemical qualities it offers, such as great strength, high hardness, excellent corrosion resistance (especially in seawater and similar environments), wear resistance and superior bearing qualities as well as favourable castability, machinability, ductability and nonmagnetic behaviour.

Evidently, all these properties are best applied where other materials can fail too soon or will be more expensive. Aluminium bronzes find widespread applications in petrochemical plants; power generation, aircraft, automotive, railway and marine engineering; in iron and steel making, electrical manufacturing and building industries.

Section B. Steel

Lead-in

I. Discuss the following questions.

a) What is steel? Can you name the constituents of this alloy?
b) Is steel widely used for engineering purposes?
c) What kinds of steel do you know?
d) What applications of steels can you list?
e) How is steel produced?
f) What properties of steels can you mention?

II. Andrew has his practice at the steel works. Listen to his conversation with Alice and name the types and properties of steels that are mentioned by the students.

Alice: Hi, Andrew, where are you going in such a hurry?
Andrew: Oh, you see, I may not be late today. We are going to the **steel works**.
Alice: Really? What will you do there?
Andrew: I don't know yet. Maybe this time we will be allowed to observe how iron is **melted**, **purified** and alloyed with other elements and steel is produced.
Alice: Have you been to this works before?
Andrew: Yes, last time we were allowed to work with **carbon steels** and **alloy steels** so we could study their properties.
Alice: And what have you found out?
Andrew: Well, many things. Do you know that the hardest, toughest, strongest and most valuable steel is **tool steel**?
Alice: I do now. Maybe you will be able to explain to me why **stainless steel** doesn't **rust**? I'm really interested.
Andrew: This is easy. Various alloying elements may be **added** to the base steel, which greatly improves its properties. Steel may be made corrosion-resistant if **chromium** is added.
Alice: I see... Well, see you tomorrow.
Andrew: OK. Bye-bye, then.

III. That's how we ask for and give permission in English. Study the table on page 126.

ASKING PERMISSION	GIVING PERMISSION
Can (may, could) ...?	You can/may if you want/like.
Is it all right if ...?	Yes, of course.
Do you mind if ... + *present simple*?	Certainly.
Would you mind if ... + *past simple*?	Go ahead.
	By all means.

IV. Complete the dialogues using the phrases for asking and giving permission.

a) – ... I have my practice at the British Steel Works?
– ...
b) – ... I observe the steel making process?
– ...
c) – ... we study the properties of various types of steels today?
– ... Later we'll discuss ... .
d) – What have you learnt ...?
– Well, steels ... be classified ... types.
– OK, and ... the main properties of steels?
– Let's see. Steels are ... . Different ... added to the base steel. This ... its properties a lot.

Language Practice

Vocabulary

I. Match the English words with their Russian equivalents.

1. hardness	a. закалять
2. to cast	b. твердость
3. pig iron	c. легированная сталь
4. malleable	d. лить, отливать
5. to temper	e. ковкий
6. alloy steel	f. передельный чугун

II. Find words formed from the first word in the line.

1. corrode – code, corrosive, charge, conductor
2. cast – substance, content, casting, steel
3. require – environment, requirement, refine, tempering
4. pure – sulphur, powerful, impurity, perform

5. metal – modern, meat, malleable, non-metal
6. considerable – carbon, constituent, construction, considerably

III. Make all possible word combinations.

to improve	furnace
molten	treatment
heat	steel
special	working
mechanical	application
electric	properties

Grammar: The Modal Verb "may"

IV. Use the following statements in Past and Future.

EXAMPLE: *He **may** continue the research.*
He ***was allowed to*** continue the research.
He ***will be allowed to*** continue the research.

1. You may use carbon steel in the construction of this building. 2. She may extract iron from iron ores. 3. You may use manganese for changing properties of steels. 4. You may apply alloy steels for various engineering purposes. 5. The engineer may increase the carbon content of the steel.

V. Your partner is an Instructor in the lab. Ask him if you may perform the following actions. Work in pairs.

EXAMPLE: *to use these substances for the experiment*
A: May I use these substances for the experiment?
B: Yes, you may. You may use these substances for the experiment.

To elaborate the plan of the research; to experiment with alloying elements; to carry out different operations on milling machines; to demonstrate the properties of tool steels; to observe the steel-making process.

VI. Your friend wanted to do a lot of things at the practical class yesterday. Ask him if he was allowed to do all of them.

EXAMPLE: *to demonstrate the new applications of steels*
A: Were you allowed to demonstrate the new applications of steels?
B: No, I wasn't. But I will be allowed to do it tomorrow.

To work in the rolling mill; to test the performance characteristics of alloy steels; to use a new milling machine; to study the structure of stainless steels to observe how steel is cast

VII. Discuss with your friend which of these things may be done.

EXAMPLE: *machine tools / to be made of pig iron*

A: May machine tools be made of pig iron?

B: Certainly they may. They may be made of pig iron.

or *B:* I'm afraid they may not. They may not be made of pig iron.

a) pure iron / to be refined
b) the properties of iron / to be modified easily
c) the carbon content of steel / to be varied
d) hydrogen / to be added to alloy steel
e) steel / to be tempered
f) steel alloys / to be protected from corrosion
g) steel / to be used for electrical wiring
h) machine tools / to be made of pure iron

VIII. Insert the necessary prepositions.

1. I'm going to study the properties ... some materials. 2. Julia is interested ... elasticity. 3. Steel tools have grown ... popularity. 4. The student plans to carry ... his research on materials engineering. 5. We use metals ... different engineering purposes. 6. Steel may be pressed ... a new shape.

IX. Correct mistakes in the following sentences.

1. Metals which are used in industry may to be called engineering metals. 2. He wasn't allowed determine the constituents of this steel. 3. The majority of metals may to become harder after they have been cold-worked. 4. You doesn't may carry out the investigation here. 5. The students be allowed to practise in the rolling mill yesterday. 6. Will be I allowed to use the mobile equipment?

X. Translate the sentences into English using your active vocabulary.

1. Теперь вы можете исследовать свойства легированных сталей. 2. Вчера нам разрешили наблюдать, как очищают железо. 3. Скажите, пожалуйста, какие свойства имеет углеродистая сталь и почему она используется наиболее широко? 4. Могу я спросить: почему эта сталь не будет ржаветь? 5. Высокопрочные стальные сплавы могут включать разнообразные элементы. 6. Углеродистая сталь не может использоваться для изготовления шасси самолета.

Reading and Speaking

I. Practise reading these words.

ancient ['eɪnʃənt]
superior [sjuː'pɪərɪə]
malleable ['mælɪəbl]
purify ['pjurɪfaɪ]
percentage [pə'sentɪdʒ]
ingot ['ɪŋgət]

II. a) Today steels are used everywhere. How can you explain the popularity of this alloy?

b) Find in the text below the following information:

1) kinds of alloys;
2) constituents of steel;
3) how the qualities of steel may be changed;
4) alloying elements;
5) properties of alloy steels;
6) names of the technological processes that are mentioned.

III. Read the text attentively to learn more about steels.

The value of alloys was discovered in very ancient times; brass (copper and zinc) and bronze (copper and tin) were **especially** important. Today the most important are **alloy steels**, which have a lot of special characteristics.

Steel is known as an alloy of iron and about 2% or less carbon. Pure iron is soft, ductile and **malleable**, useful only as an **ornamental** material. However, the **addition** of carbon **hardens** it greatly and changes its properties. Steels for special applications may contain other alloying elements **beside** carbon. This **modifies** and improves the physical properties of the base steel. For example, small **percentages** of nickel, chromium, manganese and vanadium may be used for **strengthening** steels for construction work. **Heat treatment** (i.e. **tempering**) and mechanical **working** at cold or hot temperatures may also give steel alloys **superior** qualities, such as **strength**, hardness, toughness, wear resistance, corrosion resistance, **electrical resistivity** and **workability**.

Steel making processes are known as **melting**, **purifying** (**refining**) and **alloying** at about 2,900 °F (1,600 °C). **Molten** steel may be first **cast** into **ingots**. Later ingots are worked into finished products. This may be done by two major methods: **hot-working** and **cold-working**. The latter is generally used for making bars, wire, tubes, sheets, and strips. Molten steel may also be cast directly into products.

IV. Choose the right option to complete the sentences.

1. Steel is a general name for
a) non-metals; b) ferrum; c) iron-and-carbon alloys.
2. Physical properties of iron may be modified greatly by the addition of
a) iron ore; b) hydrogen; c) carbon.
3. Pure iron is used
a) as an ornamental material; b) for construction work;
c) in machine tools.
4. Steel for special applications usually contains
a) carbon; b) various alloying elements; c) vanadium.
5. Heat treatment and mechanical working at cold or hot temperatures result in ... of steel.
a) a different carbon content; b) better qualities; c) finished products.
6. Melting, purifying and alloying are the stages of steel
a) cold-working; b) refining; c) making.
7. Bars, wire, tubes, sheets, and strips are the result of
a) melting steel; b) hot-working; c) cold-working.

V. Today you have been given a lecture on steels. You have not understood it very well. Your friend is good at materials science. Ask him to explain to you clearly what steels are and how they are produced.

If you find the task too difficult, make up a list of the questions you are going to ask.

VI. What information have you received from the text? Is it useful? Where can you apply this information?

Further Reading

I. Practise reading these words.

average [ˈævərɪdʒ]
undercarriage [ˈʌndəˌkærɪdʒ]
tungsten [ˈtʌŋstən]

II. Look at the picture and try to guess what information the text may carry. Scan the text to check your answer. What does the text deal with?

III. Read the text attentively to learn more about various kinds of steel.

Classes of Steel

Steels vary greatly but the major classes are carbon steels, low-alloy steels (up to 8% alloying elements, i.e. tool steels), and high-alloy steels (more than 8% alloying elements, i.e. stainless steels).

In carbon steels, the **carbon content** may **range from** 0.015% **to** 2%. The steel that was used for the Golden Gate Bridge, for instance, is carbon steel with the following average chemical composition: C: 0.81% (0.85), Mn: 0.66%, P: 0.026% (0.04), S: 0.028% (0.04), Si: 0.24%. The addition of this tiny amount of carbon made the steel much stronger and harder. Carbon steels **account for** about 90% of the world's steel production. They may be used for automobile bodies, appliances, machinery, ships, containers, and the structures of buildings.

Tool steels are special steels that are engineered to **particular** service requirements. These expensive alloys are **exceptionally** strong, hard, wear-resistant, tough, nonreactive to local overheating. They contain tungsten, molybdenum, vanadium, and chromium in different combinations, and often cobalt or nickel for better high-temperature performance. They are used for machine tools, aircraft undercarriages, in buildings and bridges.

Stainless steels **comprise** any alloy steel that contains 10–30% chromium. The presence of chromium, together with the low-carbon content, gives a remarkable resistance to corrosion and heat. Other elements, such as nickel, molybdenum, titanium, aluminum, niobium, copper, nitrogen, sulphur, phosphorus, and selenium, may be added for obtaining better corrosion resistance and other valuable properties.

IV. Can you read these chemical elements? If not, find their names in the text.

C, S, P, Se, W, Mo, V, Cr, Co, Ni, Ti, Al, Cu, N, Nb

V. Are these statements true or false? Correct the false statements.

1. There are many kinds of steel. 2. Three major classes are carbide steels, low-alloy steels, and high-alloy steels. 3. Carbon steel was used in building the Golden Gate Bridge. 4. Great strength, hardness and other valuable mechanical properties are obtained by the addition of a great amount of carbon. 5. Low-alloy steels are the most popular kind of steel. 6. Tool steel is used for producing automobile bodies, ships and spoons. 7. Tool steel is not cost-efficient. 8. Tungsten, molybdenum, vanadium, and chromium in different combinations may improve high-temperature performance of stainless

steel. 9. A remarkable resistance of stainless steel to corrosion and heat is achieved with the help of chromium and high-carbon content.

VI. Your friend studied the properties of different steels in the practical class. Ask him what he has found out.

These are the possible questions:

What types of steel did you study?
What is the carbon content of carbon steels? How does it influence their properties?
Where may carbon steels be used?
.............?

Activity

I. A group of students are on an excursion at the steel works. Take them around and explain what they see starting from the value of alloys and finishing with making different types of steel.

II. You are a team of engineers who design various things.

a) Consider the advantages and disadvantages of various steels carefully.

Class of Steel	*Advantages*	*Disadvantages*
carbon steels	...	...
tool steels	...	...
stainless steels	corrosion resistant	...

b) Decide which steels you will use for making the objects named below. Give your reasons.

Knives, nails, hammers, cables, automobile bodies, ships, containers, machine tools, aircraft undercarriages, bank vaults.

Writing

I. a) Complete the table with the data you have obtained.

b) Choose one type of steel and write its description.

Class of Steel	*Composition*	*Properties*	*Use*
carbon steels	Fe, C	...	...
tool steels	Fe, C, Co, Ni, W, Mo, V, Cr		
stainless steels	Fe, C, Ni, Mo, Ti, Al, Nb, Cu, N, S, P, Se, Cr	does not rust	

II. Translate the passage into Russian. Use the dictionary if necessary.

Owing to the valuable properties of stainless steel its application may vary from spoons to bank vaults. This steel does not rust because of the interaction between its alloying elements and the environment. Stainless steel contains iron, chromium, manganese, silicon, carbon and significant amounts of nickel and molybdenum. These elements react with oxygen from water and air and produce a very thin stable film of metal oxides and hydroxides, which may prevent additional corrosion because it limits the access of oxygen and water to the metal layers below. This film may not be seen without a powerful microscope that is why steel seems stainless when it is in fact corroded at the atomic level.

In summary, stainless steel does not rust because it may form a corrosion product layer for the protection against further attacks of oxygen.

Section C. Composite Materials

Lead-in

I. Discuss the following questions.

a) Are plastics widely used today? Make a list of possible applications of plastics. Compare it with that of your groupmates.

b) What properties do plastics have?

II. Alice meets her friend Andrew in the University library. Listen to their dialogue and say what you have learnt about plastics.

Alice: Hi, Andrew, are you busy now?

Andrew: Yes, I am. I have to **draw up** a laboratory **report**. Can you help me do it **properly**?

Alice: Well, as far as I know, a laboratory report must contain the **object** of the experiment, the results that were **obtained** and the **conclusions**.

Andrew: And what about the **procedure** and the equipment? Must they be **included** into the report, too?

Alice: In my view, both of them must be included if you need a **detailed** report. By the way, Andrew, what did you have to determine during your experiment?

Andrew: We had to **compare** the properties of different plastics.

Alice: And what results did you get?

Andrew: Well, you know that plastics may be divided into **thermoplastics** and **thermosetting plastics**. So we have come to the conclusion that thermoplastics may be heated several times, **while** thermosetting plastics may be heated only once.

Alice: Oh, this is very interesting. And as far as I understand, this **peculiarity** of plastics must be **taken into account** when different engineering products are produced.

Andrew: Certainly. And I will have to **prove** it in my report.

III. Complete the dialogue.

A: ...

B: Yes, I'm very busy. I have to draw up .... Do you know how to do it properly?

A: ...

B: What do I have to do to draw up a laboratory report?

A: ...

B: And must the procedure and the equipment be included into the report, too?

A: ...

B: I had to determine the basic properties of thermoplastics.

A: ...

B: Certainly. It was very interesting.

A: ...

B: Oh, we will have to carry out another tensile test in a week.

A: Well, good luck to you.

B: ...

IV. Match a line in A with a line in B.

A	B
1. Hi, Andrew, you are busy now, aren't you?	a) The hardness of polythene.
2. What are you busy with?	b) Sorry, I'm very busy now.
3. What did you determine during the test?	c) Well, yes.
4. How do thermosetting plastics differ from thermoplastics?	d) Thanks.
5. Good luck to you.	e) I have to draw up a laboratory report.
6. Could you tell me how to draw up the report properly?	f) They can't be reheated.

Language Practice

Vocabulary

I. Match these words and expressions with their Russian translation.

1. thermoplastics	a) слоистый материал
2. thermosetting plastics	b) стекловолокно
3. glass fibre	c) полиэтилен
4. carbon fibre	d) термореактивные пластмассы
5. composite	e) ровный, гладкий
6. phenolic resin	f) композиционный материал
7. polythene	g) анизотропный
8. anisotrophic	h) термопластические смолы
9. laminate	i) феноло-альдегидный полимер
10. smooth	j) углеволокно

II. Find in B the English equivalent to the Russian word in A.

A	B		
изменять	a) to modify	b) to cover	c) to replace
благодаря	a) because of	b) due to	c) thank you
достаточный	a) essential	b) sufficient	c) efficient
популярность	a) popular	b) popularity	c) famous
жёсткий	a) stiff	b) strong	c) soft
усиливать	a) to recycle	b) to enhance	c) to combine
улучшать	a) to increase	b) to improve	c) to introduce
преимущество	a) disadvantage	b) advantage	c) edge

III. Make up all possible word combinations.

materials	technology
sports	materials
glass-fibre	composites
water	absorption
plastics	industry
high-performance	ceramics

Grammar: The Modal Verb "must"

IV. Say what these people must or mustn't do in these situations.

EXAMPLE: *engineers / to finish the test in half an hour*
The engineers must finish the test in half an hour.
or *engineers / to break safety instructions*
The engineers mustn't break safety instructions.

Students / to attend classes; scientists / to perform all the experiments according to the instructions; students / to be late for their practical classes; friends / to help each other in difficult situations; students / to carry out a lot of experiments; engineers / to work with faulty devices.

V. Ask your friend whether your groupmates must do these things.

EXAMPLE: *to complete the test*
A: Must Alex complete the test?
B: No, he needn't, but Dima must.

To follow these instructions; to determine the strength of polythene; to study the advantages of polymers; to receive new data; to draw up a laboratory report.

VI. Put these statements into Present, Past and Future using the modal verb *to have to (not to have to)* instead of *must (mustn't)*.

EXAMPLE: *He **must** write a detailed report of the test.*
He **has to** write a detailed report of the test.
He **had to** write a detailed report of the test.
He **will have to** write a detailed report of the test.

1. The students must complete another series of experiments. 2. They must compare the results of two tests. 3. Alice must determine the composi-

tion of nylon. 4. The engineers must develop new plastics. 5. The scientist must elaborate the plan of his research.

VII. Ask your friend if he had to do the following things last week.

EXAMPLE: *to draw up a laboratory report*
A: Did you have to draw up a laboratory report last week?
B: No, I didn't. But I will have to draw up a laboratory report next week.

To study the influence of temperature on the strength of plastics; to describe the properties of bakelite; to compare the properties of phenolic resin and polythene; to do research on thermoplastics; to follow the procedure of the laboratory experiment.

VIII. Ask your instructor if these things must be done.

EXAMPLE: *a detailed report of the experiment / to be written*
Student: Must a detailed report of the experiment be written?
Instructor: Certainly it must. It must be written without mistakes.

oil / to be used as a raw material for plastics
plastics / to be widely applied in construction work
plugs / to be made of phenolic resin
the conclusions / to be included in the report
the procedure of the experiment / to be described in detail

IX. Give advice to your friend in the following situations. Use the modal verb *should*.

EXAMPLE: *A: I have an examination tomorrow.*
B: Well, you should work very hard tonight.

1. I don't know how to draw up a report of my expriment. 2. I'm very tired after the practical class. 3. I'd like to know more about plastics. 4. I'd like to buy good sports equipment. 5. I want to become a materials engineer but I don't know what I must study and at what University.

X. Correct mistakes.

1. Denis hadn't to write a detailed report of the experiment with thermosets. 2. I will must to study all the peculiarities of this technological process next week. 3. He have to deliver a report on the applications of plastics. 4. I don't must switch on this machine without our teacher's permission. 5. Have you to recycle unwanted nylon? 6. Must be non-recycable plastics burnt?

XI. Translate the sentences using your active vocabulary.

1. Инженеры должны были модернизировать технологические процессы. 2. Мы должны будем составить доклад об эксперименте через неделю. 3. Пластмассы можно разделить на термореактивные пластмассы и термопластические смолы. 4. На занятии студенты должны будут определить прочность различных пластмасс. 5. Рабочие должны были установить виниловые окна в здании. 6. Развитие науки о материалах должно привести к усовершенствованию многих инструментов, повышению их эффективности.

Reading and Speaking

I. Do you like sports? Make a list of all possible materials that are used in sports equipment. Compare your list with that of your groupmates.

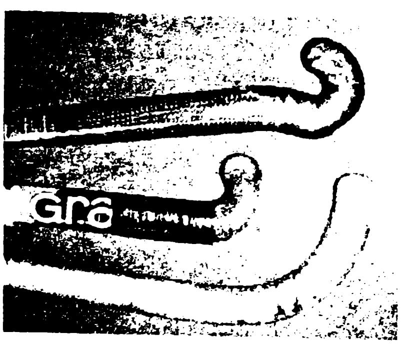
II. Study the new words and word combinations.

pole vault	прыжок с шестом
to be fit	быть в хорошей форме
considerably	значительно
hickory	дерево гикори (*род североамериканского орешника*)

What do you think the text is about?

III. What materials are tennis rackets, hockey sticks and poles made of nowadays? Skim the text to find it out.

Sports Materials



Materials engineering is the study of materials – anything from tennis racket frames to turbine blades in aeroengines. The subject **combines** sciences with engineering and looks at the structure of materials, their properties and **fabrication**.

Materials science has a dramatic **impact** on sporting records. Since 1896 the Olympic record in the pole vault, for example, has increased from 3 to about 6 metres largely due to the changes in materials technology. The first poles were made from **solid** hickory wood. In 1904 bamboo poles were introduced, which only 50 years later were replaced by aluminium poles. The latter, however, gave little improvement in performance and had to be replaced by lighter and less **stiff glass-fibre composites**. These account for the dramatic increase in performance.

The materials and design of hockey sticks have also changed a lot. Hockey sticks *used to be made*[1] from wood, and they **failed** quickly. Modern hockey sticks are made from **carbon-fibre** and glass-fibre composites, which increase stiffness. As the **failure** can be dangerous, researchers still have to improve the performance of composite sticks.

Early tennis rackets were made from solid wood (ash or maple). Because of its cellular structure, wood is **anisotropic**, i.e. its properties are not the same in each direction. This **limited** the size and stiffness of the rackets. The anisotropy was overcome by the introduction of wood **laminates**, but there was still the problem of water **absorption**, which **caused** the deformation of the racket. In the 1970s aluminium alloy frames were introduced. The greater stiffness of the aluminium meant that frames could be lighter. However, these were soon replaced by even stiffer and lighter carbon-fibre rackets. The research continues and materials engineers have not said their last word yet.

---

[1] раньше делали

IV. Choose the right option.

1. Since 1896 the Olympic record in the pole vault ...
   a) has decreased from 6 to 3 metres.
   b) has increased from 3 to 7 metres.
   c) has increased from 3 to 6 metres.
2. The poles used in 1896 were made from ...
   a) bamboo   b) hickory wood   c) glass-fibre composites.
3. The performance in pole vaulting has increased greatly because ...
   a) composite poles were made from aluminium.
   b) composite poles were lighter and less stiff.
   c) composite poles were made longer.
4. First hockey sticks were made from ...
   a) wood
   b) carbon-fibre composites
   c) carbon-fibre and glass-fibre composites.
5. Anisotropy is ... of solid wood rackets.
   a) an advantage   b) a disadvantage   c) an improvement
6. In order to improve tennis rackets ... was introduced in the 1970s.
   a) carbon-fibre composites   b) aluminium   c) solid wood

V. Complete the text with the words given below.

· The materials technology has ... a lot over the past years. New more reliable materials have ... the old ones. Other advances in materials science may lead to further ... in performance. Let's have a look at some examples of sport ... .

Poles are often ... from glass-fibre ... that increase their ... . Such poles are lighter and less ... than ... poles.

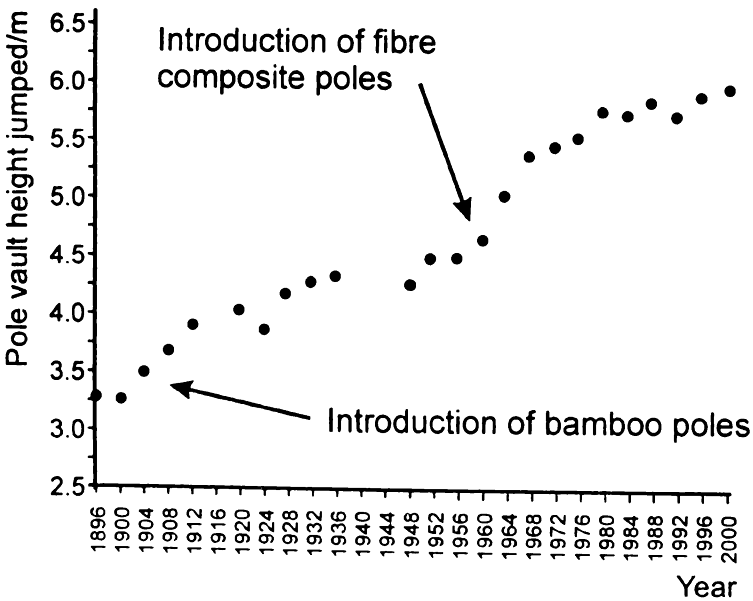
... and glass-fibre composites are also used for ... hockey sticks. This helps to ... stiffness. ..., such hockey sticks can be ... for players. That is why researchers are trying to ... their performance.

Carbon-fibre composites have also replaced aluminium in tennis ... . Such composite rackets have a higher ... than aluminium ... , so rackets can be even stiffer and ... .

changed	performance	made	improvements	improve
equipment	carbon-fibre	replaced	aluminium	alloys
composites	producing	increase	dangerous	stiff
stiffness	lighter	rackets	however	

VI. The current rules state 'the pole may be of any material or combination of materials and of any length or diameter, but the basic surface must be smooth'. Look at the graph below and describe the influence of materials technology on the sporting records in the pole vault.

Graph showing the winning height in the pole vault at the Olympic Games since 1896.



VII. You are in the shop 'Sport Master'. You want to buy a modern hockey stick and a good tennis racket. Discuss with the shop assistant the best choice.

Further Reading

I. a) Practise reading these words.

polymer ['pɒlɪmə]
celluloid ['seljʊlɔɪd]
vulcanized ['vʌlkənaɪzd]
synthetic [sɪn'θetɪk]
thermal ['θɜ:məl]

b) What can the text be about?

II. Skim the text to find answers to these questions.

1. What are the applications of plastics? 2. What is a polymer? 3. Are there any natural polymers? 4. What was the first synthetic polymer and when was it developed? 5. Do polymers possess valuable properties? 6. What is the disadvantage of plastics? 7. How can pollution by plastics be reduced?

III. Polymers influence all spheres of our life. They make health, safety and high performance possible. Read the text attentively for the detailed information about polymers.

Plastics

Whether you are aware of it or not, **plastics** play an important part in your life. From the car you drive to work to the television you watch when you get home, plastics help make your life easier and better. How?

Plastics are **polymers** – long **chains** of many units that are usually made of carbon, hydrogen, oxygen, and/or silicon. Polymers have been with us since the beginning of time – tar, amber and horns are the easiest examples. In the 1800s these natural polymers were chemically modified and many materials such as vulcanized rubber and celluloid were produced. The first truly **synthetic** polymer Bakelite was developed in 1909 and was soon followed by the first synthetic fibre, rayon, in 1911.

Polymers come in a great variety of **characteristics** and colours. This fact alone must be considered as an advantage of these materials. They are cheaper and easier to make than, say, paper. Besides, polymers possess the properties of easy processing, **durability**, light weight, **sufficient** strength, thermal and electrical **insulation** and resistance to chemicals, corrosion and **shock**. These valuable qualities of polymers can be further enhanced by a wide range of **additives**, which broaden their uses and applications.

Unfortunately, we have to admit that plastics pollute the environment. Luckily, most polymers are **thermoplastic** (e.g. **nylon**, **polythene**), i.e. they can be heated and reformed again. The recycled plastics **keep** all their properties when they are combined with *virgin plastics*[1]. The other group of polymers, **thermosets** (e.g. **bakelite, phenolic resin**), must not be recycled, as reheating causes their deformation. However, the controlled **incineration** of thermosets **converts** waste into heat energy.

The usefulness of plastics can only be measured by our imagination. These are definitely the materials of past, present, and future generations.

---

[1]пластмассы, которые ранее не перерабатывались

IV. Say if the following statements are true or false. Correct the false statements.

1. Plastics influence our life greatly. 2. Conventional polymer constituents include carbon, nitrogen, oxygen, and/or silicon. 3. Tar, amber and horns are the easiest examples of synthetic polymers. 4. Plastics both conserve and produce energy. 5. Polymers do not conduct electricity and heat. 6. All polymers are divided into two distinct groups: thermoplastics and thermostatics. 7. Unwanted thermoplastics should be recycled. 8. Bakelite and phenolic resin produce heat energy when they are incinerated.

V. Explain why the following things are made or covered with polymers. Name the properties of polymers, which are important in making these things.

Product	*Property*
plastic bottles for acids or cleaning fluids in your home	light weight (as compared with paper or metal)
electrical appliances, cables, electrical outlets and wiring	sufficient strength
microwave cookware and the handles of kitchen utensils	thermal insulation
car bodies, the frame structure of space stations	electrical insulation
portable phones and portable computers	resistance to chemicals
shopping plastic bags and packaging	resistance to corrosion
cups, plates, spoons and forks	easy processing
refrigerators and coolers	energy and cost efficiency
picnic tables and fences	easy recycling
decorations and toys	resistance to shock
bulletproof vests	
vinyl windows	

VI. Comment on the following statement.

"The usefulness of plastics can only be measured by our imagination. These are definitely the materials of past, present, and future generations."

Activity

I. Nowadays professional sportsmen want to have high-quality sports equipment in order to win different competitions. That is why the Belarusian Olympic Committee has decided to buy modern equipment for our Belarusian sportsmen.

Divide into several groups.

Materials engineers: discuss what materials should be used in making the equipment for hockey players, tennis players and athletes. Present your ideas to the representatives of the Olympic Committee.

The Belarusian Olympic Committee: listen to the projects and choose the one you like most. Give your arguments.

II. Discussion. How much do we depend on plastics?

a) Read the following arguments and think of your own ones.

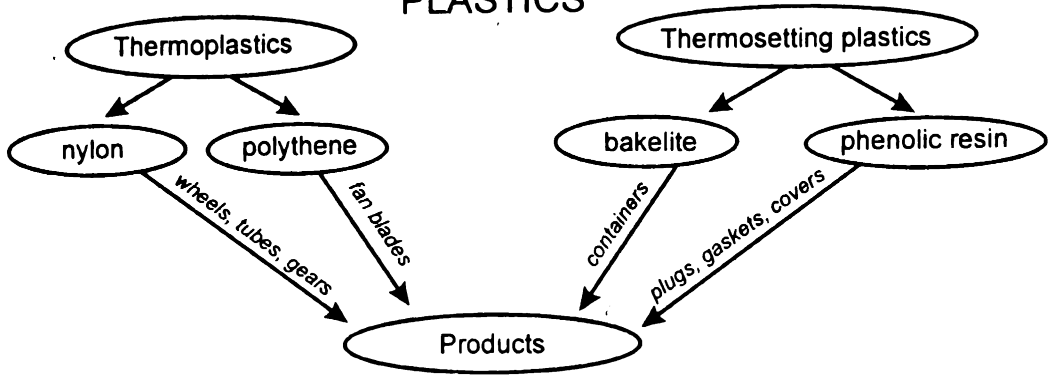
We cannot live without plastics	*We can live without plastics*
1. The soles of our shoes are made of plastics.	1. We can make leather shoes.
2. The photographic film is made of it.	2. ...
3. ...	3. ...

b) Discuss this problem in groups of 4 and make your own decision.

Writing

I. Study the diagram below and write a paragraph about the applications of different types of plastics. Point out why these products are made of plastics.

PLASTICS



II. Translate the passage into Russian. Use the dictionary if necessary.

Despite well-grounded criticism, plastics possess numerous advantages. The most important of them is certainly energy conservation. Here are some simple examples.

Food must be kept fresh and healthy. In fact, each pound of plastic packaging reduces up to 1.7 pounds of food waste. Besides, plastics make packaging more efficient, which ultimately conserves resources. For example, you need 2 pounds of plastic for the delivery of 1,000 ounces of juice. You will have to use 3 pounds of aluminum, 8 pounds of steel or 27 pounds of glass for the same amount of juice. Plastics also help conserve energy in your home. Vinyl windows lower your heating and cooling bills. Plastic parts and insulation help major appliances - like refrigerators or dishwashers - resist corrosion, last longer and operate more efficiently. Indeed, their energy efficiency has improved by 50 percent since the 1970s. Health, safety, high performance - plastics help make these things possible.

CHECK YOUR PROGRESS

I. Work in pairs. Choose the appropriate adverbial modifiers to complete the sentences. Do card A and your friend will do card B. Exchange your answers and check yourself.

Card A

1. The speedometer is indicating 3 kph.	sometimes
2. The computer processes pieces of information.	at this time
	now
3. The scientists will describe the new computer technology.	by the end of the week
	always
4. They are testing a new calculating device.	in half an hour
	usually
5. The students will have learned some facts about robot history.	from 10 till 12
	by 5 o'clock
6. The students perform a lot of experiments.	never
7. We'll be studying the properties of engineering materials.	
8. He had designed a new model of a tractor.	
9. We have mounted the tool in the manipulator.	
10. I will have seen a machining centre in operation.	

Card B

1. Many requirements have been met.	long ago
2. The new model had been equipped with up-to-date control filter.	recently
	by next year
3. He will have carried out field tests.	usually
4. The device had been repaired at next time our workshop.	by the end of the day
	lately
5. The properties of new alloys will have been studied.	by 5 o'clock tomorrow
	by that time
6. Everything had been arranged.	before the experiment started
7. This fuel was used in different engines.	
8. The experiment was carried out.	
9. The device will be made of new engineering materials.	
10. A new lathe will have been devised.	

II. Complete the sentences with the words from the box. Pay attention to the tense form of these verbs.

1. The ammeter _____ +10 A at the moment.
2. The alternator _____ a strong or weak current for the engine.
3. The students _____ three types of electrical units.
4. John _____ small crocodile clips to make a good connection between the meter and resistor.
5. Computers _____ mathematical operations such as addition, subtraction and others.
6. The first computers _____ vacuum tubes and _____ thousands of calculations per second.
7. New generations of computers will _____ more powerful.
8. The students _____ some facts about the history of computers.
9. After man _____ the robot he widened his possibilities and relieved himself from monotonous and hazardous tasks.
10. I already _____ the dimensions of the workpieces. Here they are.
11. What _____ it _____ of?
12. The students _____ an experiment yesterday.
13. The fuel _____ with air.
14. The workshop _____ with automatic machinery.
15. Most of the mini motor cars _____ in Great Britain.
16. New motor vehicles _____ all customers requirements.

carry out	indicate	use (2)	
meet	produce (2)	measure	study
mix	invent	be	perform (2)
learn	make	equip	

III. Put in *since, for, ago*.

1. We've studied Robotics ... two years.
2. I've been in the lab ... 5 o'clock.
3. My friend graduated from the Technical University three years ....
4. She's been an engineer ... eighteen years.
5. Mary completed the experiment a few minutes ....
6. I haven't seen him ... weeks.

IV. Choose the right modal verb in these dialogues.

a) – How ... I get to the Technical University (*can, may*)?
– You ... go by bus or you ... walk (*can, may*).

b) – ... I use this device tomorrow (*can, may*)?
– Of course, you ... (*can, may*).

c) – ... I have a look at your results (*can, may*)?
– Oh, yes. Here they are.

d) – Why is he late?
– He ... be busy, I'm not sure (*may, can*).

e) – ... we start the experiment tomorrow (*must, can*)?
– No, we ... (*can't, needn't*).

V. Translate these sentences using your active vocabulary.

1. На приборной панели в автомобиле можно увидеть различные приборы, самые важные из них – спидометр, тахометр и амперметр.

2. Вчера на практическом занятии мы проводили эксперимент с мультиметром.

3. Современный компьютер представляет собой сложное электронное устройство, которое способно выполнять миллионы операций в секунду с огромной точностью. Компьютеры широко используются практически во всех областях промышленности.

4. Первый прототип робота был сконструирован еще в начале XX века. За последние годы, благодаря огромным достижениям в информатике и материаловедении, роботостроение значительно усовершенствовалось. Сегодня робот состоит из многочисленных манипуляторов, приводов, сенсоров и сложного программного обеспечения. Однако робота еще не научили думать.

5. Топливная система используется для подачи топлива в двигатель и состоит из бака, топливной трубки, насоса и карбюратора. В карбюраторе топливо смешивается с необходимым количеством воздуха. Затем эта смесь сжигается в камере сгорания и вырабатывается мощность.

6. Новые белорусские тракторы будут оснащены современными акустическими системами и фильтрами климатического контроля. Кроме этого, будут установлены галогенные фары на крыше кабины. Более того, современная кабина водителя обеспечит прекрасный обзор поля. Такие тракторы будут полностью соответствовать всем требования комфорта и безопасности.

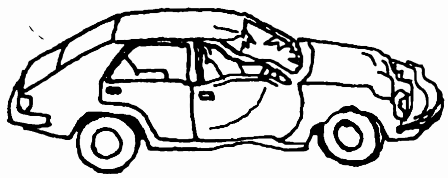
VI. Rearrange the following lines to make up a dialogue of a telephone conversation between two students.

Paul	Alice
– I'm fine. What are you doing now?	– Outside the exhibition hall. I'll be waiting for you.
– How are things with you?	–Yes, I'd love to.
– Settled. I'll see you there then.	– OK. See you later.
– Hello, is that you, Alice?	– Not bad, thanks. What

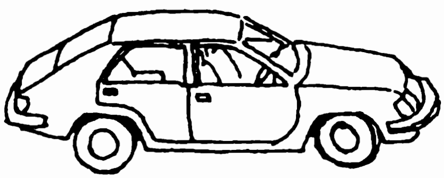
– Would you like to go to the computer exhibition?
– Where shall I meet you?

about you?
– Yes, I'm speaking.
– Well, at the moment I'm drawing up a laboratory report.

VII. Compare the pictures and say what has been changed in the car. Picture 1 shows a car in very bad condition, picture 2 shows the same car after repair.



Picture 1

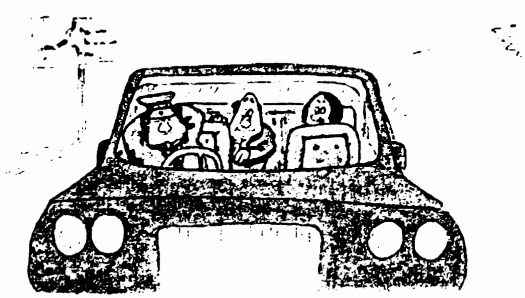


Picture 2

1. the window screen / to be replaced
2. the engine / to be changed
3. the car / to be painted
4. the instrument panel / to be repaired
5. the tyres / to be pumped

VIII. Look at this picture. This is how the author of the picture sees the future of our cars. Discuss with your partner what he wanted to say.

"Don't panic. The car's fully automated... The chauffeur's just to impress the neighbours."



– intelligent vehicle motion control
– automatic vehicle control
– ACC (adaptive cruise control)
– ABS (automatic braking sys tems)
– to adjust speed automatically
– to apply the brakes automatically
– to maintain vehicle stability and driver's safety

IX. a) Divide into two groups.

Group A: Read the text about temperature scales.

Group B: Read the text about barometers.

A: Four different scales are used for temperature measurement. The Fahrenheit scale divides the temperature between the freezing and boiling points of water into 212 units: that is, degrees. The Celsius scale (often called Centigrade) divides this same range of temperature into 100 degrees. The Kelvin scale begins its measurement at Absolute Zero with its degree intervals (intervals of temperature) corresponding to the Celsius scale - thus the freezing point of water on the Kelvin scale is 273.15°K. The Rankin scale is also an Absolute Zero scale: however, its temperature intervals are based on the Fahrenheit rather than the Celsius scale.

B: A barometer is a meteorological instrument used for the measurement of atmospheric pressure. Barometers may be classified into two general types, depending on the ways in which they record the pressure of the atmosphere. The mercury barometer is larger and more accurate of the two types, while aneroid barometer is more compact but less accurate.

The aneroid barometer is a portable meteorological instrument designed to record changes in atmospheric pressure.

The mercury barometer is a meteorological instrument used for measuring the pressure of the atmosphere in terms of the height of a column of mercury which exerts equal pressure. In its simplest form it consists of a vertical glass tube about 80 cm. long, closed at the top and open at the lower end.

b) Find a partner from the other group and tell him what you've learnt from the text. Don't look back into the text.

c) Get back to your groups again and answer the comprehension questions.

Questions for Group A	*Questions for Group B*
1. What is a barometer?	1. How many scales are used for temperature measurement?
2. What are the general types of barometers?	2. What are they?
3. Which barometer is more accurate?	3. Which scale is divided into 100 degrees?
4. What does the mercury barometer consist of?	4. What do the Rankin scale and the Kelvin scale have in common?

X. This text has been given to the students of the Technical University at the English Competition. They had only 45 minutes to translate it. Try your hand at it.

Time's Arrow

People are born, grow up, grow old and die. Never the other way round. A star shines for billions of years as it converts vast stores of nuclear energy to heat and light that radiate out into the chilly emptiness of space. Time ticks on. The star runs out of fuel and its embers glow duller and colder - the energy it has radiated spreads ever farther into the universe. Just like the hot coffee on the desk in front of me, it is cooling down and the internal energy it once contained is spreading out. Everything cools down and energy spreads out. Time ticks on and the future is a cold, dark place. The past, on the other hand, was a hot, bright place, with a huge energy density and the potential to do wonderful things. What's going on ...? Why is the future different from the past?

On the large scale, physical changes seem to proceed in one direction. They are irreversible. We do not see old people getting younger or cold coffee spontaneously reheating – the future really is different from the past and this difference is linked to irreversibility.

The future is different from the past because some changes are irreversible, but what we really want to know is why some things are irreversible and why this is only significant on the largest scale.

By the middle of the nineteenth century, physicists and engineers were intrigued by irreversible processes. They were particularly keen to understand why mechanical work can be converted to heat with 100% efficiency whilst the reverse process appears to be impossible. (Heat engines like the steam engine and internal combustion engine are designed to convert heat into work, so this question is highly significant.) This apparent irreversibility was raised to the status of a law – the second law of thermodynamics.

XI. How good is your memory? Here's a crossword for you to see how well you remember new words from the Units.

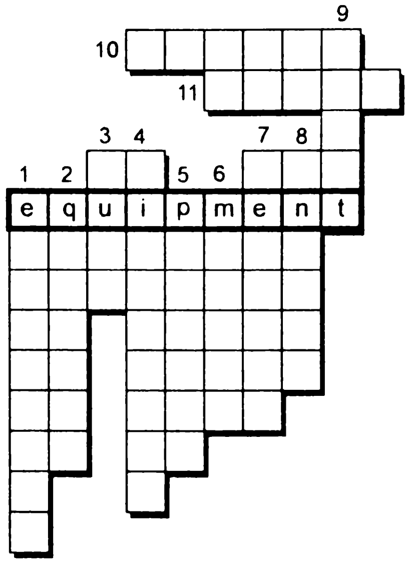
Down:

1. basic, fundamental, necessary
2. a degree of excellence
3. a material burnt as a source of energy
4. something that has been found by exploration. It is often a place or a scientific fact.
5. plastics belong to ....
6. movement, moving

7. a means of transport
8. a machine using fuel and supplying power
9. a machine programmed to move and perform certain tasks

Across:

10. a reddish-brown metallic element (symbol Cu)
11. a mixture of chemical elements at least one of which is a metal



XII. When you apply for a job you need to write a CV. Study this example below and write your own CV.

	Curriculum Vitae
Personal details	Name: Alexey Kosov
	Date of Birth: 21 January 1985
	Marital Status: Single
	Nationality: Belarusian
	Address: 12, Nezavisimosti Ave
	Minsk, 220012, Belarus
	Tel: 275-12-12
	e-mail: alexey@yahoo.com
Education	
2008-to present	Belarusian National Technical University, Mechanical Engineering
1997–2008	Secondary School No 119
Work Experience	Mechanic apprentice at a service station
Languages	Russian, Belarusian, English (fluent), German (working)
Interests and Activities	Sports, computers, automobiles, travel
Other Information	Clean driving licence

References available upon request.

XIII. When you apply for a job you will have to write an application. Study this example below and write your letter of application for the post you would like to have.

12 Nezavisimosti Ave
Minsk, 220012
21 April 2003

Belavtotrans
12, Gurskaya St,
Minsk, 220049

Dear Sir / Madam

I would like to apply for the post of Engineering Technician, which was advertised in today's issue of the *Business Week*. I enclose my CV for your attention.

You will note from my CV that I have a diploma with honours in Automobile Engineering and considerable experience. My work at the Motor Plant means that I am familiar with a wide range of steering and braking systems.

I enjoy my work at the Motor Plant but I would like now to broaden my experience, especially in the area of maintenance. I feel that I can bring considerable skill to the post together with the ability to work well in a team.

Please let me know if there is any further information you require.

I look forward to hearing from you.

Yours faithfully

Alexey Kosov

Unit Eight

MECHANICAL TECHNOLOGY

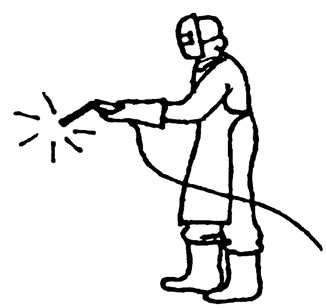
Section A. Welding

Lead-in

I. Discuss the following questions.

a) In what branches of engineering is welding used?
b) Have you ever seen the process of welding?
c) What safety rules should be observed during this process?

II. Listen to the students' conversation and learn how to weld workpieces correctly.



Denis: Will you tell me how to **join** these two workpieces, Peter?
Peter: No problem. It is not very difficult. I think you should use an **electric arc** to **weld** the pieces. Are they of **the same** metal?
Denis: Oh, yes. Why do you ask?
Peter: Well, it is **desirable** to join the workpieces of the same material, for example, steel to steel, in order to make a very strong **joint**.
Denis: Oh, I see. How do I weld them?
Peter: Look at these pictures. Everything is shown and explained here. It is **essential** to follow all these instructions.
Denis: OK, I get it. By the way, I hear that electric arc welding is **dangerous**. Is that right?
Peter: Yes. However, if you **follow** safety rules nothing will happen to you.
Denis: What **safety rules**?
Peter: Don't you know? First of all, it is necessary to put on special **protective clothing**, you know, an **apron, gloves,** rubber **boots** and a cap. Everything must be dry and clean. Then you should always **wear** a mask or a **helmet** to protect your face ...
Denis: Fine. Shall we start welding now?
Peter: Well, let's try.

III. Complete the dialogues.

1. – Is it easy to...?
   – No, it is rather difficult to do that job. To my mind, you should use an electric arc to ... .
   – ...
2. – Should the workpieces be made ... metal?
   – Yes, it is desirable to ....
3. – Electric arc welding is quite dangerous, ...?
   – ..., that is why it is important to ... .
   – Will you tell me what they are?
   – Well, it is necessary to ... .

IV. Match a line in A with a line in B.

A

1. Electric arc welding is widely used in industry.
2. Peter, could you help me, please?
3. Are the workpieces of the same metal?
4. I hear that electric arc welding is dangerous.
5. What does special protective clothing include?
6. Shall we start welding now?

B

a) No problem.
b) Actually, no. Why do you ask?
c) An apron, gloves, rubber boots and a cap, a mask or a helmet.
d) Well, let's try.
e) Oh, I see.
f) That's true.

Language Practice

Vocabulary

I. Find the English equivalents in B to the Russian words in A.

A	B			
1. луч	a) beam	b) bead	c) sunshine	d) laser
2. сварной шов	a) bead	b) cut	c) weld	d) beam
3. свойство	a) property	b) substance	c) quantity	d) trait
4. соединение	a) unit	b) joint	c) particle	d) meeting
5. трещина	a) crack	b) cracker	c) canyon	d) web
6. влиять	a) to effect	b) to avoid	c) to affect	d) to impress
7. сваривать	a) to cook	b) to weld	c) to meet	d) to damage

II. Match the words with the similar meaning.

piece	goal
must	to make up
the same	workpiece
to hold	essential
flame	similar
to create	to keep
aim	fire
important	should

III. Divide the words into four columns according to their part of speech:

workpiece, electric, powerful, transformer, melt, dangerous, continuously, join, safety, quickly, soften, fusion, essential, dry, investment, currently, property, investigate.

Grammar: Infinitive

IV. Give advice to your friend how to do things in column A. Choose in column B the right variant.

EXAMPLE: To mark a hole on the plate you should use a pencil.

A	B
to drive in the nail	use this new method of welding
to get a strong joint	use these two gases
to cut holes in metal	use a transformer
to create a suitable flame	use a hammer
to provide the necessary electric current	use gas welding
to join two steel plates	use an electric drill

V. Say what device you will use to do the following things.

EXAMPLE: – *to drill a hole in a plate*
In order to drill a hole I will use a drill.

If you want:
- – to find the necessary information quickly
- – to join two workpieces
- – to assemble cars
- – to cut metals
- – to perform difficult tasks
- – to measure the speed of the car

VI. Explain why people do the following things. Give as many reasons as you can.

EXAMPLE: *Why do you use calculators?*
We use calculators (in order) to count quicker to avoid mistakes, to save time, etc.

1. Why do people need computers? 2. Why does everybody want a car? 3. Why did you practise in the lab yesterday? 4. Why are we using solar energy nowadays? 5. Why have engineers created robots?

VII. These two sentences have a different structure but the same meaning. Change the structure of the sentences below so as to keep their meaning unchanged.

EXAMPLE: *It is very important to make a strong joint.*
To make a strong joint is very important.

1. It is impossible to store gas in an open tank. 2. It is quite necessary to make metal electrodes. 3. It is very essential to provide a hot enough flame. 4. It is not difficult to adjust the welding flame. 5. It is unnecessary to mix these substances. 6. It is easy to follow these instructions.

VIII. How do you find doing these things? Use the adjectives: *important, essential, valuable, easy, difficult, necessary.*

EXAMPLE: *to put on protective clothing*
It is absolutely necessary to put on protective clothing.

To weld metal joints; to follow the safety rules; to use an electric arc; to join two workpieces of the same material; to provide a powerful electric current; not to use a transformer when welding.

IX. Translate the following pairs of sentences into Russian. Pay attention to the difference between the sentences of each pair.

1. a) To check the ammeter is necessary.
   b) To check the ammeter it is necessary to connect it to the circuit.
2. a) To improve the quality of welding is very important.
   b) To improve the quality of welding we use lasers.
3. a) To make strong joints you should weld two pieces of the same metal.
   b) To make strong joints is essential in automobile industry.
4. a) To follow these instructions is really difficult.
   b) To follow these instructions you should read them attentively first.

X. Restore the original sentences.

1. is, gas welding, to join, used, steel to steel
2. these metal plates, to join, is, rather, difficult
3. must be supplied, in order to, a current, an arc, create
4. to provide, is, current, at a low voltage, it, necessary
5. to make, a strong joint, to weld, is, the same metal surfaces, it, desirable
6. the operator, protective clothing, himself, should have, to protect

XI. Correct mistakes.

1. It is difficult do this job. 2. You should to put on special clothing to protect yourself. 3. You have to wear uniform be safe. 4. The overalls should to be dry and clean. 5. Take workpieces of the same metal in order make a strong joint. 6. It is essential not provide a weak flame. 7. Important not to move the electrode too quickly. 8. To join these plates it is rather difficult.

XII. Translate the sentences into English using your active vocabulary.

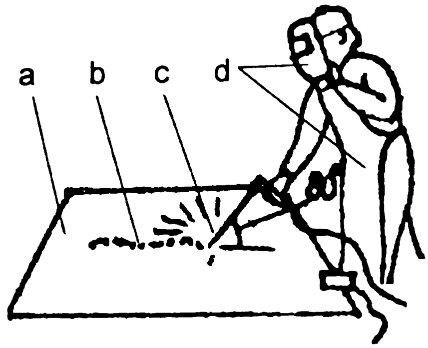
1. Чтобы соединить эти детали, необходимо использовать электрическую сварку, 2. Обычно используют трансформатор, чтобы подать необходимый ток. 3. Сварить эти две металлические пластины совсем нетрудно. 4. Ток должен быть достаточно высоким, чтобы создать необходимую дугу. 5. Чтобы получить прочное соединение, нужно сваривать детали из одинакового материала. 6. Очень важно правильно держать электрод при электрической дуговой сварке. 7. Чтобы получить сварочное пламя, необходимо смешать эти два газа. 8. Лазерная сварка в настоящее время используется для сварки сталей, сплавов и различных материалов, не так ли? 9. Важно упомянуть, что лазерная сварка имеет уникальные преимущества: низкая стоимость, глубокое проникновение и узкий шов, а также скорость и прочность. 10. Чтобы определить свойства лазерных сварных швов, нужно провести много экспериментов.

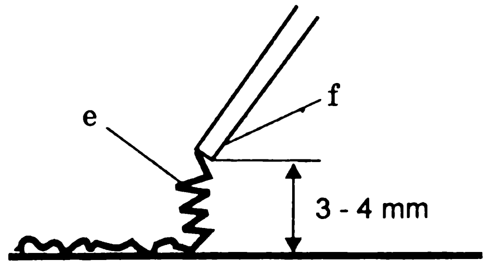
Reading and Speaking

I. Look at the pictures (p. 158) and guess what the text is about. Skim the text to see if you were right.

II. How is welding connected to electricity? Find in the text sentences with words of the same root and translate them into Russian.

III. Read the text attentively and find out how to weld plates correctly.





Welding is one of the most important operations that are used in industry. Many parts of machines, automobiles, airplanes, ships, bridges and buildings are welded.

In order to **join** two metal pieces it is necessary to **soften** them with heat and then to press, hammer or **fuse** them together. The most widely used method of welding is **electric arc welding** where the workpieces are joined **by means of** electricity at the temperature of about 7,232 °F. This is the hottest heat that can be obtained for engineering purposes.

In electric arc welding two workpieces are welded by an **electric arc**. In order to create the arc a powerful electric current should be provided. The current must be at least 60A and for thicker workpieces it may be 250A or more.

To supply the current it is necessary to use a **transformer**. **The latter** must be switched on to **strike** the arc. To join the workpieces the **electrode holder** should contain an electrode **rod**. When the arc is struck the electrode must **brush against** the workpiece at 80° to its **surface**. As the current flows between the electrode and the workpiece the **tip** of the electrode melts and falls onto the workpiece. Thus a joint is created.

It is essential to hold the electrode approximately 4 mm from the surface of the workpiece. One should not leave the electrode too long in the same position because it will become **attached** to the workpiece. The electrode must be moved across the joint continuously backwards in a **straight** line. However, if it is moved too quickly **neither** the electrode **nor** the workpiece will melt.

And it is important to remember that to weld plates by an electric arc is quite dangerous. In order to protect yourself you should always follow certain safety rules. For example, it is absolutely necessary to **wear overalls** with long sleeves, **gloves**, an **apron**, a cap, and rubber **boots**. A mask or **helmet** is used to protect the face and especially eyes from sparks.

IV. What do letters a-f in the pictures refer to?

V. Answer the questions below.

1. What is welding? What processes does it involve? 2. What method of welding is the most widely used today? 3. What device is used to supply the current? 4. How is a joint created? 5. How far should the electrode be held from the workpiece? 6. Why is it dangerous to leave the electrode in the same position? 7. In what way is it necessary to move the electrode across the joint? 8. What safety rules should you follow in the process of welding?

VI. Complete the following sentences with suitable words.

1. ... two workpieces an electric ... is used. 2. It is necessary ... a powerful electric ... for arc welding. 3. ... the workpieces the electrode holder must contain an electrode ... . 4. The electrode should be ... some millimeters from the ... of the workpiece. 5. ... a strong joint the workpieces must be of the same ... . 6. The electrode can become ... the workpiece. 7. The electrode must be ... across the ... continuously.

VII. Give a title to the text.

VIII. Make a dialogue according to the instructions below. Use the words *necessary, useful, essential*, etc. and expressions of request and opinion.

Student A. You have missed your class and you don't know how to weld plates. Prepare your questions and ask your friend for instructions.
Student B. Help your friend to understand the welding process. Get ready to answer his questions.

Further Reading

I. Modern life is much facilitated by the use of lasers. This equipment has some advantages. Can you name any?

II. Laser is an international word today. Skim the text and find all the international words in it.

III. Give Russian equivalents to these compound nouns.

laser beam welding	laser welded joints
high power density welding process	joint performance
cost effectiveness	conventional weld joint

IV. Read the text carefully and say what you have learnt about laser welding.

Laser Beam Welding

The **unique** properties of lasers account for their **widespread** application in manufacturing industry. Laser beam welding is **currently** used in order to weld steels, aluminum alloys and dissimilar materials. This high power density welding process has unique advantages of cost effectiveness, deep **penetration** and narrow **bead** in comparison with **conventional** welding processes. As the thermal cycles of laser beam welding are generally much faster than those of arc welding it is possible to form a rather small weld zone that **exhibits** locally high hardness.

However, it is important to point out that the metallurgical and mechanical properties of laser welds and the **response** of conventional materials to this new process have not been fully **established** yet. It is currently difficult to determine the **tensile** properties of the laser welded joint area **owing to** the small size (2—3 mm) of the **fusion** zone. Therefore an experimental investigation of the mechanical properties of laser-welded joints was carried out. To determine the hardness profile of the welded metal three similar joints were produced by a CO_2 laser and microhardness measurements were conducted at three **locations**. It is important to mention that the microhardness test results, however, exhibited no **significant** difference between these three locations for all the welded joints.

The welding process may lead to **drastic** changes in the microstructure with accompanying **effects** on the mechanical properties and, **hence**, on the performance of the joint. Laser welded joints, like all other welded joints, may contain defects in the form of **cracks** in the narrow weld area. The size and location of such cracks directly **affect** the joint performance and the lifetime of a structure. **Nevertheless**, it is essential to remember that laser beam welding has a number of advantages over conventional processes. **Despite** the high investment cost of laser welding equipment, it is expected that laser beam welding will have a great impact on fabrication and manufacturing industries within the next **decade**.

V. Say if the following statements are true or false. Correct the false statements.

1. Laser beam welding is widely used at present. 2. Arc welding is less advantageous than laser beam welding. 3. Laser beam welding is very hard. 4. The research on laser welding has been carried out recently. 5. It is currently difficult to establish the properties of the laser welded joint area because the workpiece is very thin. 6. Laser beam welding may lead to dramatic changes in the microstructure and the performance of the joint. 7. Laser welded joints may contain defects in the form of crackers. 8. Laser beam welding is rather expensive, that is why it will not be widely used in industry in the near future.

VI. Discuss these questions in groups:

a) What are the advantages and disadvantages of laser beam welding? Fill in the table.

Laser Beam Welding	
Advantages	*Disadvantages*
1. cost effectiveness 2. ...	1. unestablished properties 2.

b) How does laser beam welding differ from arc welding? Compare them. Use the logical patterns of comparison and contrast.

comparison: in comparison with, similarly, in the like fashion, as does X, so does X
contrast: in contrast to, on the one hand, on the other hand, however, nevertheless

c) Can you suggest any other ways of welding?

VII. You are an engineer and you want to introduce laser beam welding at the Automobile Plant you work at. Persuade the chief engineer that laser beam welding is better than arc welding.

Activity

I. Ask your friend for his opinion.

EXAMPLE: *(good) to complete this work today / to put it off till tomorrow*
A: Which is better: to complete this work today or put it off till tomorrow?
B: Well, to my mind, it's better to complete this work today so tomorrow you will be free.

(easy)	to collect the data / to process it
(useful)	to check welding equipment regularly / to check it occasionally
(difficult)	to follow safety instructions / to neglect them

(valuable)	to invent new things / to improve existing things
(important)	to learn theory / to practise
(good)	to attend classes / to study independently

II. Study these Safety Rules. Discuss with your partner why it is necessary to follow them. Consult the dictionary if necessary.

CAUTION

Welding can be dangerous. Any of these accidents may happen to you:

(a) you could be blinded by sparks;
(b) you could get an electric shock;
(c) your face, body, arms, legs or feet could be burnt;
(d) there could be a fire in the workshop.

PROTECTIVE CLOTHING

1. A mask or helmet must be worn in electric arc welding. (In gas welding, goggles can be used.)
2. Clothes must be kept dry and clean.
3. Thick, heavy boots must be worn. These must be made of some insulating material such as rubber.
4. Gloves, an apron and a cap must be worn.
5. Overalls must have long sleeves and no pockets or cuffs.

WORKSHOP

1. The floor must be made of concrete.
2. There must be a metal container on the floor for the sparks.

You can begin as follows:

– Peter, why is it necessary to wear a mask or goggles in electric arc welding?
– Well, it is important to wear a mask and goggles because otherwise you can ... .

III. Solve the crossword.

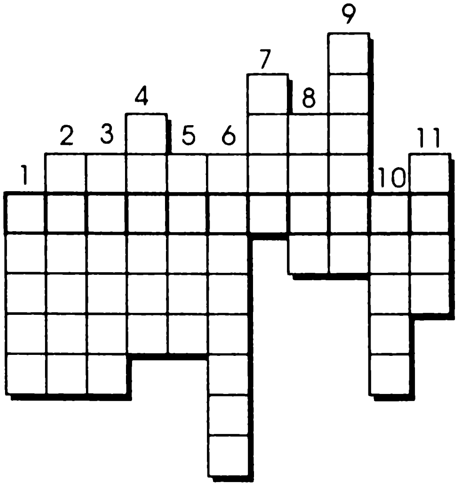
Down:

1. a flat, thin, usually large piece of something hard
2. something imperfect, a fault
3. to produce something new
4. to change the usual shape of somehing so as to spoil its appearance or usefulness
5. a place where things are joined together

6. a stated quality, power or effect that belongs naturally to something
7. a line of light shining out from some bright objects
8. laser beam welding produces a very narrow weld ...
9. not easily broken, changed or destroyed
10. a very thin mark caused by breaking, but not into separate parts
11. to join by pressure or melting together

Across:

1. ...?



Writing

I. You are a materials engineer and specialize in welding. Recommend your client to introduce LBW in his plant. Point out the advantages of laser beam welding. The linking words and connectors in the box can help you.

first, next, also, besides, furthermore, finally, so, as, because, thus, however, etc.

Complete the memo given below.

MEMORANDUM

To: Mr. A. Kiselev
From: Mr (*your name*)

Welding processes

Although this is a preliminary* report, and further detailed study is necessary, I can safely say that the introduction of laser beam welding is an advantageous alternative to arc welding for a number of reasons.

First of all, it is necessary to ...

...

Thus I strongly recommend that you immediately consider replacing arc welding by laser beam welding. As a first step I suggest you contact the following companies for advice ...

*предварительный

Section B. Mechanisms

Lead-in

I. Discuss the following questions.

a) What car mechanisms do you know? Make a list and compare it with that of your partner.

b) Can you name the functions of the car mechanisms that you have in your list?

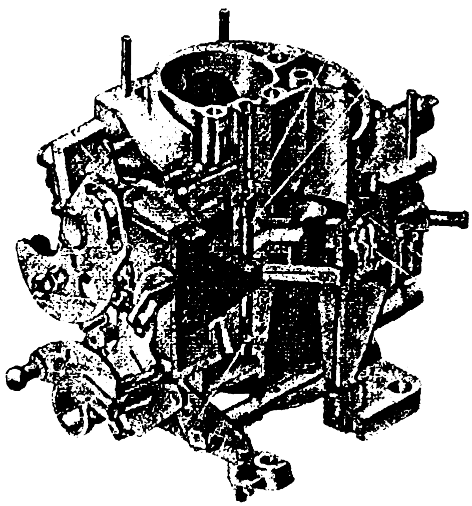
II. Listen to the teacher's explanations and learn the functions of the carburettor.

Pavel: Could you tell me what a carburettor is? What system does it belong to?

Teacher: Well, it belongs to the fuel system of the car.

Pavel: And what **functions** does it perform?

Teacher: The two functions to be performed by the carburettor are very important. Its first function is to measure **exact quantities** of the petrol to be mixed with air.



Pavel: What is the second function, I wonder?

Teacher: Oh, it is to break up petrol into **fine particles** so that the mixture will burn rapidly, of course.

Pavel: And may the carburettor be **blocked**?

Teacher: Certainly, it may happen as petrol contains some dirty **particles.**

Pavel: I see. What is there above the carburettor?

Teacher: That's an air filter. Its function is to **clean** the air to be **delivered** to the carburettor.

Pavel: Does that mean that the carburettor can't be blocked if the filter works well?

Teacher: Certainly.

III. Complete the dialogues.

a) – ... does the carburettor perform, I wonder?
– Well, ...
– And what is the second ..., I'd like to know?
– As for ... , it is to ... .

b) – The carburettor is blocked sometimes, ...?
– Of course, if... . But there is ... .

c) – And what is the function of the filter?
– ... .
– Oh, I see, ...

IV. Match a line in A with a line in B.

A	B
1. What system does the carburettor belong to?	a) It is above the carburettor.
2. Does the carburettor measure exact quantities of the petrol to be mixed with air?	b) It happens when petrol contains some dirty particles.
3. What other functions does the carburettor perform?	c) Its function is to clean the petrol to be delivered to the carburettor.
4. When does the carburettor get blocked?	d) Well, for example, it breaks up petrol into fine particles.
5. Where is the air filter situated?	e) It belongs to the fuel system of the car.
6. What is the function of the air filter?	f) Certainly.

Language Practice

Vocabulary

I. Find the English equivalents in B to the Russian words in A.

A	B		
1. воск	a) substance	b) mix	c) wax
2. транспортное средство	a) transport	b) means	c) vehicle

3. потребление	a) use	b) need	c) consumption
4. охладитель	a) engine	b) carburettor	c) coolant
5. предотвращать	a) to perform	b) to prevent	c) to avoid
6. клапан	a) piston	b) radiator	c) valve
7. заряжать	a) to charge	b) to discharge	c) to fill
8. количество	a) quality	b) quantity	c) a lot

II. Match the words with the similar meaning.

to consume	to include
to contain	purpose
amount	to purify
to possess	to carry out
to switch on	to turn on
to perform	to use
petrol	gasoline
to clean	quantity
aim	to own

III. Complete the table with the missing words.

	Verb	*Noun*
потреблять		
		revolution
	to sense	
		pressure
охлаждать		
	to expand	

Grammar: Infinitive

IV. Point out the purpose of the objects according to the model.

EXAMPLE: A: *This paper describes important properties of new engineering materials.*

B: The purpose (aim, goal, object) of this paper is to describe properties of new materials.

1. This experiment establishes the relations between these two quantities. 2. The article deals with the prospects for electric road cars. 3. This book gives the description of the electrical instruments in the car. 4. His report presents some information on the new fuel system. 5. The speedometer is used to indicate the speed of a car. 6. The filter is used to clean petrol.

V. Define the functions of these objects: *a petrol tank, a robot, the Internet, a carburettor, a battery, a vehicle, a laser, a ruler, a tachometer.*

EXAMPLE: The function (purpose) of a speedometer is to indicate the speed of a car.

VI. The two sentences below have a different structure but the same meaning. Change the structure of the sentences so as to keep their meanings unchanged.

EXAMPLE: A: *The substance that should be analysed is of great value.*
B: The substance to be analysed is of great value.

1. The equipment that should be installed in the workshop has specific use. 2. The petrol that should be delivered from the petrol tank should be clean. 3. The new battery that should be used in the car is very effective. 4. The new car devices that should be developed have several advantages. 5. The car emissions that should be controlled are very harmful to the environment. 6. The automobile that should be developed will run on hydrogen.

VII. Restore the original sentences.

1. the carburettor, the function of, petrol, is, to break up, fine particles, into
2. the instruments, to be located, with important information, the instrument panel, provide, the driver, on
3. the petrol, should be, clean, to be delivered, to the carburettor
4. the hydrometer, is, the condition of the battery, the function of, to check
5. to be performed, very important, the functions, are, by this device
6. is, the new fuel system, in this car, completely, of a new design, to be employed

VIII. Correct mistakes.

1. The aim of an instrument panel is provide the driver with certain information. 2. When the driver notices some fault it essential to repair it at once. 3. The function of the tachometer to indicate the engine speed in revolutions per minute. 4. The speed limit to was adopted in populated areas is 30 mph. 5. I have a battery to recharging. 6. Drivers must don't speed, especially when they see speed limit signs. 7. The properties to studied may be of great value. 8. You must go to the service station in order repair the brakes.

IX. Translate the sentences into English using your active vocabulary.

1. Моя задача заключается в том, чтобы найти неисправность в этом приборе. 2. Функция этого прибора – измерять давление в системе. 3. Статья дает следующую информацию: назначение карбюратора – дозировать количество бензина, который должен смешиваться с воздухом. 4. Новая топливная система, которую нам нужно разработать, будет иметь ряд преимуществ. 5. Важно помнить, что карбюратор может быстро засориться, если в бензине есть частицы мусора. 6. Известно, что функция фильтра – очищать бензин от сора и пыли. 7. Если в бензобаке мало топлива, на панели загорится предупреждающая лампочка. 8. Вот термостат, который нужно заменить.

Reading and Speaking

I. Modern cars have a complex instrument panel. Why is it a necessary component of any car? What instruments does it include? What are their functions? Scan the text to get the answers to the questions.

II. Look through the text and find the derivatives from the following verbs: *to alternate, to revolve, to drive, to supervise, to sense.*

III. Read the text for more information about the instrument panel of the car.

The Instrument Panel of a Car

A modern car is a complex **means of transport**. However, it is relatively easy to operate as a number of devices help you to keep control. An instrument panel in a modern car, for example, provides the driver with valuable information. It includes such instruments as a speedometer, a **fuel gauge**, a tachometer and an ammeter.

The function of the speedometer is to indicate the speed of the car. A speed limit to be adopted for towns and built-up areas is 30 miles per hour or 60 km per hour.

The purpose of the fuel gauge is to indicate the amount of fuel to be contained in the petrol tank. If its level in the tank is very low, the **warning light** switches on in the car. When this happens it is necessary to put some more petrol into the tank.

The tachometer is necessary to indicate the engine speed in revolutions per minute. When the engine turns slowly at the minimum speed the alternator also turns slowly. It doesn't produce enough current for the engine. Therefore, the battery must supply the necessary current.

A car battery can easily become discharged in quite a short time. The function of the ammeter is to indicate whether the battery is charging or discharging.

Instrument panels in the cars in the near future will become much more complicated. The common devices will soon be replaced by onboard computer systems, as intelligent vehicles are the field to be researched nowadays. The idea is to create automatic cars on automatic highways. The vehicles to be introduced will move with the minimum **supervision** on the part of man since they will communicate with one another and with the road sensors on the way. This is necessary in order to reduce the **load** on drivers and to **ease** the **stress** on the road network. The **leading** engineering companies are using advanced mechatronics to achieve this **goal**.

IV. Fill in the table with the data from the text.

The Instrument Panel	
Instruments	*Functions*
1. ...	to indicate the speed of a car
2. a fuel gauge	...
3. ...	to indicate the engine speed in revolutions
4. an ammeter	...
5. onboard computers	

V. Answer the questions.

1. The aim of the instrument panel is to provide the driver with information, isn't it? 2. Does the instrument panel include such instruments as a multimeter and a fuel gauge? 3. Is the speed limit for towns and built-up areas 30 mph or more? 4. What is the function of the fuel gauge? 5. Why does the warning light switch on? 6. What instrument indicates if the battery is charging or discharging? 7. How will the instrument panel change in future? What will cause the changes?

VI. Complete the following sentences.

1. An ... panel provides the ... with valuable information. 2. The ... of the ... is to indicate the amount of the petrol to ... in the petrol tank. 3. An instrument panel in the car ... a speedometer, ..., a fuel gauge and ... . 4. The tachometer indicates the ... of the engine in ... per minute. 5. The battery must ... the necessary ... . 6. A car ... can easily ... discharged. 7. The function of the ... is to indicate whether the ... is ... or discharging. 8. The idea is ... intelligent ... that will ... the load on drivers and ... the stress on the ... .

6а Зак. 355

VII. Give the gist of the text. Start with the words given below.

1. In this text we look at ...
2. The text deals with ...
3. The text gives information on ...
4. The text is about ...

VIII. Discussion. Some of the city authorities want to introduce the automatic car system on the road in Minsk but some of them have doubts. Make two teams ('for' and 'against') and discuss the following question: *Are automatic cars worth introducing?* Try to come to an agreement.

Further Reading

I. What do you know about thermostats? Where are they used? What are their functions? What are the types of thermostats? Scan the text to find the answers.

II. Find in the text international words and translate them into Russian.

III. Translate the following compound nouns into Russian:

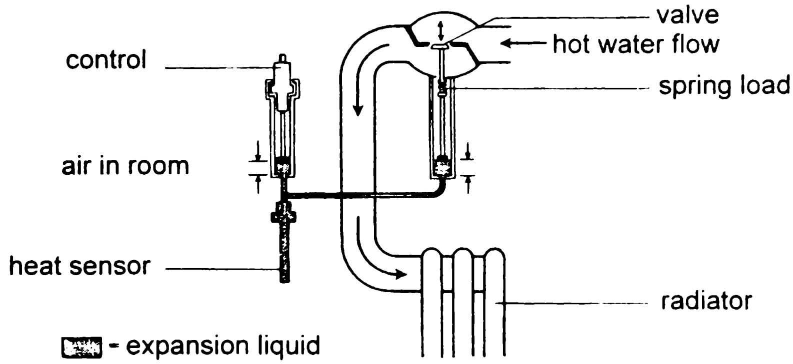
a heat sensor
liquid pressure
hot water flow
a wax type thermostat
a temperature-sensitive valve
a top hose
the coolant temperature
a coil spring
engine wear
fuel consumption

IV. Read the text and say what you have learnt about thermostats.

As the dictionary says, the **thermostat** is an apparatus that can be set to keep a room, machine, etc., at an **even** temperature as it connects and disconnects the supply of heat when necessary. In short, the thermostat is used to control the temperature. How does it work?

As it is known liquids **expand** when they are heated. This effect is used in the thermostat in the picture. With an increase in the air temperature the liquid expands in the heat sensor. This expansion causes the valve to close in order to reduce the flow of hot water. After a short time, the temperature goes down and **consequently** the liquid **cools** and **contracts**. The spring load is now greater than the liquid pressure, so the valve will open. Once again, the hot water flow is increased. This type of the thermostat is widely spread in various heating systems.

The same principle is used in the **wax** type thermostat, which is almost universal in modern vehicles. This thermostat is a temperature-**sensitive** valve



that is situated just below the top hose. As the coolant temperature rises, the valve is opened by the **expansion** of the wax **inside** it. When the temperature falls, the valve is automatically returned to the closed position by a **coil spring**. When thermostats of this type fail, it is very important to replace them **immediately**. It is normally more **convenient** to **fit** a new one than to **overhaul** the old one.

The thermostat is used to **prevent** the flow of water to the radiator when the coolant temperature is less than about 80 °C. Its functions are as follows:

– to **allow** the engine to become warm quickly. **Both** engine wear **and** fuel **consumption** are increased if the engine is operating at a low temperature;

– to prevent the engine from remaining cool under running **conditions**.

V. Say if the following statements are true or false. Correct the false statements.

1. The thermostat is a device to control the supply of heat. 2. Liquids expand when they are cooled. 3. Wax does not expand when the temperature rises. 4. The valve is opened by the expansion of the wax outside it. 5. When the wax type thermostat fails you should replace it at once. 6. The thermostat prevents the flow of water to the battery when the coolant temperature is below 80 °C. 7. The higher the temperature of engine operation, the more fuel is consumed.

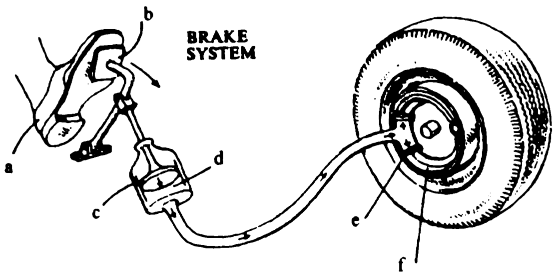
VI. Read these gists of the text and find the one which corresponds to the contents best. Explain your choice.

1. In this text we consider universal devices in modern vehicles. 2. This text deals with the wax type thermostat, its operation and functions. 3. This text provides information on the principles of the thermostat operation. 4. The text informs us of thermostats, their functions and principles of operation.

VII. Make a short report on thermostats, their functions and principles of operation.

Activity

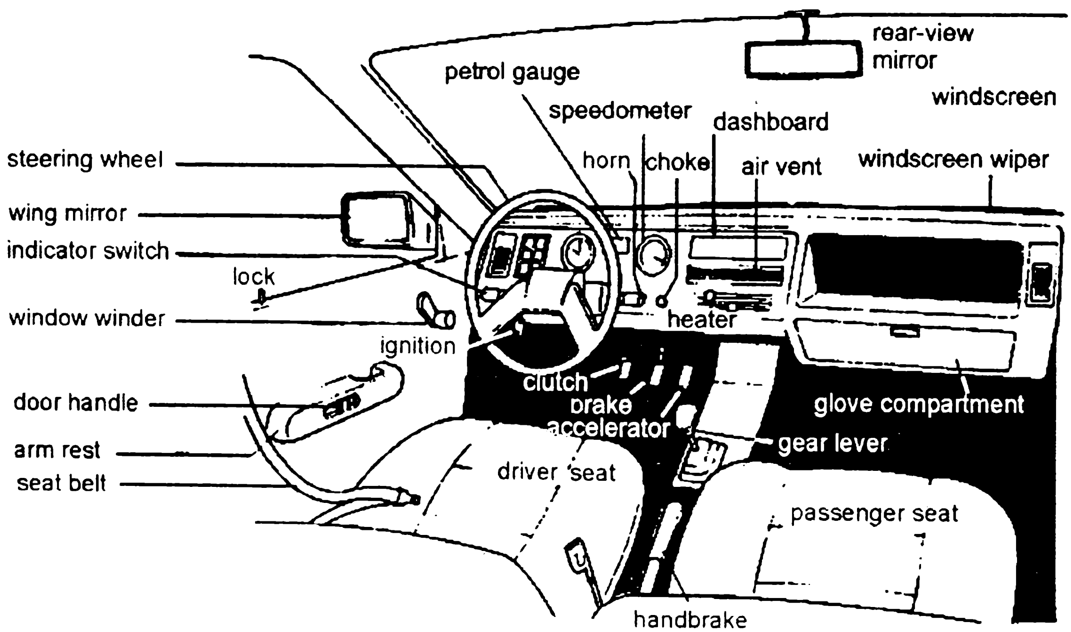
I. Name the objects in the picture according to the following description and say what functions they perform. Work with your partner.



1. The foot presses the pedal. 2. The pedal pushes the first piston down. 3. The piston squeezes the oil. 4. The oil pushes the second piston outwards. 5. The second piston pushes the brake shoe against the wheel. 6. The wheel stops.

EXAMPLE: – What is *e* called, I wonder?
– It is called a piston, of course.
– And what is its function?
– Its function is to push the brake shoe against the wheel.

II. Ask your friend to explain to you the purpose of various devices in the car. Use the dictionary if necessary.



Writing

I. Write a short paragraph that contains a description of the most important car mechanisms and their functions.

Unit Nine

ELECTRICITY

Section A. Electricity Basics

Lead-in

I. Discuss the following questions.

a) Can you imagine our life without electricity?
b) What benefits can we get from electricity?

II. Some students are writing their coursework now. Suddenly the light went off. Listen to their conversation to see how they will solve this problem.

Olga: Alex, I need your help badly. I'd like you to have a look at my table lamp.
Alex: What is wrong with it?
Olga: I have no idea. I was writing my **coursework** when suddenly the light went off. Can you repair it?
Alex: I'll try. Give me the lamp.
Olga: Well?
Alex: No wonder the light doesn't work. The **bulb** has a broken **filament**.
Olga: What do you mean?
Alex: The bulb has simply **burnt out**. All we have to do is to **turn** the burnt bulb **out** of the **socket** and replace it with a new bulb. Do you have one?
Olga: Unfortunately not. And my roommates are all asleep – I can't ask them. You can't lend me your own lamp, can you?
Alex: Well, yes. But it is time to sleep already. Why don't you finish the coursework in the morning?
Olga: You see, my **supervisor** asked me to bring it to the consultation tomorrow. He **expects** me to finish it.
Alex: OK. Don't sit up too late anyway. I'll ask Irene to bring you a new bulb. Don't switch on the power till you have turned it into the socket.
Olga: I won't. Thanks a lot.

III. Complete the dialogues.

1. – Nick, I need you to ...
   –...? It was all right five minutes ago.
2. – I'm afraid ...
   – Don't worry. We'll ask somebody to ...
3. – Let's ...
   – Well?
   – You see, ...
   – What shall we do?
   – ... . But I'd like you to ... the power first.
   – ...
   – I'm sure you won't forget to turn on the ... again. The light will let ... your report.

IV. Match a line in A with a line in B.

A	B
1. Is Michael busy now?	a) Let's have a look.
2. Did you ask me to come?	b) What is wrong with it?
3. What did the engineer tell you?	c) Yes, the teacher made him rewrite his lab report.
4. Why are you in such a hurry to complete the course-work?	d) He warned me not to switch on the power till he asks.
5. The lamp is out of order.	e) Yes, we'd like you to change the burnt bulb.
6. Could you help me repair the circuit?	f) Well, my supervisor expects me to bring it to the consultation tomorrow.

Language Practice

Vocabulary

I. Find the English equivalents in B to the Russian words in A.

A	B		
1. непроводник	a) dielectric	b) discharge	c) domestic
2. выпрямитель	a) condenser	b) rectifier	c) capacitor
3. обмотка	a) voltage	b) winding	c) insulator
4. первичный	a) primary	b) secondary	c) early

5. передавать	a) to keep	b) to store	c) to transmit
6. нить накала	a) filament	b) gap	c) coil
7. частота	a) resistance	b) frequency	c) alteration
8. светиться, накаляться	a) to reverse	b) to rotate	c) to glow

II. Match the words with the opposite meaning.

to turn into	to increase
insulator	to turn out (of)
to decrease	closed
direct	step-down
initial	alternating
opened	final
step-up	conductor

III. Cross out the odd word. All the words in the line should belong to one part of speech.

1. complete, carry out, measurement, perform
2. wire, bulb, socket, switch off
3. winding, capacitor, frame, rectify
4. current, power, electrical, flow
5. into, out of, from, careful
6. transformer, alternate, rectifier, generator
7. voltage, insulate, frequency, resistance

Grammar: Complex Object

IV. Explain why these things happen.

EXAMPLE: *water / to flow down – wheel / to turn*
The water flows down. – This makes (lets) the wheel turn.

temperature / to increase – liquid / to expand
valve / to be open – water / to flow in the system
bulb / to burn out – you / to change it
contact / to be closed – current / to flow in the circuit
leads / to be connected – current /to pass through the conductor
batteries / to discharge – electric car / to stop

V. a) What do these people want others to do for them? Fill in the table.

EXAMPLE: *Oleg: – Students, switch on the power, please.*

Oleg	would like	them (the students)	to switch on the power.
Alice	want(s)	...	...
Helen	wish(es)	...	...
Roman	desire(s)	...	...
Teacher	need(s)	...	...
Natasha and Rita	expect(s)	...	...
We	...	...	...

1. Alice: – Nick, test the bulb.
2. Helen: – Oleg, carry out all the necessary calculations.
3. Roman: – Olga, describe the work of a transformer.
4. Teacher: – Helen, draw a simple circuit, please.
5. We: – Alex, complete the measurements.
6. Natasha and Rita: – Please, turn off the power.

b) What would you like your friends to do for you? Give as many versions as you can.

VI. a) Say what things these people don't want others to do.

EXAMPLE: *Students: – Pavel, don't switch off the lights, please.*

Students I Nina and Alice	don't	want wish desire need expect	him (Pavel)	to switch off the lights.
Olga Nick	doesn't			
Denis Sasha	wouldn't	like		

1. I: – Students, don't touch the wiring.
2. Nina and Alice: – Peter, don't connect the voltmeter to the circuit.
3. Olga: – Marina, don't turn off the whole current.
4. Nick: – Freshmen, don't apply the old method of calculations.
5. Denis: – Professor, don't switch off the ceiling lights, please.
6. Sasha: – Don't turn the bulb out of the socket.

b) Name 5 things that you wouldn't like your friends to do.

VII. These two sentences have a different structure but the same meaning. Change the structure of the sentences below so as to keep their meanings unchanged.

EXAMPLE: *This allowed him to follow the rules.*
This allowed the rules to be followed.

1. This device enables the students to measure the current in the circuit. 2. This analysis permitted them to obtain new data. 3. The information enables us to predict the properties of the new substance. 4. This result forced them to check the circuit again. 5. Modern equipment caused us to introduce new methods. 6. The tutor would like us to complete the course-work on time.

VIII. Restore the original sentences.

1. this device, an electrical charge, enables, to be built up and stored
2. I, you, out of the socket, told, to remove, the bulb
3. this, the current, makes, flow, through the circuit
4. she, him, the contacts, wanted, of the circuit, to connect
5. the transformer, to be increased or decreased, the voltage, allows
6. one, the current, can assume, in one direction, to flow, only

IX. Correct mistakes.

1. Nick asked Boris turn the bulb clockwise. 2. New data let us to carry out another experiment. 3. Mr. Pavlov told the students to not use a broken voltmeter. 4. The flow of water makes the wheel to turn. 5. His discovery allowed an invention be made. 6. Roman was asked test the bulb. 7. Alice expected Paul connect the contacts of the circuit. 8. This fact didn't let Andrew to break the rules. 9. The assistant warned them not create a magnetic field.

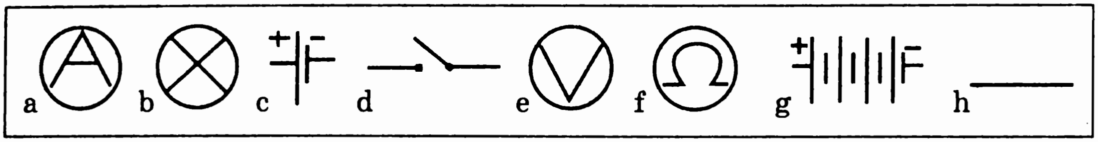
X. Translate the sentences into English using your active vocabulary.

1. Лампочка перегорела, и я хочу, чтобы ты ввинтил в патрон новую.
2. Мне нужно, чтобы он сейчас отключил электричество.
3. Вы хотели бы, чтобы я объяснил вам основы электричества?
4. Выпрямитель позволяет электрическому току протекать только в одном направлении.
5. Этот прибор позволяет нам измерять напряжение в цепи.
6. Преподаватель попросил начертить схему электрического прибора.
7. Магнит заставляет ток менять направление.

Reading and Speaking

I. Are you good at electricity? Match the objects with their symbols.

cell, 6V battery, wire, bulb, switch, ammeter, voltmeter, ohmmeter

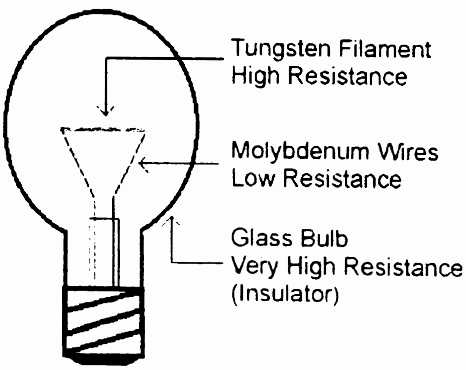


II. Practise reading these words.

filament ['fɪləmənt]
insulator ['ɪnsjʊleɪtə]
kinetic [kaɪ'netɪk]
alternating [ˌɒltə'neɪtɪŋ]
frequency ['fri:kwənsɪ]

III. Look at the title and the picture and say what information the text gives. Read the text attentively for the details.

Electricity Basics



Electricity is something we do not **notice** until we do not have it. However, few people understand what it is and still fewer can explain it. Let us try it anyway.

So, what is electricity? Electricity is simply a movement of **charged** particles **through** a **closed circuit**. The electrons, which flow through this wire, carry a **negative** charge. A lightning discharge is the same idea, just without the wire.

Electricity is made by converting some form of energy into flowing electrons at the **power plant**. The type of power plant depends on the source of energy used: **thermal** power (coal, oil, gas, **nuclear**, **underground steam**), **solar** power (photovoltaic), **kinetic** power (water, wind) and chemical power (**fuel cell**).

After it is made, electricity is sent into a system of cables and wires called a **transmission grid**. This system enables power plants and end users to be connected together.

The basic **notions** in electricity include the following.

An Amp (A) is a unit measure of the amount of current in a circuit. An ammeter permits the current to be measured.

The pressure that **forces** the current to flow is measured in Volts (V). A **transformer** is used to change the voltage of electricity. This allows electricity to be transmitted over long distances at high voltages, but safely used at a lower voltage.

A Watt (W) is a unit measure of electric power that depends on amps and volts. The more watts the bulb uses the more light is produced. Watts = Volts × Amps.

An Ohm (O) is a unit measure of materials resistance to a flowing current. The **filament** in this light **bulb glows** because its high resistance makes it hot. Low resistance of the support wires does not let them glow. The glass has a resistance so high that it does not allow the current to move through it – this property makes glass a good **insulator**.

IV. Provide answers to the questions below.

1. What is electricity and an electron? 2. How is electricity produced? 3. What types of power plants do you know? 4. What is the function of the transformer? 5. How does the light bulb work? 6. Glass is a poor insulator, isn't it?

V. Complete the table with the data from the text.

Symbol	*Unit*	*Electrical Notion*	*Measuring Device*
1.			ammeter
2.	Volt		
3.		resistance	
4. W			

VI. You are taking your exam in Physics. Your examination card says: Electricity, its definition and basic notions. Your partner is your examiner. Answer his questions and try to get a good mark.

You may begin like this: – Well, what is electricity?
– Oh, electricity is ...

VII. What new information have you learnt about electricity from the text? What things have you already known?

Further Reading

I. Practise reading these words.

rectifier ['rektɪfaɪə] wound [waʊnd]
wind [waɪnd] primary ['praɪmərɪ]

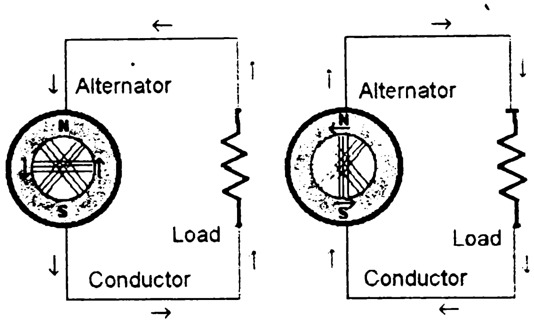
II. Do you know what DC and AC mean? How are they produced? What are their functions? What do you know about the transformer?

III. Skim the text to find out the functions of these things:

a) power station,
b) transformer,
c) rectifier,
d) overhead conductor wires,
e) magnetic field,
f) capacitor.

IV. Read the text carefully for more information on electricity.

Electricity Basics (continued)

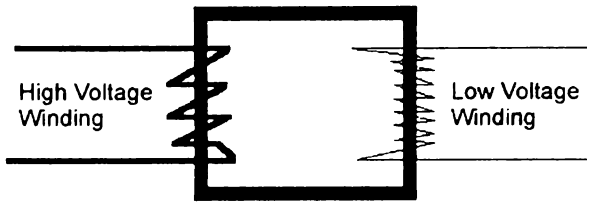


There are two different kinds of electrical current. One is called **direct current** because electrons are made to move in one direction only. It is usually **abbreviated** to DC. This kind of electricity is produced by a battery.

AC **stands for alternating current**, which is **generated** by power stations for domestic and industrial use. The wires in the centre of the generator **rotate** past the North and South poles of the (red) magnet. This movement forces the electrons in the circuit to **reverse** the direction of their flow. The number of these **alterations** (or cycles) per second is known as **frequency**.

As domestic supply requires alternating current it is therefore necessary to change it to direct current inside most electrical appliances. A **rectifier** allows AC to be converted into DC.

Power stations are designed to provide electrical energy to large housing developments. This causes the necessity to transmit power from its source, the generating station, to wherever it is required for use, which may be far away, with minimal energy **losses**. It is cheaper and easier to carry a very high voltage but low current, over long distances. It can be done with the help of thinner **overhead conductor wires**, with an **air gap** between them to act as an insulator.



Simplified drawing: the wires are usually placed closely together, though they are insulated from each other.

A transformer is used to increase or decrease the voltage of an electric power supply. This is a static machine since it has no moving parts. It consists of two coils of wire that are **wound** around a soft iron **core**. The coils are called **windings**, one is the **primary**, or **input** winding, and the other is the **secondary**, or **output** winding.

When current passes through the primary winding, a magnetic field is created around the iron core, which **induces** a voltage in the secondary winding. If the number of **turns** in the secondary winding is greater than that in the primary winding it is a **step-up** transformer and the output voltage is greater than the input voltage. And vice versa, a **step-down** transformer enables the input voltage to be reduced.

A device, which allows an electrical charge to be built up and stored for some time is known as a **capacitor** (or a **condenser**). A simple capacitor is made from two metal plates (electrodes), which are separated by an insulator such as air, paper or **mica** (the **dielectric**).

V. Say if the following statements are true or false. Correct the false statements.

1. There are two different kinds of electricity: AD and BC. 2. Direct current is received from a battery. 3. AC is used for domestic and industrial purposes. 4. The frequency is the number of cycles per second. 5. Conversion is brought about by means of an insulator. 6. Air is a rather good insulator. 7. High voltage is supplied by a transformer. 8. To decrease voltage a step-down transformer should be used. 9. The function of a capacitor is to transmit electricity to electrical appliances.

VI. Explain why...

a) two kinds of current exist;
b) electrons change the direction of the flow in AC;
c) a rectifier is necessary;
d) energy is lost on the way from the power plant to the end user;
e) a high voltage and low current are transmitted through the wires;
f) a transformer is used;
g) a transformer is known as a static machine;

h) a step-up transformer permits the input voltage to be increased.
i) a condenser is necessary in domestic appliances.

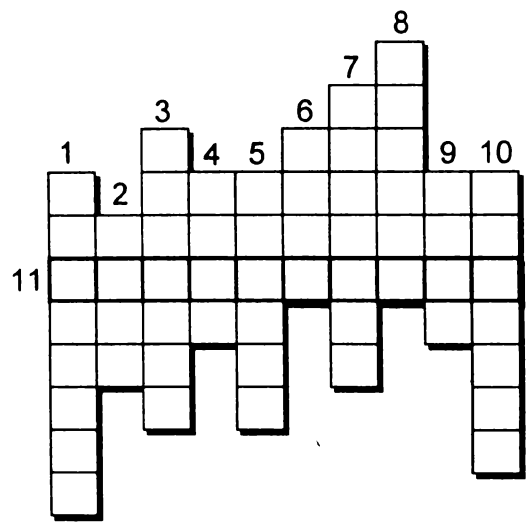
VII. Give another title to the text. Can you render its contents in 6 simple sentences?

Activity

I. Create a questionnaire on the topic 'Basic Electricity' and test your classmates' knowledge.

II. Describe a step-down transformer, its structure, operation and function. Use the description of a step-up transformer as a model.

III. Solve the crossword.



Down:

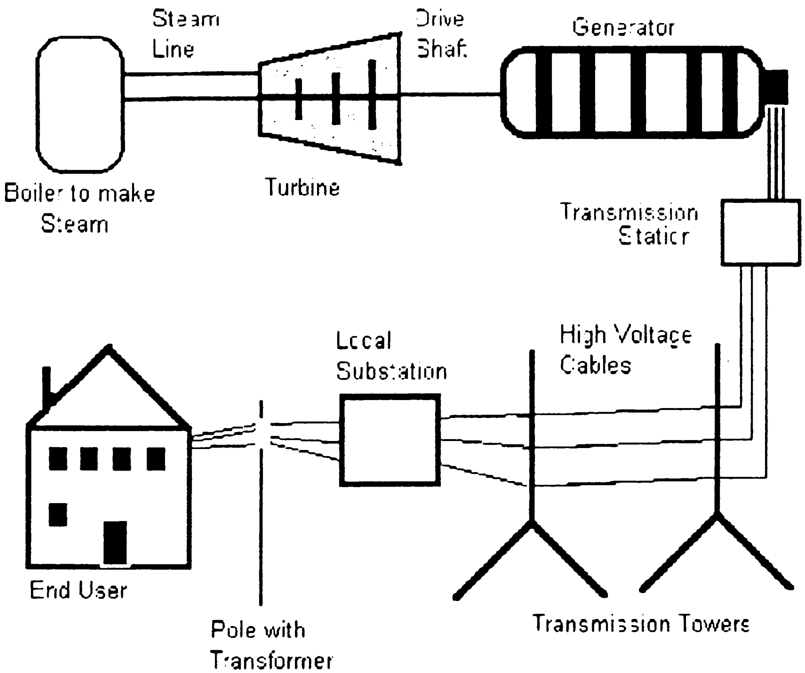
1. to pass power from its source to the end-user
2. power, current, ...
3. to change alternating current into direct current
4. up-down, closed – ...
5. current that flows in one direction
6. their number in the winding influences voltage
7. the input winding is also called ... winding
8. it alters the direction of charges
9. support wires in the bulb don't do it because they have low resistance
10. the complete circular path of an electric current

Across:

11. ?

Writing

I. Study the picture and describe in writing how electricity is produced and then transmitted to our houses.



Section B. Solar Energy

Lead-in

I. Discuss the following questions.

a) What role does the Sun play in our life?

b) Some pocket calculators are powered by solar cells, but many use batteries. What are the advantages of using solar cells? Are there any disadvantages?

II. Listen to the students' conversation and name the advantages and disadvantages of solar-powered cars.

Sveta: Alex, just look at this car. It seems to be quite modern.

Alex: Well, it is the latest model of a **pollution-free** car.

Sveta: How interesting! What fuel does it **run on**?

Alex: It is a **solar-powered** car – it runs on solar energy.

Sveta: Are these cars fast moving?

Alex: Well, they are reported to take part in races and even win them.

Sveta: Oh, really? Do these cars have any disadvantages? As far as I understand, they are sure to stop in cloudy weather and at night when there is little or no **sunlight**.

Alex: You have a reason here. However, for such cases these cars are provided with solar batteries that **accumulate excess** energy when there is lots of sunlight and power the car when there is no sunlight.

Sveta: That appears to be a **solution** to the problem.

Alex: Yes, but these solar batteries are numerous and quite heavy. This makes solar-powered cars rather inefficient at present. There are other questions to **tackle**.

Sveta: Why do engineers develop these cars if they cause so many problems?

Alex: As the pressure on **fossil fuels** is likely to increase we have to search for other sources of energy and the solar power is one of them. This energy source is considered to be inexhaustible.

Sveta: I see.

III. Complete the following dialogue.

– This car seems quite modern, doesn't it?
– ...
- What source of energy does it use?
– ...
– ...! Does this car develop high speed?
– Well, ...
– I'm afraid such cars are sure to ...
– No need to worry. They are supplied with ...
– Do they make solar-powered cars efficient?
– Not quite, ...
– What is the major advantage ...?
– ...

IV. Match a line in A with a line in B.

A	B
1. What is so special about these cars?	a. They are believed to reduce water-heating costs by about 50%.
2. Are solar-powered cars fast?	b. They appear to be very expensive.
3. What are the drawbacks of these cars?	c. Well, they are considered to be pollution free.

4. Why are solar-powered cars created?
5. There are still numerous problems to tackle.
6. Are solar heating systems cost-efficient?

d. It seems so.
e. Yes, they are reported to win races.
f. We are likely to run out of fossil fuels soon and there will be no petrol.

Language Practice

Vocabulary

I. Match the words with the similar meaning.

to convert	to tackle
to solve	large
to absorb	to turn into
to seem	to provide
to supply	to consider
usually	to appear
huge	to capture
to think	normally

II. Make up all possible word combinations.

solar	array
huge	amount
electrical	energy
inexhaustible	resource
to power	cars
metal	surface
to supply	heat

III. Find in B the derivatives from the words in A.

A	B
1. to pollute	– power, pollution, production, pressure
2. to charge	– change, research, discharge, consumer
3. to power	– solar-powered, overcharge, operation, piping
4. to exhaust	– explanation, expensive, efficiently, inexhaustible
5. to vary	– vice versa, variation, weekly, invention
6. new	– well-known, consequently, renewable, efficiency
7. complete	– competition, completely, tremendous, economical

IV. Match the beginnings of the sentences with their ends. Pay attention to the verbs used with Complex Subject.

1. Second-year students are expected to ...
2. The kilowatt-hour is known to ...
3. Alternative sources of energy are considered to ...
4. The solar village was reported to ...
5. The resources of fossil fuels seem to ...
6. Solar-powered cars turned out to ...
7. A small windmill is likely to ...
8. Electricity and magnetism are sure to ...

a) generate 100 kilowatts of electricity.
b) know the basics of electricity.
c) be the unit measure of electricity.
d) be inexhaustible.
e) produce no pollution.
f) be connected.
g) come to an end.
h) be built in Australia.

V. Open the brackets and use the verbs in the correct form.

1. Some materials (to prove) to produce electricity when they are exposed to light. 2. The battery (to be likely) to be recharged. 3. Mr. Frolov (to say) to be a good engineer. 4. The collector (to suppose) to be black. 5. That energy source (to seem) to be inexhaustible. 6. A specialist (to expect) to tackle all the technical problems. 7. The solar thermal heating systems (to assume) to be very efficient.

VI. These two sentences have a different structure but the same meaning. Change the structure of the sentences below so as to keep their meaning unchanged.

EXAMPLE 1: *It is found that the battery is dead.*
The battery is found to be dead.

1. It is believed that a single PV cell produces approximately 0.5 V. 2. It is likely that the energy crisis will soon begin. 3. It seems that the results of the solar project are very important. 4. It is unlikely that engineers will find a solution to the problem quickly.

EXAMPLE 2: *We expect this method to offer some advantages.*
This method is expected to offer some advantages.

1. They consider this housing development to be unique. 2. The car mechanic believes the solar-powered car to have many advantages. 3. We assume the solar power to be tremendous. 4. He supposes the Sun to run water turbines.

VII. Express the same idea:

a) less categorically.

EXAMPLE: *This method gives good results.*
This method seems (appears, is likely, is said) to give good results.

1. This new substance has valuable properties. 2. Solar collectors are very efficient. 3. These batteries are overcharged. 4. The results of the experiment are inaccurate.

b) more categorically.

EXAMPLE: *I believe that he will become a good specialist.*
He is sure (certain) to become a good specialist.

1. I believe that this problem is of vital importance. 2. We suppose that electric cars will find a wide application. 3. We assume that hot water will be supplied by solar thermal heating systems. 4. We think these new car batteries are long lasting.

VIII. Restore the original sentences.

1. are known, semiconductors, to be made of, silicon
2. numerous, to offer, solar heaters, seem, advantages
3. efficient, to be, this method, proved, very
4. citizens, the solar village, to inhabit, ordinary, are likely
5. he, to adjust, is believed, the solar batteries, in this car
6. valuable, this new substance, to possess, is sure, properties

IX. Correct mistakes.

1. The engineers was expected to take into account variations in the intensity of sunlight. 2. Young specialists known to be professionals in their field. 3. The system reports to be pollution-free. 4. The water seem to be heated naturally. 5. The nuclear power stations were turned out to be dangerous. 6. Max is believing to study theoretical mechanics. 7. We are likely exhaust our fossil fuels quickly. 8. This information said to be of utmost importance. 9. Before the race any driver sure to fuel his car.

X. Choose the correct translation for the underlined part of the sentence.

1. The scientists are said to be developing solar thermal heating systems nowadays.

a) разработали　　　　b) разрабатывают

2. They seem to have improved previous results.

a) улучшают　　　　b) улучшили

3. An experimental solar heating system proves to have been built in this region.

a) строится b) была построена

4. Our total solar energy consumption is estimated to be increasing.

a) увеличивается b) увеличится

5. The research is reported to have been carried out successfully.

a) было проведено b) будет проведено

6. The sufficient amount of electricity is likely to be generated by a small windmill.

a) вырабатывается b) вырабатывает

XI. Translate the sentences into English using your active vocabulary.

1. Известно, что отдельный фотоэлемент производит 0,5V. 2. Сообщается, что ученые скоро разработают новый источник энергии. 3. Предполагается, что потребление энергии будет увеличиваться. 4. Говорят, что вода в солнечных домах будет нагреваться естественным образом. 5. Наверное, солнечная энергия в будущем заменит даже топливо для машин. 6. Считается, что альтернативные источники энергии экологически чистые и неистощимые. 7. Оказалось, что некоторые материалы на свету производят электрический ток. 8. Похоже, ваш проект имеет ряд преимуществ.

Reading and Speaking

I. We are likely to suffer from fossil-fuel shortage in the near future. What do you know about the use of solar energy?

II. Scan the article to get the answers to the following questions.

1. What source of energy is used to light the Olympic torch? 2. What is the total solar energy consumption in Australia? 3. What are the ways to obtain solar energy? 4. How is sunlight converted into electricity? 5. How much electricity is generated in the solar village? 6. Why are collectors normally dark? 7. Are solar heaters efficient? 8. What is the purpose of solar furnaces?

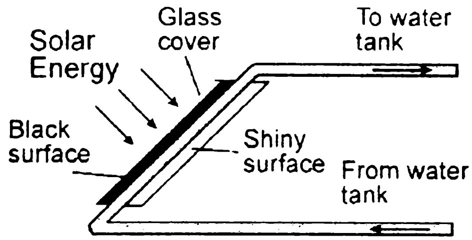
III. Read the article attentively for more information about solar energy.

Olympic Solar Energy

Four months before the start of the Sydney games, Olympic officials stood with a magnifying lens in the ancient temple of Zeus in Olympia, Greece – the site of the first Olympic Games. Like the original Olympians, they focused the rays of the Sun onto dry grass in order to make it burn, and from that 'Mother Flame' the Olympic torch was lit.

As the lightning of the Olympic flame shows, the solar energy that strikes the Earth is tremendous, despite travelling nearly 150 mln km across space to get here. In fact, every minute enough energy arrives at the Earth to meet our demands for a whole year. However, we do not use it efficiently. For example, Australia is estimated to consume only 0.02% of the solar energy that falls on it annually.

Capturing Energy from the Sun



Solar energy can be **collected** in three main ways: **photovoltaic** (PV) **cells**, solar **collectors** and **solar furnaces**. The first are used to convert sunlight directly into electricity. They are known to be first introduced in 1958 in order to power satellites in space. Now the cells seem to run everything from lighting systems to water pumps not to mention pocket calculators. At the Sydney Olympic village more than 8,000 photovoltaic panels that **cover** over 6,000 square metres provide 650 kilowatts of electricity. All houses in the Olympic village have PV cells built into the roof, to make the most of sunlight that falls on them.

Hot water for the village is supplied by solar thermal heating systems. Such systems include solar panels on the roof and large solar collectors. These are normally dark in order to **absorb** more sunlight. Their surface is covered with glass to let in the rays but hold heat. The heat is **transferred** to water, which runs through small pipes. The hot water is then **circulated** through the house. Solar thermal heaters are believed to reduce water-heating costs by about 50% as some still use natural gas as a back up on cloudy days. It is estimated that 40 million solar heated buildings will be constructed in the near future.

Solar furnaces use a **huge array** of mirrors to concentrate the Sun's energy into a small space and achieve temperatures up to 33,000°C. They are likely to be used for scientific experiments but they are also known to generate electricity.

The Olympic village is likely to be converted to **housing** for ordinary citizens now the games are over, and the houses are expected to generate electricity for years to come. The village is one of the largest **housing developments** in the world to use solar electric power.

IV. Explain why ...

1) the officials used a lens in the temple,
2) the torch is lit in the temple of Zeus,
3) Australia consumes so little solar energy,
4) solar cells are built into the roofs of houses,
5) collectors become very hot,
6) solar heaters sometimes use natural gas,
7) solar furnaces achieve such high temperatures,
8) ordinary citizens will live in the solar village.

V. How has the use of photovoltaic cells in the Olympic village helped to spread the word about photovoltaic power systems?

VI. a) Your friend volunteered to live in an experimental solar village for a year. You have decided to visit him to see how he is going on. Your friend seems to be quite happy. He is glad to show you around and explains how things work as you seem to be very interested in details.

b) Make a brief report on what you have found out.

Further Reading

I. Do you believe that one day stopping for petrol is likely to become a thing of the past? Why?

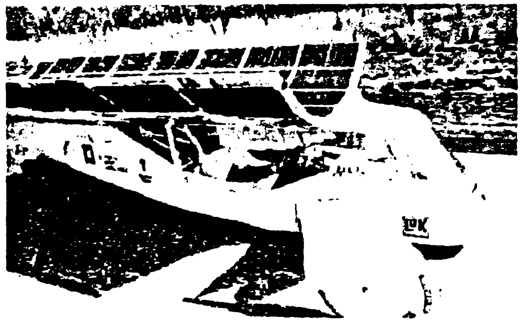
II. Look at the headline of the article and try to guess what information it contains. Skim the article to check your guess.

III. Read the article attentively for more detailed information about solar-powered cars.

Solar-powered Cars

One of the ways we can reduce the **amount** of **pollution** from traffic seems to power our vehicles using **renewable resources**. To demonstrate this, the World Solar Challenge Car Race from Darwin to Adelaide annually involves dozens of cars that are powered only by the energy of the Sun. The cars are reported to use photovoltaic (PV) cells to convert sunlight into electricity. A single PV cell is known to produce only a small amount of electrical power (approximately 0.5 volts). To increase the power, lots of PV cells are connected together to make a 'solar panel'. Panels can be linked to form a large solar array that is certain to produce enough electricity to power a car.

When the World Solar Challenge teams design their electrical systems, they have to **take into account variations** in the intensity of sunlight. The Sun's energy is supposed to power the car's motor and also charge a battery for use at night or at times when the Sun is hidden by a cloud. If a car is designed to put all its energy toward driving and keeps nothing in reserve, it is sure to stop completely in cloudy weather. If too much energy is **diverted** to the battery, the engine is found to run too slowly.



Engineers still have many questions and problems to **tackle** before solar power becomes an efficient and economical way to fuel vehicles. Today's **solar-powered** cars are **rather** expensive but as the pressure on **fossil-fuel** resources is certain to increase scientists will continue to **search for** alternative energy sources, including harnessing the Sun's energy to drive vehicles. The most fascinating part of using solar power as an energy source is that it is considered to be **pollution-free** and **inexhaustible**. If research continues, stopping for petrol is likely to become a thing of the past.

IV. Say if the following statements are true or false. Correct the false statements.

1. Energy from renewable sources is reported to cut pollution. 2. Only solar-powered cars are reported to take part in the World Solar Challenge Car Race. 3. The intensity of sunlight is sure to be taken into consideration when electrical cars are designed. 4. A solar-powered car is unlikely to operate in cloudy weather. 5. The overcharged battery doesn't let the car win the race. 6. Many problems still have to be solved. 7. Solar power as an energy source appears to have no particular advantages. 8. Alternative energy sources are expected to replace fossil fuels in the future.

V. Fill in the table below and decide what is better at the moment: a traditional car or a solar-powered car. Which vehicle would you like to have? Why?

	Advantages	*Disadvantages*
Traditional car	... ...	pollutes the atmosphere ...
Alternative car	pollution-free ...	... ...

Activity

I. An automobile engineer has designed a new vehicle, which runs on solar energy. He turns to a manufacturer in order to start a large-scale production of such vehicles.

Student A. You are an automobile engineer. Think of advantages and possible disadvantages of the car you have designed. Prove to the manufacturer that it is very efficient.

Student B. You manufacture cars running on petrol and/or diesel. Remember their pluses and minuses. Discuss with the engineer his invention and take a decision.

You can start like this:

– Sir, I would like to discuss with you the following question...

II. Discuss in small groups the possibility of constructing an experimental solar village in your country.

Optimists: you see only advantages in this project. Prove that the village is worth building.

Pessimists: you believe that the project is a no-go. Defend your opinion.

Writing

I. Write an advertisement of a solar village. You can begin like this:

Tired of smog and dirt? Looking for fresh air and a clean spot to live? Welcome to the Solar Village! ...

ENGINEERING PROBLEMS

Section A. Energy Problems

Lead-in

I. Discuss the following questions.

a) What do you know about the energy crisis we are facing today?
b) What solutions can you offer?

II. Listen to the students' discussion and name advantages and disadvantages of alternative energy sources.

Sveta: Alex, I would like you to read this article. It seems to be very interesting.

Alex: Does it really? What's so special about it?

Sveta: Well, you had better read it by yourself. Anyway, it appears to discuss the energy crisis **threatening** us today.

Alex: Oh, I hear something about it. We consume too much energy and **exhaust** our fossil fuel **resources** consisting of oil, coal and gas. However, technological progress cannot be stopped.

Sveta: Don't worry. The solution is likely to be found anyway. Have you heard about **alternative energy sources** developed by the scientists all over the world?

Alex: Certainly, these alternative sources of energy are assumed to have many advantages, but actually they are very expensive and rather inefficient.

Sveta: Well, the new method only needs perfection. Besides, as we are sure to run out of fossil fuels soon, do we have other **options?**

Alex: No, we don't. And moreover, the alternative sources of energy seem to be inexhaustible and causing no pollution.

Sveta: That speaks for itself, doesn't it?

Alex: Without any doubts. OK, where is the article? I need further information.

Sveta: Here it is.

III. Complete the following dialogues.

a) – Alex, ... to skim this article. ... .
– ...? What's ... about it?
– ..., it seems to ... the problem of ... .
– ... interesting.

b) – I'm afraid we are sure to ... .
– No need to worry. The scientists are ... .
– Are these ... ?
– Not yet, but ... to improve.

c) – ... are considered to have many ..., aren't they?
– Yes, certainly. ... pollution-free and ... .
– ... disadvantages?
– ..., they are said to be ... .

IV. Match a line in A with a line in B.

A	B
1. This article seems to be very interesting.	a) Don't worry. The scientists are sure to solve the problem.
2. Could you tell me what the article is about?	b) I think not.
3. We are facing an energy crisis today.	c) Does it really?
4. What is so advantageous about alternative energy sources?	d) Without any doubts.
5. We don't have other options, do we?	e) Well, you'd better read it by yourself.
6. Am I right?	f) They seem inexhaustible and pollution-free.

Language Practice

Vocabulary

I. Match the English words with their Russian equivalents.

essential	пар
steam	десятилетие
available	почти
reason	неотъемлемый
evident	постоянно

nearly	доступный
decade	причина
constantly	очевидный

II. Match the words with the opposite meaning.

to accelerate	excess
adequate	pollution free
renewable	inexhaustible
polluting	inadequate
safe	to slow down
shortage	unsuitable
expensive	nonrenewable
suitable	dangerous
exhaustible	cheap

III. Find in B the derivatives from the words in A.

A	B
1. to civilize	– civilization, civil, sensible, unsuitable
2. to consume	– converter, conservation, consumption, measurement
3. use	– consumer, usable, reduction, increase
4. short	– report, comfort, ensure, shortage
5. power	– empire, powerfully, sensible, waterwheel
6. to suit	– consist, student, suitable, institute
7. to exhaust	– example, inexhaustible, exhibition, explanation
8. to pollute	– plant, pursuit, production, pollution

Grammar: Participle

IV. Express the same idea in a shorter way.

EXAMPLE: *The engineers who researched fossil fuels came to disappointing results.*
The engineers researching fossil fuels came to disappointing results.

1. In the future we are certain to have vehicles that will move at a greater speed. 2. The student, who is controlling the work of a relay, does not follow safety rules. 3. The person who changes a burnt bulb must switch off the power first of all. 4. In the laboratory I found students that were studying the work of a switching device. 5. Windmills that make 100 kW can provide enough electricity to power several houses. 6. Man that consumes a lot of energy is faced with the energy shortage.

V. Join these sentences into one.

EXAMPLE: *Students were carrying out a test in the lab. They were discussing it.*
They were discussing the test <u>being carried</u> out in the lab.

1. The battery is producing a current. I'd like you to measure it. 2. Engineers are constructing solar villages worldwide. They are very economical. 3. Man is exhausting fossil fuels quickly. They are not likely to last long. 4. They are tackling the energy problem now. The problem is of great importance. 5. The teacher is checking an electric circuit. It is broken. 6. Olga is connecting the coils to a battery. They are made of copper.

VI. Provide more detailed information.

EXAMPLE: *Scientific investigations were of great value.*
(to carry out in this lab)
Scientific investigations <u>carried out in this lab</u> were of great value.

1. The new properties of engineering materials were discussed at the last seminar. (to refer to at the lecture). 2. The results of the check of the complete electric circuit have revealed many faults. (to describe in the engineer's report). 3. Numerous advantages of a new personal computer interested scientists from different countries. (to enumerate in the report). 4. The lecture was followed by a demonstration of interesting data. (to obtain during a set of experiments). 5. The car does not pollute the environment. (to supply with solar batteries). 6. Robots have made our life much easier. (to develop recently)

VII. Choose the right option.

1. The engineers *tackling/tackled/being tackled* the energy problem did not reach a compromise.

2. The equipment *delivering/delivered/being delivered* yesterday has just been installed.

3. The coils *connecting/connected/being connected* to each other will be attached to a battery through an on-off switch.

4. Tests of the properties of the electromagnetic circuit *carrying/carried/being carried* out by this team have shown good results.

5. The high voltage circuit *checking/checked/being checked* now will be used soon.

6. Many people are against power plants *burning/ burnt/being burnt* waste.

VIII. Open the brackets and use Participles in the right form.

1. Scientists (to deal) with solar energy have made great progress. 2. The investigation (to carry out) by the students now is very interesting. 3. The

bulb (to turn) into the socket burnt out at once. 4. The project (to discuss) by the engineers at the moment has numerous advantages. 5. The professor (to deliver) a lecture on the use of solar energy provided working models. 6. In Japan there are many villages (to use) geothermal energy of the Earth for heating.

IX. Correct mistakes.

1. I saw Boris being repaired an electrical device in the lab. 2. Serious faults finding in the project had to be corrected quickly. 3. A new method of investigation using gave unique results. 4. The Sun radiated a tremendous amount of energy provides us with everything. 5. Vehicles driving automatically will appear on the market soon. 6. Water and wind power using extensively today seem to be inexhaustible.

X. Translate the sentences into English using your active vocabulary.

1. Студенты, наблюдавшие за работой электрического реле, сейчас находятся в мастерской. 2. Электроприборы, установленные в лаборатории, будут использоваться студентами во время практики. 3. Количество энергии, потребляемой цветным телевизором за год, составляет 93 кВт. 4. Метод превращения солнечной энергии в электричество, разработанный этим ученым, очень эффективен. 5. Человечество, потребляющее огромное количество энергии, скоро столкнется с энергетическим кризисом. 6. Биомасса, сжигаемая для получения энергии, является неистощимым энергетическим ресурсом.

Reading and Speaking

I. What do we need energy for? Make a list of the uses of energy and compare it with that of your partner.

II. Translate the following compound nouns into Russian.

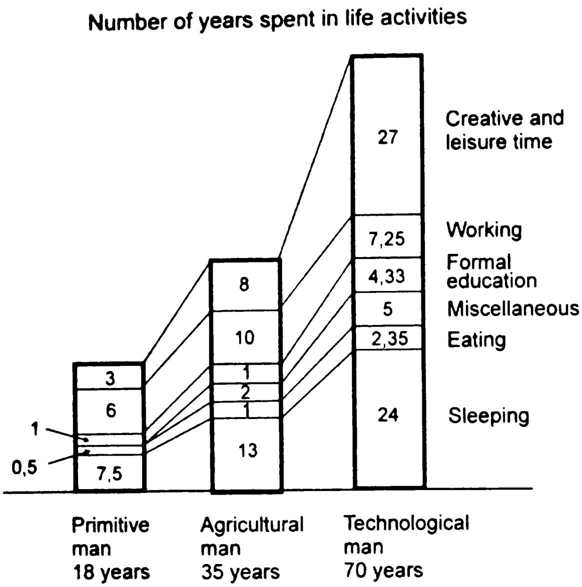
energy crisis prospects	energy cost
steam engine	total fuel consumption
oil-equivalent	overall energy supply

III. Scan the text to find answers to these questions.

1. How did primitive man get the energy he needed? 2. How much energy does man consume today? 3. What does technological man do half of his

life? 4. In what two ways is energy used? 5. What is the standard measurement of energy cost? 6. Does the car require much energy? 7. Why is it essential to cut energy consumption? 8. What is the primary source of energy?

IV. Read the article carefully for the details about the energy problems.



Energy is an essential part of our civilization. A million years ago primitive man used only 6,000 (kJ) a day, which he got from the food he ate. A hundred thousand years ago people had learnt to make fire and used four **times as much** energy (the equivalent of 25,000 kJ). By the 15th century man using animals, windmills and waterwheels, and a little coal, was already consuming nearly twenty times as much energy (120,000 kJ). By 1875 the steam engine made 340,000 kJ a day available to industrial man in England. Today's technological man uses 1,000,000 kJ a day, or one hundred and fifty times as much as primitive man, about one third in the form of electricity.

Why is our energy consumption **constantly** increasing and accelerating? The **reasons** are **evident**. Technological man lives four times as long as primitive man and **twice** as long as man in the 15th century. **Nearly** half of man's life today is spent on educating himself, leisure and creative activities. Medieval man spent only a quarter of his thirty-five years in these pursuits, and primitive man only one sixth in his short life of eighteen years.

What do we need energy for? Comfort and lighter work, first of all. Energy consumed in great quantities falls into two kinds: a) energy needed every day (lighting, heating, etc.) and b) energy used to produce necessary objects (house, clothes, etc.). Take a man building a small house (10 tons of oil-equivalent), heating (3 tons of oil-equivalent) and lighting (200 kg of oil-equivalent or 700 kW·h) it for a year and having a car (1.3 tons of oil-equivalent + 1.3 tons for every 12,000 km run). The energy cost of these basic things is tremendous but multiply it by 6 billion to get the real picture of man's needs. Besides, energy consumption is sure to increase since the more energy is consumed, the easier our life becomes.

The current energy problem caused by many interrelated factors must be tackled quickly. Strange as it sounds, there is no **shortage** of primary energy.

The sun provides ten thousand times as much energy as we require today, in many forms ranging from solar radiation through wind and waves to trees and plants. The problem is to convert these resources into mechanical work or other **usable** forms of energy. The history of energy has been the history of converters - man's body itself converting food into warmth and mechanical work, animals doing such work more powerfully, the waterwheel, the windmill, the steam engine, the nuclear reactor and in the near future, the solar cell.

V. Read these figures: 6,000; 120,000; 340,000; 1/2; 1/3; 1/4; 1/6; 1.3; 700; 1,000,000. What do they refer to?

VI. Complete the table with the information from the article.

Time	*Man*	*Years of life*	*Energy consumption*	*Why?*
...	...	...	...	...

Consider food, domestic consumption, services (trade, office work, teaching, leisure), industry and agriculture, transport.

VII. a) Study the diagram in the text and discuss these questions with your partner.

1. What goes under the heading 'Miscellaneous'? 2. Do you observe any interesting tendencies? 3. Can you explain why it takes us more time to do these activities? Compare the columns. 4. Why do we spend less time on work and more time on leisure than, say, agricultural man? 5. Why do we live longer?

b) Continue the diagram and draw the fourth column for the Man of the Future. Point out how long he will live, what activities he will have and how much time they will take. Give reasons for your forecast. Discuss it with your group and try to come to a general agreement.

VIII. Expand the following situations.

1. What are the ways of using energy? Supply your own examples.
2. How much energy (in oil-equivalent) is necessary to build a house and light and heat it for a year?
3. What is the energy problem? Describe its causes and ways of solving it.

4. Continue the sentence: The less energy we will use, the ... . Do you agree? Give reasons for your opinion.

5. What energy sources on the Earth are or have been provided by the Sun?

IX. a) Does the article provide any interesting information? What is the main idea of the article? What other questions does it discuss?

b) Give a title to the article.

Further Reading

I. What alternative sources of energy do you know? List as many as you can and compare your list with that of your groupmate.

II. These words are taken from the text. Use the dictionary to find out their meanings.

dam, n
flood, v
land, n
rough, adj
underground, adj
poisonous, adj
dung, n
cane, n
  sugar cane
plant, v
wrong, adj
  go wrong
drive, v
  drive smb nuts

III. Read the text for detailed information about alternative sources of energy.

Alternative Sources of Energy

It is not a secret that energy consumption has increased **immensely** in the last decades. But do we have enough fossil fuels to **satisfy** our **needs**? As fossil fuels are **nonrenewable** we are highly interested in developing alternative sources of energy.

Solar Power is renewable. It is used for heating houses. Solar cells and furnaces make electricity from sunlight. Solar cells are expensive. Solar power isn't much use unless you live somewhere sunny. It doesn't cause pollution and doesn't need fuel.

Wind Power is renewable as well. It doesn't cause pollution, doesn't need fuel. However, a lot of generators are needed to get a **sensible** amount of power. It is necessary to put them where winds are **reliable**. And the noise can drive you nuts.

Hydroelectric Power plants are built for getting energy from flowing water. Usually we build a dam, and let the water turn turbines and generators as it goes through pipes in the dam. Renewable. No pollution, no fuel needed, no waste. Very expensive to build. Building a dam we flood a lot of land.

Waves Power. There's a lot of energy in waves on the sea. However it is not easy to get it. A wave power station needs to be able to stand really rough weather, and yet still be able to generate power from small waves. This source of energy is renewable – the waves will come whether we use them or not.

Geothermal Energy means heat from underground hot rocks. Hot water comes up and we use the heat to make steam to drive turbines, or to heat houses. It is renewable - so long as we don't take out too much, the energy keeps on coming. However, there are not many places you can do it – the rocks must be suitable. Sometimes we get poisonous gases coming up too.

"Biomass" means burning wood, dung, sugar cane or similar. It is renewable – we can always plant more trees. We burn the fuel to heat water into steam, which drives turbines, which drive generators. Burning anything we pollute the environment.

Nuclear (atomic) power stations use uranium as fuel. It is nonrenewable. Heat from the reactor **turns** water **into** steam, which drives turbines, which drive generators. It doesn't cause pollution unless something goes wrong.

IV. Answer the following questions.

1. Why do we have to develop alternative sources of energy? 2. What is solar energy used for? 3. What are the disadvantages of wind power? 4. What requirements should hydroelectric power stations meet? 5. Why can the use of geothermal energy be dangerous? 6. Are nuclear power plants considered safe?

V. Name the sources of energy that are ...

1) renewable; 2) pollution-free; 3) producing no waste; 4) needing no fuel; 5) safe.

VI. Can these sources of energy be used in your country? Give your reasons.

Power Source	*Can Be Used*	*Cannot Be Used*
solar power		
wind power		
hydroelectric power		
waves power		
geothermal power		
biomass		
nuclear power		

VII. What new or useful information have you learnt from the text?

Activity

I. Your country is running out of fossil fuels soon and is facing an energy crisis. Other sources of energy must be developed quickly. Divide into several groups.

a) Discussion.

The Government: state the problem; announce the award for the best project.

The Engineering groups: carry out your research, consider all the factors (both positive and negative) and suggest a power plant to be built.

b) Presentation.

The Engineering groups: present your project; explain your choice and answer possible questions.

The Government: ask the engineers questions after their presentation, choose and award the best project with a prize.

Writing

I. We are surrounded by electrical appliances and take modern conveniences for granted, ignoring the fact that we are rapidly exhausting our energy resources. Write a paragraph discussing the following questions:

1. What electrical appliances do you have at home?
2. How much electricity do they consume?
3. Is it possible to reduce their energy consumption? If so, how?
4. Why is it important to save energy?

Section B. Automotive Problems

Lead-in

I. Discuss the following questions:

a) Are you good at repairing cars?
b) What are the most common faults in a car?
c) Do you know how to repair them?

II. Listen to the students' conversation and learn what faults can occur in a car.

Peter: Alex, I would like you to have a look at my car, please.
Alex: What's wrong with it?
Peter: I don't know. Having just started the engine stops again.
Alex: There is no petrol in the tank, I'm afraid.
Peter: On the contrary! The tank is full and the battery seems to be **in order**.
Alex: Let's go into the garage then and ask Denis to have a look at it. He is said to be a good car mechanic and is sure to find the **fault** in your car.
Peter: OK. Considering the situation, we are going to need his help.

(a couple of hours later)

Peter: What are you busy with?
Denis: I'm repairing the engine of your car.
Peter: But what has happened? It's quite new as far as I know.
Denis: Don't you understand that you should never operate the engine if the air filter is **out of order**? Well, having entered the engine, **dust** and **dirt** damaged the cylinders, pistons and **piston rings**.
Peter: OK, I get it, I should have changed the filter.
Denis: Yes. By the way, have you ever checked your **spark plugs**?
Peter: Let's see... But they are as good as new!
Denis: Certainly, they are all right. Having cleaned and tested them, I only have to repair the engine now.
Peter: Oh, now it's clear why there was no spark.
Denis: And there wouldn't be. Being covered with oil the spark plugs will not give a spark. That's why your engine stops.
Peter: I see.

III. Complete the following dialogues.

a) – Vlad, ...?
– ...
– What's wrong with it?
– ...

b) – ...
– The tank is full, I have checked it.
– What about the ...?
– ...

c) – Well, let's go into the garage and ...
– Is he good at repairing cars?
– ...
– OK. ...

d) – The engine seems completely ... . What can it be?
– Look here, the spark plug is ... .
–... The car won't start as ... .

IV. Match a line in A with a line in B.

A	B
1. My car doesn't start.	a) Not yet.
2. I think there is no petrol in the tank.	b) But I have just charged it!
3. What are you busy with?	c) No wonder, the pistons are damaged.
4. The engine is out of order.	d) I'm changing the air filter.
5. Have you checked the spark plugs?	e) What's wrong with it?
6. The battery must be flat.	f) On the contrary! It is full.

Language Practice

Vocabulary

I. Find the English equivalents in B to the Russian words in A.

A	B		
1. количество	a) amount	b) quality	c) count
2. чистить	a) to change	b) to block	c) to remove
3. свободный	a) difficult	b) easy	c) free
4. увеличивать	a) to reduce	b) to decrease	c) to increase
5. примесь	a) starter	b) particle	c) spark
6. тщательный	a) clockwise	b) thorough	c) backwards
7. ремонт	a) overhaul	b) research	c) maintenance

II. Match the words with the similar meaning.

to damage	to get into
downwards	ordinary
to change	free
impurity	to break
common	to overhaul
unobstructed	to replace
to enter	dust and dirt
to repair	down

III. Complete the table with the missing words.

	Verb	*Noun*
заводить (мотор)		
		absorption
	to radiate	
		circulation
охлаждать		
	to conduct	

Grammar: Participle

IV. Make all possible sentences, matching the actions that take place at the same time.

EXAMPLE: *to repair the car / to follow the mechanic's instructions*
(When) repairing the car I followed the mechanic's instructions.

to park your car	to remember about the speed limit
to maintain the car in order	to start the engine
to press the accelerator	to save yourself a lot of trouble
to push a car forwards and backwards	to consider road signs
to introduce automated vehicles	to keep the distance
to drive a car	to take into account the safety of traffic

V. Explain why these things happen.

EXAMPLE: *The spark plugs gave a spark at last. (to clean)*
Being cleaned the spark plugs gave a spark.

1. The engine needs cooling. (to heat) 2. The ammeter is recording no current. (to break) 3. The moving parts work almost without friction. (to oil) 4. Solar-powered systems operate at night. (to supply with batteries) 5. The project promises good results. (to design carefully) 6. The car needs a serious overhaul. (to damage)

VI. Expand the following sentences as shown in the example.

EXAMPLE: *When removed the particles of dirt can't cause damage.*
When the particles of dirt are removed, they can't cause damage.

1. If tested the engine may be started. 2. When repaired and repainted, the car looked as good as new. 3. If removed impurities cannot block the carburettor. 4. When removed from the pump, the filter is cleaned with a brush. 5. If added to the engine, oil decreases friction between the moving parts. 6. When adjusted properly, the spark plugs produce a spark.

VII. Study the following sentences and point out the differences in their translation.

1. a) A car running on hydrogen was invented long ago.
   b) Running on hydrogen this car is not likely to cause pollution.
2. a) Students attending classes regularly study better.
   b) Attending classes regularly students understand the material quicker.
3. a) The exhaust system being repaired at the moment produces too much smoke.
   b) Being repaired by a skilful mechanic the exhaust system is now in order.
   c) If not repaired, the exhaust system will have to be replaced.
4. a) When redesigned the engine will perform better.
   b) Being redesigned completely the engine became more efficient.
   c) The engine redesigned and improved by the researchers showed excellent performance.

VIII. Match the beginning of each sentence with its end.

1. Having been cleaned
2. Having been repaired by a good mechanic
3. Having been stopped by a policeman.
4. Having been damaged badly
5. Having been shown the results of the research

a) the participants of the conference were surprised.
b) I had to pay the fine for speeding.
c) the car needed a serious overhaul.
d) the filter increased the airflow.
e) the car was as good as new.

IX. Fill in the gaps with the words given in the box.

clockwise, anticlockwise, to the right, to the left, in front of, upwards, downwards, forwards, backwards

1. To start the car the key should be turned ... . 2. Take the first turn ..., the second ... and you will see the service station ... you. 3. If the starter is jammed, you should try to push the car ... and ... . 4. It is necessary to turn the bulb ... in order to take it out of the socket. 5. The pistons in this car move ... and ... .

X. Translate the sentences into English using your active vocabulary.

1. Устранив неисправность, водитель уехал со станции техобслуживания. 2. Проверяя тормозную систему машины, механик обнаружил дефект. 3. Попав в двигатель, сор и пыль повредили цилиндр и поршневые кольца. 4. Будучи серьезно поврежденной, машина не заводилась. 5. Удаляя различные примеси из воздуха, фильтр не дает карбюратору засориться. 6. После того, как свечи зажигания были зачищены, они дали искру. 7. Заметив, что топливо заканчивается, он остановился на заправочной станции, чтобы наполнить бак. 8. Регулярно проходя техосмотр, вы экономите, по крайней мере, время и деньги.

Reading and Speaking

I. Look at the headline and try to guess what the text is going to be about.

II. Scan the text to find the answers to the following questions.

1. Do modern cars need servicing regularly?
2. What are the three most common faults in the car?
3. What should you do if the battery appears to be dead?
4. What does a fuel warning light show?
5. Why is there no spark sometimes?
6. What is likely to happen to the petrol pump?
7. How can the fuel pipe become blocked?
8. How do you know that the starter motor is likely to be jammed?
9. Is the air filter an important part of the engine?

III. Read the text attentively and learn about the most common faults in the car and the ways to repair them.

Finding a Fault in the Car

Servicing your car regularly you prevent it from becoming unreliable. Of course, you can't **foresee** everything. Having failed to **start** the car in the morning you had better check three things first: the **battery**, the fuel level and the spark plugs. It is quite easy to repair these **faults**.

If the battery appears to be **flat,** it is necessary to recharge it. If this doesn't work, you should replace it.

An empty tank is another **common** fault in the car. Having noticed a fuel warning light on the instrument panel of your car you should **fill up** the tank with more petrol.

Dirty spark plugs are also certain to cause a problem. To drive the car it is important to clean them regularly and adjust the **gap** in the spark plugs to the proper width. If the gap is not correct, the engine will not run well.

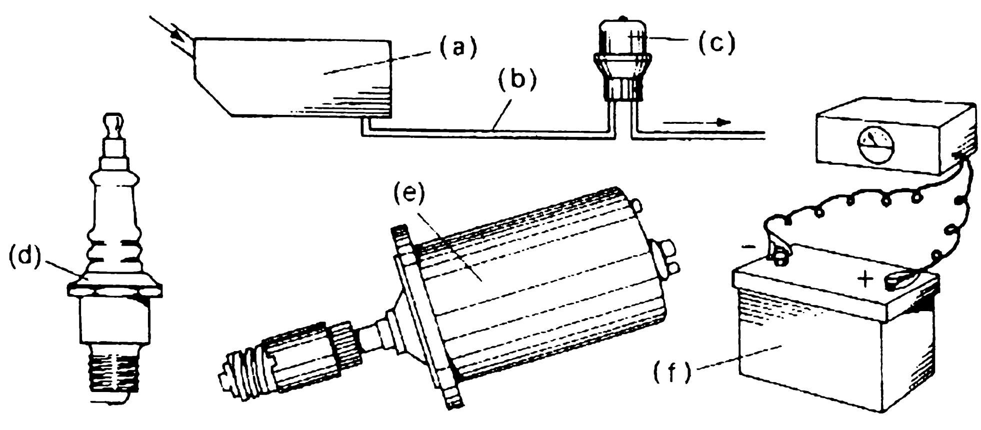
If your car still does not start, the petrol pump may be broken, or the fuel pipe may be blocked. Having discovered a broken pump, it is a good idea to repair or replace it. If the fuel pipe is blocked, take it off and unblock it.

Having heard a loud CLICK! when you turn the key, you are sure to realize that the **starter** motor may be **jammed**. If it is, you can try to **release** it **pushing** the car **forwards** and **backwards** (in the 2nd gear). If the car still doesn't start, the starter motor should be repaired or even replaced.

And don't forget about the air filter. Its function is to remove particles of dirt, dust and other **impurities** from the air passing to the carburettor. A blocked filter decreases the airflow to the carburettor thus increasing the amount of fuel in the mixture. This causes the engine to operate inefficiently. Cleaning and changing filters regularly you prevent a considerable damage that is certain to be caused inside the cylinders. In this case the engine will need a **thorough overhaul**.

If you are a poor mechanic, stopping at **service stations** periodically you will save at least time and money. As they say, prevention is better than cure.

V. Do you recognize these parts of the car engine? Find their names in the text.



VI. Fill in the table with the data from the text.

A component of the car	*The fault*	*What to do*
1. the battery	flat	...
2. ...		
3. ...		

VII. You are studying to get a driving license. The topic of the lesson today is 'Maintenance of a Car'. Your friend is your instructor. Ask him about the most common faults in the car and the ways to repair them.

You can start like this: – What shall I do if the car doesn't start?
– Well, you should ...

VIII. Expand this gist of the text.

The text deals with common faults in the car and ways to repair them. Special emphasis is laid on the necessity of regular car servicing.

Further Reading

I. The cooling system is a necessary component of any engine-driven vehicle. Why is it important to cool the engine? How can the engine be cooled?

II. Scan the text to get the answers to these questions.

1. Why does the engine become very hot?
2. How much energy pushes the pistons?
3. What are the two functons of the cooling system?
4. How are motorcycles usually cooled?
5. What increases the efficiency of air-cooling?
6. Why is liquid-cooling preferred to air-cooling in large engines?
7. Where is hot fluid cooled in the car engine?
8. What liquids are used in the cooling system?
9. What requirements must the coolant meet?

III. Read the text attentively for more details about cooling systems.

1. Cooling Systems

When you drive a car, the engine becomes very hot. Why?

Burning in the engine the **fuel-air mixture** produces energy. But only *a quarter of* this energy makes the pistons move. *Most of* it turns into heat.

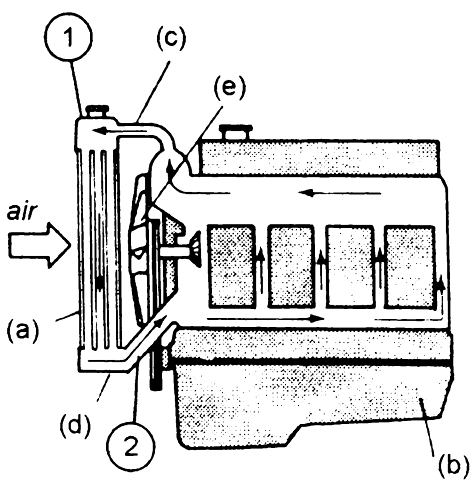
About half of this heat goes down the **exhaust pipe** and *the other half* stays in the engine making it very hot. In fact, the cooling system on a car driving down the freeway **dissipates** enough heat to heat two average-sized houses! The primary job of the cooling system is to cool the engine and to keep it from **overheating**. However, the cooling system also has several other important jobs. The engine in your car runs best at a fairly high temperature. When the engine is cold, components wear out faster, and the engine is less efficient and **emits** more pollution. So, another important job of the cooling system is to allow the engine to heat up as quickly as possible, and then to keep the engine at a constant temperature. There are two types of cooling systems found on cars: air-cooled and liquid-cooled.

2. Air Cooling

Some older cars, very few modern cars and most motorcycles have air-cooled engines. Constructing the engine block covered in numerous **external** aluminum fins engineers greatly increase its surface area, which can be cooled by the flow of air passing over it. A powerful fan is used to supply an increased amount of air for cooling multi-cylinder engines. The forced air-flow conducts heat away from the cylinders radiating it into the air more efficiently.

However, it is difficult to design large engines with an **unobstructed** air-flow over all the cylinders. The alternative is a liquid (water)-cooling system.

3. Liquid Cooling



Most cars are equipped with liquid-cooling systems. Flowing around the *engine* the **fluid** absorbs its heat, which consequently allows the engine to get cooled. Then, having entered through the *top hose* the hot fluid passes through the heat exchanger or *radiator*. The radiator transfers the heat from the fluid to the air **pulled** through the exchanger by a *fan*. Leaving the radiator through the *bottom* hose the cooled fluid is **pumped** around the engine again.

Cars operate in a wide variety of temperatures. So whatever fluid is used to cool the engine it has to have a very low **freezing point**, a high **boiling point**, and it has to have the capacity to hold a lot of heat. Water holds heat quite effectively, but it freezes at too high a temperature to be used in car engines. The **coolant** used in most cars is a mixture of water and ethylene glycol ($C_2H_6O_2$), also known as **antifreeze**. Adding ethylene glycol to water, the boiling and freezing points are improved significantly.

IV. Name the objects in the picture in the text. Use the words in italics from paragraph 3.

V. You are taking a test for a driving license tomorrow. Today you have a consultation. Your friend is your instructor.

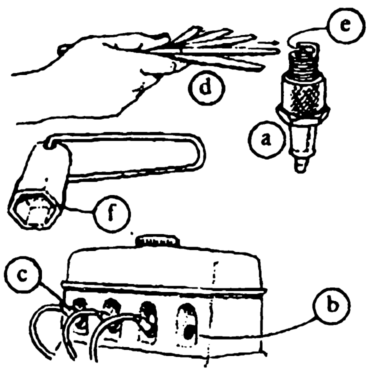
Student: Prepare a list of questions concerning cooling systems and ask the instructor for explanations.

Instructor: Look at the picture again and explain the operation of the cooling system to your student.

Activity

I. Discuss in small groups what system is better: air-cooling or water-cooling. Consider advantages and disadvantages of both.

II. a) What are these objects called? You can choose from the following:



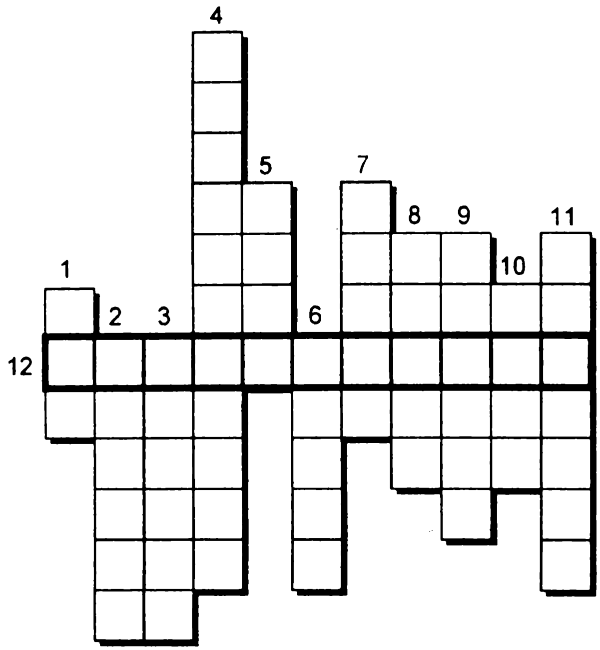
1) cover
2) spark plug
3) socket
4) spanner
5) gap
6) gauge

b) Complete the instructions with the suitable words.

How to Check a Spark Plug

First you should remove the cover. Having achieved this, place the ... over the spark plug. Then it is necessary to rotate the ... anti-clockwise until it seems to be loose. Having removed the plug from the ..., examine the gap and check it to be clean. After that, insert a ... in the gap. Check that the ... is between 0.65 and 1.00 mm wide. Having replaced the plug in the socket you should rotate it clockwise until it is hand-tight. Next, it is necessary to place the spanner over the plug and give ONLY a quarter turn clockwise. Caution should be taken not to overtighten the plug. Finally, replace the ... .

III. Solve the puzzle.



Down:

1. part of a cooling system;
2. ordinary, conventional;
3. it can be either positive or negative;
4. part of the engine where fuel is mixed with air;
5. petrol, diesel, gas;
6. the fuel warning light shows that the tank is ...;
7. dirty spark plugs cannot produce it;
8. if you want to stop you should push it;
9. gasoline;
10. a device to produce a sound signal;
11. you should do it to keep your car reliable.

Across:

12. ?

Writing

I. You are a mechanic at the service station. Write a set of instructions 'How to maintain a car'.

ADVANCES IN TECHNOLOGY

Section A. Holograms

Lead-in

I. Discuss the following questions.

a) Have you ever seen a hologram? What is it?

b) Where are holograms used nowadays? Make a list of their possible applications and compare it with that of your partner.

II. Listen to the students' conversation and learn how holograms are made.

Nick: Sveta, I'm looking for Boris. Have you seen him today?

Sveta: Yes, he is making a **hologram** in the lab.

Nick: Is he? And what is a hologram?

Sveta: Look at your watch! See? A hologram is a **three-dimensional image**. It is produced when laser light is recorded on a **holographic plate.**

Nick: I can't **imagine** Boris experimenting with a laser beam.

Sveta: Well, just ten minutes ago I saw him **splitting** the laser beam into two separate beams by means of a **beam splitter**.

Nick: As far as I can see, it's rather difficult to make a hologram.

Sveta: Oh, it is not. If you have all necessary equipment, you can make holograms at home.

Nick: Really? What equipment do I need?

Sveta: Well, the easiest hologram requires a laser, a **lens**, a holographic plate, a **stable** table, a dark room with green safelights and a holographic model. Of course, you are supposedto know what to do with this equipment.

Nick: Right. Where can I learn how to make holograms?

Sveta: If you are so interested, you can join our Science Club. By the way, Boris is still in the lab. You can watch him producing a hologram right now.

Nick: Indeed. See you at the Club tomorrow then.

III. Complete the dialogues.

a) – I wonder, ... now.
– ...
– What is he doing there?
– ...

b) – I suppose it is not easy to ...
– Why?... I have just seen ...
– ...? It is difficult to imagine ...
– ...

c) – ...
– A hologram is ...
– Can it be produced at home?
– ...
– What equipment do I need?
– Well, ...

IV. Match a line in A with a line in B.

A	B
1. Where is Denis?	a) Oh, really?
2. It's rather difficult to make a hologram, isn't it?	b) In the lab.
3. I can't imagine Paul experimenting with a laser beam.	c) Indeed.
4. Holograms can be made at home.	d) Neither can I.
5. You can watch me doing a hologram right now.	e) You are welcome.
6. Thank you for the information.	f) Actually, no.

Language Practice

Vocabulary

I. Find in B the English equivalents to the Russian words in A.

A	B		
1. пленка	a) image	b) film	c) coating
2. видимый	a) visible	b) seen	c) sensitive
3. разбивать	a) to split	b) to remove	c) to record
4. одноцветный	a) ultrasonic	b) sound	c) monochromatic
5. отражать	a) to reflect	b) to emboss	c) to belong
6. первоначальный	a) first	b) original	c) early

II. Match the words with the similar meaning.

visible	single-colour
to separate	to coat
monochromatic	whole
to light	spectator
to cover	viewable
image	to split
complete	to illuminate
viewer	picture

III. Divide these words into four columns according to their part of speech.

normally, theorist, originally, incidentally, imperfect, achievement, considerably, numerous, vibrate, viewable, spread, reflection, viewer, multidimensional, specialize, holographic, sensitive, interference, monochromatic, insulate, typically, directly, split

Grammar: Participial Constructions

IV. These two sentences have a different structure but the same meaning. Change the structure of the sentences below so as to keep their meaning unchanged.

EXAMPLE: *We found that a laser beam is split by means of a beam-splitter device.*
We found <u>a laser beam being split</u> by means of a beam-splitter device.

1. We found that a laser beam is split into two separate beams. 2. The students assumed that laser beams are reflected off the two mirrors. 3. She supposed that one of the laser beams is reflected off the mirror onto the holographic plate. 4. You heard how the teacher was explaining the properties of a laser beam. 5. I'd like to watch how they are working with a holographic plate. 6. We consider that a hologram is a three-dimensional image.

V. Say what you saw (heard, noticed, observed, watched, found) these people doing yesterday.

EXAMPLE: *Boris – to explain the way of doing a hologram.*
I saw <u>Boris explaining</u> the way of doing a hologram.

the engineers	to demonstrate real-image holograms;
the students	to carry out the analysis of the data with the help of a computer;

the chief engineer	to speak about the prospects of holography;
the students	to test a beam-splitter;
my friend	to work with holographic lenses;
the teacher	to record laser light on a holographic plate

VI. Change the structure of these sentences so as to keep their meaning.

EXAMPLE: *It is found that a laser produces a powerful beam of light.*
A laser is found producing a powerful beam of light.

1. It is known that lasers produce multidimensional images. 2. It is found that a laser beam is split into two beams. 3. It is assumed that holograms are widely used in industry. 4. It is believed that this group of researchers experiments with a new type of a hologram. 5. It is considered that this scientist applies advanced methods of research. 6. It is observed that the student explains the principles of hologram production.

VII. Say how you want these things changed.

EXAMPLE: A: *The laser is out of order (to fix)*
B: I'd like to have (see, get, etc.) the laser fixed.

1. The beam-splitter has gone wrong (to test). 2. The hologram has been badly produced (to reproduce). 3. The green safelights are out of order (to repair). 4. The dimensions of the object are badly measured (to measure them again). 5. The equipment for making a hologram is not ready yet (to prepare). 6. The TV-set is producing a lot of noise (to switch off).

VIII. Restore the original sentences.

1. being made, to see, I'd like, a hologram
2. properties, having, this group of substances, valuable, is considered
3. many faults, is assumed, having, the device
4. is found, the splitter device, many advantages, revealing
5. reported, the engineers, improving, the quality of a hologram, are
6. being, the wavelength, short, extremely, is known

IX. Translate the sentences into English using your active vocabulary.

1. Если один луч лазера отражается от объекта, другой луч отражается от другого зеркала на голографическую пластину. 2. Голограмма – это отражение в 3-х измерениях, причем для его получения необходимо специальное оборудование. 3. Мы наблюдали, как студент проверял электрическую цепь. 4. Преподаватель смотрел, как мы создавали голограмму. 5. Выяснилось, что лазерный луч расщепляется на два отдельных луча. 6. Мы видим, как инженер использует лазер, чтобы сделать голограмму.

Reading and Speaking

I. Translate the following compound nouns into Russian.

electron microscope	rainbow hologram
light source	quality control
laser light	stress analysis

II. Technological progress supplies us with unusual things and holograms are a good example. Scan the text to find answers to these questions.

1. What is the difference between holography and a hologram?
2. Who discovered the holographic effect?
3. How was the word *hologram* coined?
4. What was the aim of Dennis Gabor's research?
5. Was the aim achieved?
6. Why were first holograms imperfect?
7. When was the first laser operated?
8. What are the basic types of holograms?

III. Read the text attentively to learn more about holography.

Holography and Holograms

***History*.** **Holography** and **hologram** are normally referred to as a process and as a **plate** or **film** itself **respectively**. In 1947 Dennis Gabor (the father and the first theorist of holography, **awarded** with the Nobel prize for his research) coined the term *hologram* from the Greek words 'holos' meaning *whole* or *complete* and 'gram' meaning message. Gabor's theory was **originally intended** to increase the resolving **power** of electron microscopes. Incidentally, it was proved not with an electron beam, but with a light beam. The result was the first hologram ever made. Gabor's hologram was clear, but **imperfect,** as he **lacked** the correct light source - the LASER, which was first seen operating in 1960.

***Types*.** The latest achievements in laser technologies being applied, holography has developed considerably. **Numerous** types of holograms can be noticed operating everywhere. The following are considered the most frequent:

a) transmission holograms. They are **viewable** with laser light when both beams approach the film from the *same* side;
b) **reflection** (white-light) holograms. These are viewable with white light

from a suitable source (spotlight, flashlight, the sun, etc.) when both beams approach the film from the **opposite** sides;

c) multiple-channel (rainbow) holograms. These holograms with several images are not only **visible** from different angles; they also change colour at each new angle;

d) real-image holograms. They produce the **image** *in front of* the plate towards the viewer. Most holograms in holography museums are of this type.

Application. Holography being an art that attracts people's attention and curiosity, **colourful multidimensional** images are widely used in advertising, stamps, jewelry, with holography museums exhibiting masterpieces. Credit cards are considered original if supplied with a hologram. Holographic **lenses** are lighter than traditional lenses and mirrors and can be designed to perform more specialized functions, for instance, to make the panel instruments of a car visible in the windshield in order to increase safety. Holographic interferometry (a very precise technique used for measuring changes in the dimensions of an object) is widely used in industrial stress analysis and quality control. The list of applications may be continued **indefinitely**.

IV. Complete the table below with the data from the text.

Type of a Hologram	*View*
	...

V. Where is holography used nowadays? Can you continue the list of applications? Where is holography likely to be applied in future? Give reasons for your opinion.

VI. You are very interested in holograms. Your friend is taking a course on holograms at the Science Club. Ask your friend what he has already learnt about holography.

Further Reading

I. Match the following noun compounds with their Russian equivalents.

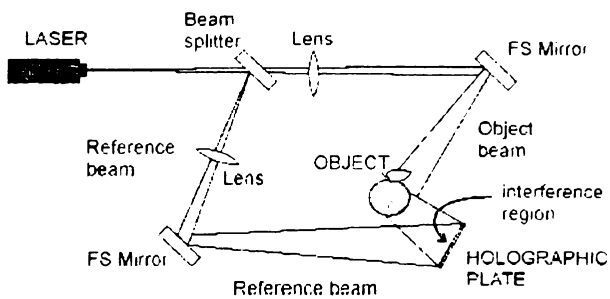
1. laser beam
2. beam splitter
3. reference beam
4. object beam
5. interference pattern

a) интерференционная картина
b) луч лазера
c) разделитель луча/светоделитель/ расщепитель
d) опорный луч
e) объектный луч

II. Do you know how holograms are made? What equipment is necessary for this? Study the picture and say what the text is going to be about. What other information can it provide? Skim the text to check your guess.

III. Read the text attentively to find out how holograms are made.

How Holograms Are Made



A hologram is a **three-dimensional image**, special equipment being necessary for producing it. A hologram is created when laser light is **recorded** on a holographic plate (a piece of glass **coated** with a substance, sensitive to light). The laser beam is **split** into two **separate** beams by means of a device called a **beam splitter**. One beam is **reflected** off the **mirror** directly onto the holographic plate, while the other beam is reflected off another mirror onto an object. **The former** is called the **reference beam, the latter** being called the **object beam**.

When reflected off the object onto the holographic plate, the object beam meets the reference beam and an **"interference pattern"** is produced. It is this interference of the two beams that is recorded on the plate to produce a hologram.

If a hologram is **illuminated** in the **direction** of the reference beam, a three-dimensional image of the object appears where the object was originally. Some holograms are **viewed** with laser or **monochromatic** (**single-colour**) light, others with white light.

Holograms being mass-produced, it is advisable to divide them into categories:

– ***embossed*** *holograms.* These are **stamped** on **foil** backed Mylar **film** using a metal **master** (most common method).
– ***polymer*** *holograms.* These are made from light sensitive plastic. The Polaroid Corporation mass produces holograms by this method.
– ***dichromate*** *holograms.* Very bright holograms on jewelry, watches, etc., which are recorded on a light sensitive **coating** of gel containing dichromate.

Holograms can be homemade as well. The easiest type of holography for amateurs requires a holographic model, a **stable** table, a laser, a **lens**, a holographic plate and some darkroom supplies (e.g. green **safelights**). Freedom from any (air and sound) **vibrations** within millionths of a centimeter must be **assured**. The greater the number of optical components, the greater the destructive effect of vibrations. One more thing must be always kept in mind — SAFETY RULES.

IV. Answer the questions using the data from the text.

1. A hologram is a three-dimensional image, isn't it? 2. In what way is a hologram made? 3. How many beams is the laser beam split into? 4. What are the functions of these two separate beams? 5. What are the two beams called? 6. How is 'interference pattern' produced? 7. Is the interference of the two beams recorded on the plate? 8. How can a hologram be viewed?

V. What are the categories of holograms? Fill in the table below.

Category	*Material*	*Usage*
		...

VI. Explain why ...

1) you need green safelights when making a hologram,
2) the table used should be stable,
3) there must be no movement in the room while producing a hologram.

VII. Can you shortly describe the process of creating a hologram? Use the diagram for help. Do you think it is difficult to make a hologram at home? Give reasons for your opinion.

Activity

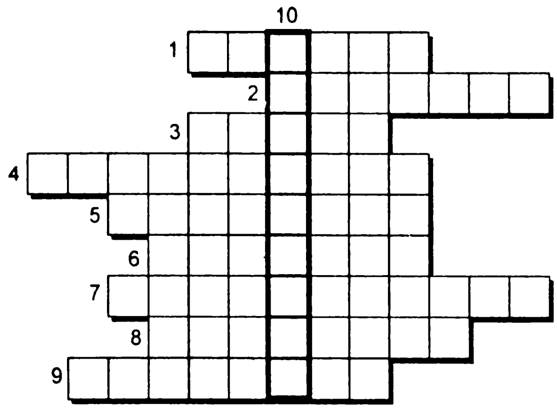
I. Students in the lab are discussing how to make a hologram.

Student A: You want to make a hologram but are not very sure of your skill. Ask your friend for help and more information.

Student B: Explain to your friend how a hologram is made. Give him instructions how to produce a hologram.

II. You had a unique chance to visit the world-famous Science Museum at Exhibition Road, London, during your winter holidays. The Holographic Gallery attracted your attention. Now you are back home. Tell your friend what you have seen and learnt at the exhibition.

III. Solve the puzzle.



Across:

1. a person who watches sth. happening; a spectator;
2. temperature changes and noise cause the air to ...;
3. complete, not broken or split;
4. the degree of clearness with which objects can be seen according to air or weather conditions;
5. a person who consumes goods or services;
6. a covering of a surface, can be insulating;
7. when an object is used everywhere it is said to have a wide ...;
8. a device for recording;
9. first, earliest, new, not copied.

Down:

10. ?

Writing

I. Write a 'How to Make a Hologram' guide for those who want to create holograms at home. Cover the following questions.

1. What is a hologram?
2. How is it created?
3. What special equipment is necessary?
4. What must everyone remember while making a hologram?
5. Where can holograms be applied?

You can start like this:

1. A hologram is a three-dimensional image. It is created when laser light ...
2. To produce a hologram at home ...
3. ...

Section B. The Age of Robots

Lead-in

I. Take a piece of paper and within one minute put down your associations with the word 'robot'. Compare your ideas with those of your groupmates.

II. Listen to the engineers' conversation and learn about the latest achievements in robotics.

Chief Engineer: Look, Andrew, I've got terrific news for you.

Engineer: Oh really? What is it?

Chief Engineer: We've received a grant from the government for buying new equipment for our research laboratory. I **suggest** buying a robot.

Engineer: That's a good idea. And I think we should buy a robot called ASIMO.

Chief Engineer: ASIMO?

Engineer: Yes, it's an up-to-date model capable of performing various tasks, such as walking, talking, moving different objects from one place to another.

Chief Engineer: Are there any difficulties in operating this robot?

Engineer: No, I don't think so. It's one of the latest achievements in robot technology. So there shouldn't be any problems.

Chief Engineer: And what about compiling programmes for it?

Engineer: Oh, you don't need to compile any programmes, as they are ready-made on disks. Besides, you have a possibility of switching to another programme without using **additional** controlling devices.

Chief Engineer: That sounds interesting. We'll be able to continue our research on **artificial intelligence** then.

Engineer: OK then, settled.

III. Complete the dialogues.

a) – Have you heard the news?
– ... . What is it?
– We are going to receive ... and obtain ...
– Is this robot worth buying?
– ...! It is a brand-new ...

b) – ...?

– No difficulties at all! It is the latest ...

– ... . Do you have to compile ...?

– No need. ...

– Does it require many additional devices?

– ...

– That sounds fascinating. When do we continue ...?

– ...

IV. Match a line in A with a line in B.

A	B
1. Why is this robot worth buying?	a) No need. They are ready-made on disks.
2. What can this robot do?	b) Buying new equipment for the lab.
3. What do you suggest doing with the grant received?	c) None.
4. Are there any difficulties in operating this device?	d) Without using additional devices.
5. What about compiling programmes for the robot?	e) It is an up-to-date model.
6. How do you switch from one programme to another?	f) Well, it is capable of performing various tasks, like walking, talking and moving objects.

Language Practice

Vocabulary

I. Match the words with the similar meaning.

precise	evidence
capable	surroundings
creature	able
data	one more
clever	exact
additional	to carry out
to perform	being
environment	intelligent

II. Make up all possible word combinations.

artificial	intelligence
intelligent	creature
precise	definition
dangerous	task
repetitive	environment
humanoid	robot
to imitate	humans
conscious	instructions

III. Find in B the derivatives from the words in A.

A	B
1. to supervise	– pressure, supervision, ultrasonic, suggestion
2. to exist	– exit, existence, exhibition, exactly
3. to invent	– intention, invention, infrared, internal
4. to define	– definition, defusing, despite, deformation
5. to manipulate	– medieval, man-made, manipulator, numerous
6. to repeat	– report, preparation, action, repetitive
7. to explore	– expensive, exploration, conscious, extremely
8. to sense	– suitable, considerable, sensor, intelligence

Grammar: Gerund

IV. How do you find these ideas? Use the table to make your own sentences and express your opinion.

EXAMPLE: In my opinion, the idea of performing operations in this way is quite new.

the idea the method the way the purpose the necessity the importance the technique	*of*	compiling new programmes exploring space calculating the dimensions supervising robots imitating humans using robots gathering data	is seems appeared sounds proved	very quite rather	important simple specific obvious modern necessary strange

V. a) Say if it is impossible (hard, difficult, easy, etc.) to do these things.

EXAMPLE: *to carry out underwater welding / to use robots*
It is hardly possible to carry out underwater welding without using robots.

to calculate at high speed / to apply a computer
to make further experiments / to estimate the results obtained
to control this robot / to reprogramme
to make the robot move / to use actuators
to make exact measurements / to use a laser
to apply new technologies in industry / to test them first

b) Name 5 actions we cannot live without.

VI. Do (or would) you mind doing these things? Explain why not.

EXAMPLE: *to experiment with a laser*
I don't mind experimenting with a laser because it is very interesting.

To have a robot at home; to watch the Skyworker robot in operation; to develop robotics further; to explore distant galaxies with the help of robots; to test artificial intelligence; to create a child robot.

VII. Discuss the following questions with your partner. Pay attention to the use of prepositions with gerunds.

EXAMPLE: *How did they improve the results of the first experiment?*
They improved the results of the first experiment by doing further research.

1. What are robots capable of? 2. What do some researchers insist on? 3. What are remote control devices used for? 4. What do scientists object to? 5. What have the latest developments in science resulted in? 6. What did different scientists receive the Nobel prize for?

VIII. Restore the original sentences.

1. it is worth, devices, buying, high-quality
2. on completing the test, results, found, the researcher, interesting
3. is not, compiling, a complex task, a programme
4. carrying out the test, must, the operator, before, prepare, all necessary equipment
5. insisted on, the teacher, the lab work, our carrying out, immediately
6. analysing, we, interested, this phenomenon, were, in

IX. Insert prepositions (*at, of, without, instead of*) if necessary.

1. People get tired ... doing the same work for a long time. 2. Science is worth ... developing. 3. Intelligent machines are clever ... performing various tasks. 4. What is the use ... creating playing robots? 5. You had better check the calculations ... doing another test. 6. Quick processing of information is impossible ... applying computers. 7. They suggest ... using another actuator.

X. Correct mistakes in the following sentences.

1. I know everything of their researched artificial intelligence. 2. Scientists invented a new way investigating space. 3. The engineers object carrying out the experiment. 4. He will be quite capable to do all the calculations by himself. 5. The idea of use robots for performing difficult tasks is extremely old. 6. Do you mind of my testing the new robot? 7. Without analyse evidence you will result in making mistakes.

XI. Translate the sentences into English using your active vocabulary.

1. Стоит ли покупать это оборудование? – Да, безусловно. Я даже настаиваю на его покупке. 2. Робот – это устройство, способное выполнять действия самостоятельно. 3. Если вас интересует выполнение подсчетов, вам лучше использовать персональный компьютер. 4. При анализе данных исследователи получили интересные результаты. 5. Составление программы – задача достаточно сложная. 6. Данный метод решения этой проблемы является наилучшим. 7. Это открытие привело к получению очень важных данных. 8. Вы не против, если я проведу этот эксперимент? – Безусловно, нет.

Reading and Speaking

I. These words are taken from the text. Use the dictionary to find out their meanings.

defuse, v	qualify, v
smith, n	salary, n
ashtray, n	solder, v
turn on smb, v	dull, adj
take over sth, v	teammate, n

II. You already know quite a lot about robots. Discuss the following questions with your friend.

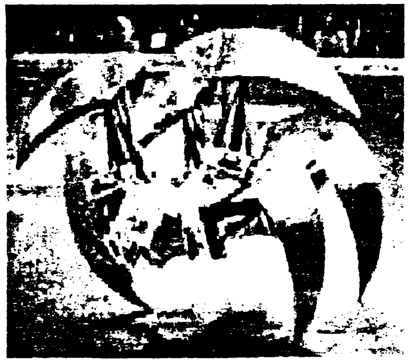
1. What is a robot?
2. What does the word 'robot' mean?

3. When did first robots appear?
4. What are the most common applications of robots today?

Scan the text to check your answers.

III. Read the text attentively to find something new about robots.

Robots in Perspective



If you think robots belong to space movies, think again. Right now, all over the world, robots are on the move. Putting chocolates into boxes, walking into live volcanoes, driving trains in Paris and **defusing** bombs in Northern Ireland are their common tasks. Today's robots are doing more and more things humans can't do or don't want to do.

The idea of creating an intelligent machine is very old. Homer described gold girls, mechanical helpers built by Hephaistos, the Greek god of smiths. In 1495, Leonardo da Vinci designed a mechanical man. But only the invention of transistors and integrated circuits in the 1950s and 1960s made real robots possible. Compact, reliable electronics and computers added brains to already existing machines. In 1959, researchers demonstrated the possibility of robotic manufacturing ashtrays.

The Czech word 'robota', meaning hard work, was first used by the writer Karel Chapek in the story where robots are invented to help people by performing simple tasks, but being used to fight wars, they turn on their human masters and take over the world.

There's no precise **definition** of a robot. It is normally defined as a programmable machine **imitating** an intelligent **creature**. Getting information from its **surroundings** and doing something physical (moving or **manipulating** objects) qualify a machine as a robot.

Name a boring or dangerous job. Somewhere, a robot is probably doing it. Robots are ideal for doing jobs that require repetitive, precise and fast movements. Robots are good at doing the same thing without asking for a safe working **environment**, salary, breaks, food and sleep, without getting bored or tired, without making mistakes. Factories are so highly automated that most human workers carry out only **supervising** and maintaining the robots.

People keep finding new uses for robots – making and packing drugs and foods, soldering tiny wires to semiconductor chips, **inserting** integrated circuits onto printed circuit boards used in electronics, working in radioactive "hot zones", **exploring** space.

All work and no play make anyone dull – even a robot. Soccer-playing robots **gather** each year at RoboCup, an international event collecting over 100 teams from 35 countries. Robotic players use radio signals to coordinate their actions with their teammates. Teams are placed in divisions based on size, ranging from the size of a pizza box. By 2050, the organizers of RoboCup **count on** developing a team of fully autonomous humanoid robots that can beat the human world champion team in soccer.

IV. Provide extensive answers to the following questions.

1. Can you prove that robots belong not only to space movies?
2. What were the first ideas of a robot?
3. Why did real robots appear only in the late 50s?
4. Who coined the word 'robot'?
5. What is the idea of K. Chapek's story?
6. Why is there no exact definition of a robot?
7. What two factors determine a robot?
8. Have robots replaced man in all kinds of activities?
9. What are the basic applications of robots? Where else can they be used in the future?
10. How do robots play soccer?

V. Will you agree to these statements? Give reasons for your opinion.

1. Right now, all over the world, robots are on the move.
2. The idea of creating an intelligent machine is very old.
3. Name a boring or dangerous job. Somewhere, a robot is probably doing it.
4. All work and no play make anyone dull - even a robot.
5. Robots will replace professional sportsmen in the future.
6. Robots must not be allowed to compete with humans.

VI. Have you heard that robots turned out to be dangerous for man. Nevertheless, robots are found increasingly replacing man in various activities. Discuss the problem with your partner who has a different opinion. Can you reach a compromise?

The optimist: you believe robots are safe, useful and have a great future.
The pessimist: you do not like the idea of artificial mind and find robots too dangerous to be developed and applied further.

You can begin like this:

– Hello, ... Why are you so happy?
– Haven't you heard the news? We have got a brand-new robot for our lab!
– Oh ...

Further Reading

I. These words are taken from the text. Use the dictionary to find out their meaning.

ultrasonic, adj	corresponding, adj
navigate, v	exposure, n
infrared, adj	response, n
gearbox, n	detect, v
linear, adj	pursue, v

II. Look at the photos attentively. What is the text going to be about? Skan the text to find answers to these questions.

1. What kind of machine is a robot?
2. What can a robot sense?
3. What are the functions of the light sensors?
4. How does a robot 'see'?
5. What is the difference between a robot and a computer?
6. Is the actuator a device for thinking?

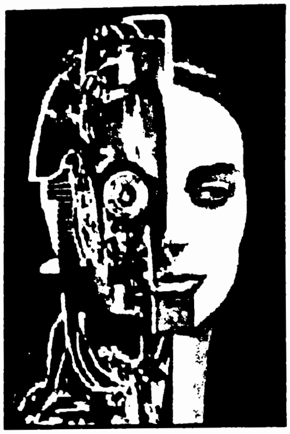
III. Read the text more attentively to learn more about robots.

Advances in Robotics

A robot is a machine that **gathers** information about its **environment** (**senses**) and uses that information (thinks) to follow instructions to do work (**acts**).

Imitating humans, robots also **sense** magnetic fields and **ultrasonic** waves. Robotic light sensors work by creating or changing an electric signal when light falls on them. When **navigating**, the robot sends out a beam of infrared light, which bounces off objects and returns to a light sensor of the robot. However, making 3D images requires large amounts of computer memory.

The **ability** to move sets robots apart from computers. A mechanical device for producing motion is known as an actuator. A single robot is supplied with dozens of actuators, each chosen to do a specific task. Electric motors are actuators that produce motion from electricity by the electromagnetic effect. Their high speed and a small turning power make a gearbox necessary. Special **stepper motors** turning in precise 'steps' are ideal for adjusting position. A **servomotor** is used for turning only 90° to the right or left. If you've ever driven a toy car, boat, or plane by **remote control**, a ser-



vomotor was probably responsible for the steering. **Solenoids** are electric motors for producing **linear**, or in-and-out motion. Solenoids are used in switches turning things off and on. Although making a robot move like a person is not easy, engineers at Honda have designed robots capable of walking, climbing stairs and keeping their balance – no two-legged robot has ever done it before.

How to make robots think? There are three **approaches** to **artificial intelligence**.

Most robots have a microcomputer for 'brains', which allows programming a lot of information. But they work only according to their programme and cannot learn. **Neural networks** are modelled after the human brain. A neural net 'learns' by exposure to lots of input and corresponding output. Once trained, the neural net **responds** to an input with a likely output. Unlike **rule-based systems**, neural networks are incapable of giving definite answers. **Stimulus-response robots** pioneered by Rodney Brooks at MIT have no memory and no logical decision-making – only hard-wired responses to stimulation.

Can a robot be **conscious** in the way that we are? So far, no artificial intelligence has ever shown such signs of life. However, if robots **eventually** think like us, detect and express emotions, pursue their own interests and even make copies of themselves, drawing the line between machines and living things will be increasingly difficult.

IV. What is necessary to create moving robots? Fill in the table with the data from the text.

Mechanism	*Function*
actuator	

V. Will you agree with the following statements? Give your reasons.

1. It is impossible to create thinking machines. 2. The three approaches to artificial intelligence are all imperfect. 3. 'Computer brains' have numerous disadvantages. 4. Neural networks are modelled after the human brain but they are worse than rule-based systems. 5. Stimulus-response robots 'live

and learn' like children. This makes them dangerous as it is difficult to foresee their reaction and they can get too clever.

VI. You are taking part in the students' conference devoted to the latest achievements in technology. Deliver a report on the topic 'Robots – humans with artificial intelligence'.

Activity

I. Most people find robots dangerous. They have good reasons to think so. How will you comment on the idea of this paragraph? Would you like to have such a future?

Silicon-based life forms are seen by some as the next step in evolution, replacing carbon-based life forms like us. Robots becoming more intelligent and capable, we can soon be out of control. However, if robots do develop consciousness, they may also develop conscience and choose to be kind to their human creators. In the meantime, we may want to remember where the 'off-switch' is ... just in case.

II. Robotics is a quickly developing science. It certainly brings advantages but also puts difficult questions. Here are some of them. Discuss these questions in small groups.

1. If in the future machines have the ability to think, be conscious and have feelings, then what makes a human being a human being, and a robot a robot?
2. Would you like to have a robot to do any task you like or do not want to do yourself? If yes, how do you think this can affect you as a person?
3. Are there any kinds of robots that shouldn't be created? Why?
4. Do you think the development of new technologies, and their application, are inevitable? Should we do anything for the people who will lose their jobs when replaced by robots? If yes, what?
5. Do you think a special law on robots must be made? Will you agree with these *Three Laws of Robotics*, 'created' by Isaak Asimov?
   a) A robot may not injure a human being or, through inaction, allow a human being to come to harm.
   b) A robot must obey the orders given to it by human beings, except where such orders conflict with the first law.
   c) A robot must protect its own existence, as long as this does not conflict with the first two laws.

Writing

I. Study the example and write your own advertisement of a new model of a robot.

A Robot's Best Friend

Tired of walking your dog and finding its hair everywhere? Sony's robotic dog, AIBO, may be for you.

AIBO is a totally autonomous robot capable of hearing and seeing, sensing balance and touch. Eighteen specialized motors allow such dog-like motions as rolling over, scratching, playing dead, and chasing a pink ball.

Like a puppy, with time and training AIBO develops perfect movements and unique behaviour patterns. Programmed to seek companionship, AIBO simulates emotions like happiness, surprise, and anger and is clever at responding to verbal commands.

DANGERS OF NEW TECHNOLOGIES

Section A. Laser

Lead-in

I. Discuss the following questions.

a) What is a laser? Where are lasers applied?
b) Are lasers dangerous? If so, give your reasons.

II. Listen to the conversation and learn what a laser is and how it works.

Teacher: Hello, my friends. Today, I'm going to show you an operating laser.
Ivan: That's great! By the way, what does the word 'laser' **mean**?
Teacher: It **denotes** light **amplification** by stimulation of emission of radiation. Looking at the operating laser one can see it producing a very powerful beam of light.
Ivan: When did the first lasers appear, I wonder?
Teacher: As far as I know, in the 1960s. Yet, we hear of their having numerous applications. Industrial welding, cutting materials, making measure ments, etc. will be practically impossible without this device.
Ivan: And how do lasers work?
Teacher: Their work is based on the principle of **amplifying** the light of a certain **wavelength** in the **resonator cavity**.
Ivan: I'm rather interested in making experiments with laser beams.
Teacher: Then let's try to make one. But be very careful. Lasers can be very dangerous.
Ivan: Why are they dangerous?
Teacher: Well, they produce a very powerful beam of light and if **treated** in the wrong way it can hurt or even kill you.
Ivan: Oh, I'm pretty scared.
Teacher: Don't worry. If you follow all the safety instructions, nothing will happen to you.

III. Complete the dialogue.

– We are going to ..., aren't we?
– ... . But first, I'd like you ... questions. To begin with, ...?
– The word 'laser' ...
– OK. Then ...?
– A very powerful ...
– The first ..., ... they?
– No, you are ... . They appeared about ... ago.
– And ... many uses?
– Without any doubts. ...
– I also would like you ...
– Oh, that is easy . ... is in the basis of laser operation.
– I see. Why are lasers considered ...?
– ...
– That's pretty scary.
– ...
– Fine.

IV. Match a line in A with a line in B.

A	B
1. Are lasers amplifiers or oscillators?	a) It is a device for increasing the strength of a signal.
2. What is an oscillator?	b) Welding, cutting, holography.
3. What is an amplifier?	c) It is a generator or source of light.
4. What makes lasers dangerous?	d) Oscillators.
5. What are lasers used for?	e) When treated inadequately.
6. When does the laser become a source of destruction?	f) Their producing an extremely powerful beam of light.

Language Practice

Vocabulary

I. Match the words with their definitions.

1. laser, n	a) to send out heat, light, sound
2. behaviour, n	b) in only one colour
3. cavity, n	c) the larger number or amount

4. majority, n
5. amplifier, n
6. to emit, v
7. monochromatic, adj

d) an apparatus for producing a very hot narrow beam of light used for cutting metals
e) acting in a particular way
f) a hole or hollow space in a solid mass
g) an instrument for making a signal stronger

II. Match the words with the similar meaning.

synthetic	feature
exactly	powerful
characteristic	usage
application	to offer
to suggest	to possess
single	artificial
strong	precisely
to have	separate

III. Find in the list these parts of speech.

(noun) amplify, weak, absorption, to treat
(noun) partially, excited, bounce, pulse
(adjective) activate, solution, flat, principle
(adjective) tiny, purify, majority, totally
(adverb) intense, forth, numerous, since
(adverb) powerful, infrared, exactly, cavity
(preposition) input, actually, via, ultraviolet
(verb) radiation, synthetic, reflective, manipulate
(verb) emit, unique, oscillator, quality

Grammar: Gerund and Participle I

IV. Continue the sentences in two possible ways.

EXAMPLE: *experimenting with lasers*
Experimenting with lasers <u>is very dangerous</u>.
Experimenting with lasers <u>you must observe</u> safety rules.

1. Studying industrial gases ...
2. Playing volleyball with robots ...
3. Discovering new worlds ...
4. Converting the energy of wind into electricity ...
5. Travelling at the speed of light ...
6. Applying laser technologies ...

V. These sentences have a different structure but the same meaning. Change the structure of the sentences below so as to keep their meanings.

EXAMPLE: *To make a hologram is rather difficult.*
Making a hologram is rather difficult.

1. To produce a powerful beam of light is possible with the help of a laser. 2. To recognize a problem is the first step to its solution. 3. To establish relationship between natural phenomena is a major task of his theory. 4. To introduce the invention into practice sometimes requires more effort than making it. 5. To point out the mistakes to some people proves quite difficult. 6. To analyze the evidence correctly requires a lot of attention.

VI. Shorten these sentences but do not change their meanings.

EXAMPLE: *Having made a hologram we drew up a laboratory report.*
On (after) making a hologram we drew up a laboratory report.

1. Having recognized the problem the scientist tried to find its solution. 2. Having changed the light spectrum we received another hologram. 3. Having invented the laser man expanded his possibilities. 4. Having studied the specific features of a new laser we put it into operation. 5. Having considered all the factors the engineers changed the whole system. 6. Having applied the laser at the works we increased the production dramatically.

VII. What is the difference between these things? Ask your partner for explanations.

EXAMPLE: *boiling point / boiling water*
A: – Peter, could you tell me what the boiling point is?
B: – Sure. It's the temperature at which the liquid boils.
A: – And what is boiling water?
B: – Oh, it's quite simple. It's the water that boils.

1. building block / building crane
2. melting point / melting metal
3. driving license / driving man
4. cooling system / cooling surface
5. reading material / reading students
6. working conditions / working device

VIII. Restore the original sentences.

1. without being helped, the laser, won't succeed, in testing, he
2. a laser, in making, should use, you, a hologram
3. man, having invented, is capable of, the laser, light shows, successfully, producing

4. became possible, after the appearance, making holograms, in the 1960s, of a laser

5. all his knowledge and experience, applied, this work, doing, he

6. will provide, applying, another solution, the new device, to the problem

IX. Translate the sentences into English using your active vocabulary.

1. Имея разные уровни энергии, электроны нижних уровней могут переходить на более высокие путем поглощения света или тепла. 2. Без использования лазера голограмма невозможна. 3. Используя новый метод, они изменили спектр света. 4. Получение мощного луча возможно только с помощью лазера. 5. Проводя эксперименты с лазером, профессор объяснял студентам принцип его работы. 6. Выполнение этой работы требует опыта. 7. Учет отдельных компонентов изменит всю систему. 8. Что такое 'melting substance'? – Это вещество, которое плавится. А 'melting point' – это точка плавления.

Reading and Speaking

I. Practise reading these words.

coherence [kəʊ'hɪərəns]
wavelength ['weɪvleŋθ]
characteristic [ˌkærɪktə'rɪstɪk]

II. Lasers appeared not long ago but we find it immensely difficult to imagine our life without them. What do you know about the history of lasers? When did they appear? Who constructed the first-known laser? What materials produce laser action? Scan the text to get the answers to these questions.

III. Study the text for more detailed information about lasers.

The Past and the Future of the Laser

A laser is a source of light but **unlike** anything that had ever been seen before 1960 when Theodore H. Maiman of Hughes Aircraft placed a specially prepared synthetic **ruby** rod inside a powerful **flash lamp similar to** the type used for high-speed photography. Activating the flash lamp produced an **intense pulse** of red light, which possessed the unique properties of monochromicity (the light is of the same **wavelength** or colour), **coherence** (all the waves move precisely in step), and **directionality** (the beam can be easily manipulated). These features account for the enormous difference between the output of a laser and that of an incandescent light bulb.

With Maiman's invention the laser age was born. Everybody became interested in exploring this promising **area** of science. Within a very short time, numerous solid-state materials, gases, liquids, and semiconductor crystals were found possessing laser qualities. Almost every imaginable material was tried in order to produce new and interesting lasers. Even some **varieties** of jelly brand dessert were announced emitting xenon light, and according to this legend, they are supposed to work fairly well.

In many ways, the laser was a solution looking for a problem. Well, the problems soon followed in great numbers. It would be hard to imagine the modern world without lasers. They are used in everything from CD players to laser printers, fibre-optics and free-space communications, industrial cutting and welding, medical and surgical treatment, holography and light shows, basic scientific investigations in **dozens** of fields, including Star Wars weapons research. The unique characteristics of laser light make these and numerous other applications possible. In fact, it is safe to say that the vast **majority of** laser applications have not yet even been suggested.

However, if **treated** inadequately, an extremely powerful beam of laser light can be a source of **destruction**. You must never stand in the way of the cutting laser beam. Only by looking directly into the beam or its reflection from a shiny object you can damage your eyes. Besides, laser power supply being typically 2500 V or more, a qualified person must provide external power supply, as ordinary insulation is not enough. Thus, no matter how advantageous and useful they are, lasers *are* dangerous. Hence, safety rules must be strictly observed.

IV. Provide detailed answers to these questions.

1. What is a laser? What other sources of light do you know? 2. What was the first laser like? 3. Does the laser possess any unusual properties? What are they? 4. When did the laser age begin? 5. Many substances produce laser light, don't they? 6. Were there any surprising discoveries? 7. Why is it difficult to imagine our life without lasers? 8. What are the most common uses of lasers? 9. Why are lasers considered dangerous?

V. Explain what the author means by the following statements.

1. A laser is a source of light but unlike anything that had ever been seen before 1960. 2. With this invention the laser age was born. 3. According to this legend, they are supposed to work fairly well. 4. In many ways, the laser was a solution looking for a problem. 5. In fact, it is safe to say that the vast majority of laser applications have not yet even been suggested. 6. If treated

inadequately, an extremely powerful beam of laser light can be a source of destruction.

VI. Complete the gaps with suitable words from the box.

wavelength	destruction	applications	safety
liquids	intense	powerful	features
coherence	semiconductor		

A laser is a source of monochromatic, directional and coherent light. Monochromicity means light of the same ... or colour. Light waves travelling precisely in step explain the property of ... . Besides, the laser beam can be easily manipulated. These unusual ... make laser light unique. The first laser consisted of a specially prepared synthetic ruby rod and a ... flash lamp. During the experiment the researchers observed an ... pulse of red light. Later solid-state materials, gases, ... and ... crystals were recorded having laser qualities. Lasers are considered to be a multibillion-dollar industry having numerous ... such as cutting and welding. However, lasers can be the source of both construction and ... . That is why ... rules must be strictly observed.

VII. You have visited a very interesting exhibition on the applications of lasers. Your friend could not go with you and now he is interested in everything you saw or heard. Share your impressions with him and persuade him to visit this exhibition.

You can start like this: – Hello, Peter. I hear you have visited a laser exhibition. Is that true?

– Certainly! And I must say it was worth visiting. ...

VIII. What information have you received from your friend? Would you like to visit this exhibition? What do you expect to see there?

Further Reading

I. Practise reading these words.

oscillator [ˌɒsɪ'leɪtə]
excited [ɪk'saɪtɪd]
spontaneous [spɒn'teɪnjəs]
behaviour [bɪ'heɪvjə]
via [vaɪə]

II. Match the English words and expressions with their Russian equivalents.

1. light amplification	a) усилитель
2. spontaneous emission	b) вынужденное излучение
3. stimulated emission	c) излучение; радиация; испускание
4. radiation	d) спонтанное излучение
5. oscillator	e) усиление света
6. amplifier	f) возбужденная частица
7. ground state	g) генератор
8. population inversion	h) высший энергетический уровень
9. excited particle	i) основное (квантовое) состояние
10. upper energy level	j) инверсия заселённости (энергетических уровней)

III. Do you remember what the word 'laser' means? Read the text and learn how lasers work.

How Lasers Work

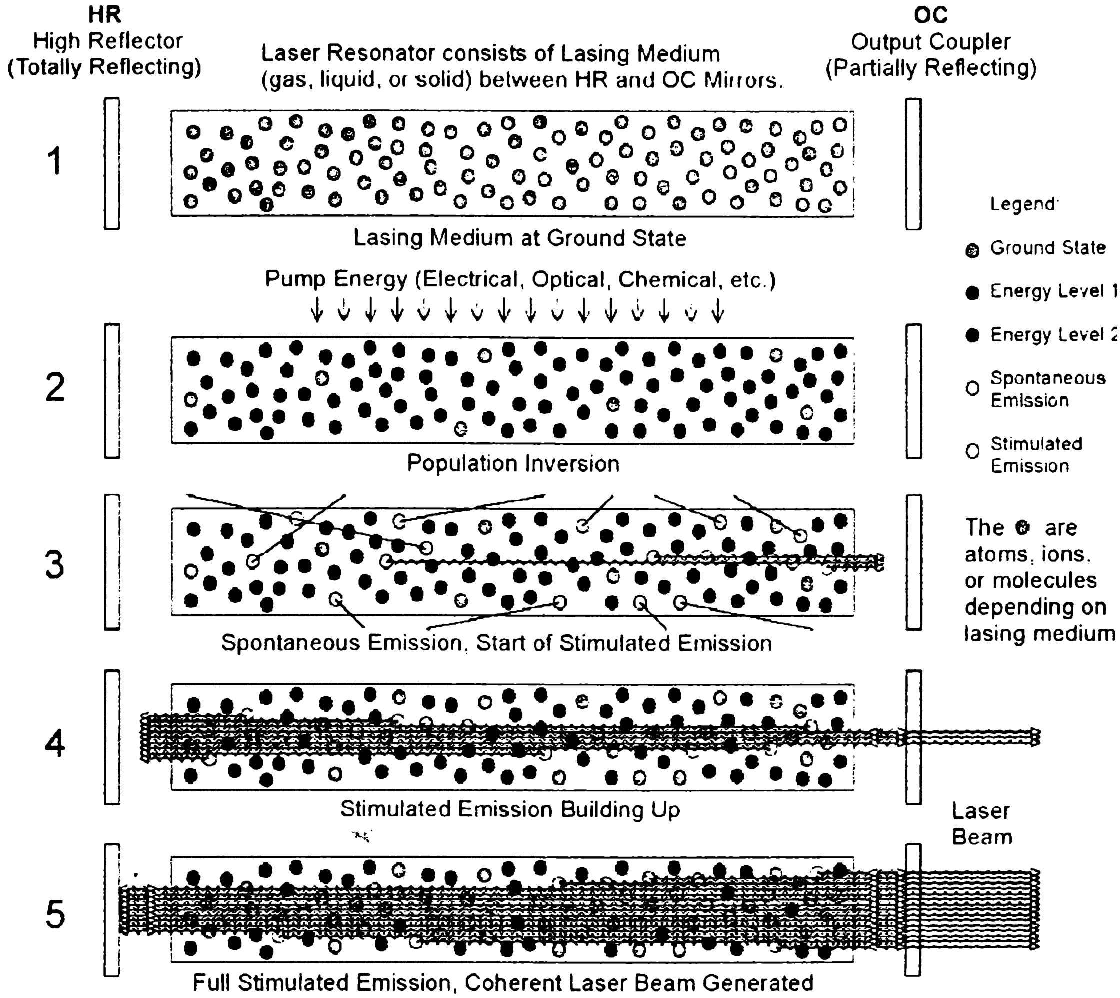
The word 'laser' is an acronym standing for light amplification by stimulated emission of radiation. This is not exactly so since most lasers are actually **oscillators** (generators or sources of light) and not **amplifiers** (devices for increasing the strength of a signal), though such lasers are also possible and used for some applications. However, nearly all lasers have the following in common:

1. A lasing **medium**. This can be a solid, liquid, gas, or semi-conductor material, which can be pumped to a higher energy state.

A means of pumping energy into the lasing medium can be: optical, electrical, mechanical, chemical, etc.

2. A **resonator** consisting of a **cavity** with a pair of mirrors (**flat** or **concave**), one at each end of the laser for making stimulated light **bounce back and forth** through the lasing medium. One of the mirrors is **totally reflective**, the other being **partially transparent** to allow the laser beam to escape.

Lasers are based on a simple principle of atomic **behaviour**. Normally, nearly all atoms, ions, or molecules (depending on the particular laser) of the lasing medium are at their lowest energy level or 'ground state' (1). To produce laser action, the energy-pumping device must achieve population **inversion** through driving the majority of particles to the **upper** energy level (2). Sometimes dropping to the 'ground state' the **excited** particle emits a single photon of light. This is called 'spontaneous emission', not exactly useful, although causing the glow of a neon sign or the phosphor coating of a fluorescent lamp



Basic Laser Operation

(3). Yet Einstein showed that a photon emitted nearly parallel to the direction of the resonator (3,4) will bounce back and forth many times stimulating excited particles along the way to lose the photons possessing three exactly the same qualities: **wavelength**, phase and direction. The tendency progresses resulting in the photons flow increasing **via** this 'stimulated emission' process (5). The resulting beam can be **pulsed** or **continuous**; visible, infrared or ultraviolet; less than a milliwatt – or millions of watts of power. It has the unique properties of being highly monochromatic, coherent and easily manipulated – something impossible with more common light sources.

There you have it! Everything else is just details.

IV. Explain the meaning of these words and expressions.

laser, oscillator, amplifier, photon, 'ground state', 'spontaneous emission', 'stimulated emission'

V. Give detailed answers to these questions.

1. Why is the acronym 'laser' not very exact? 2. Do lasers have a common structure? 3. What lies in the basis of laser operation? 4. The lasing medium consists of various particles, doesn't it? 5. What are the stages of emission? 6. In what condition are the particles found normally? 7. Why is it necessary to move the particles to the upper energy level? 8. When do excited particles lose photons? 9. How does the massive flow of photons begin? 10. What is the output of the laser?

VI. What does the laser consist of? Complete the table with the data from the text.

Laser Part	*Function*
...	...

VII. You are at the Great Laser Show with your friends. One of them gets interested in how lasers work. What basic information will you give him?

Activity

I. Your friend is not attentive at the lesson and has understood nothing about lasers. At the end of the lesson the teacher suddenly gives a test. Your friend has some questions about laser structure and operation. Help him to pass the test.

II. <u>Discussion.</u> Lasers are certainly part of our life. However, like many other things they are not perfect. What are advantages and disadvantages of lasers? Do you think all laser technologies should be developed? What are the potential dangers of lasers?

III. Solve the crossword.

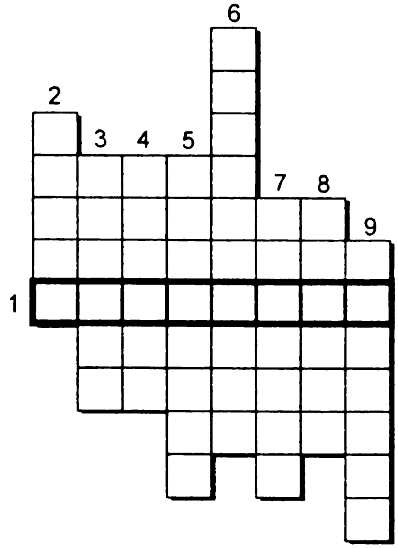
Across:

1. it is measured with the help of a laser

Down:

2. substances can be gassy, liquid and ...
3. part of a resonator

4. if the supply of energy is not maintained, the laser beam becomes ...
5. an atom / ion / molecule
6. a generator or a source of light
7. opposite to 'flat'
8. it is necessary to ... a particle in order to make it lose a photon
9. the function of a mirror is to ... objects



Writing

I. Write two paragraphs, one about advantages, the other about possible dangers of lasers.

Section B. Industrial Gases

Lead-in

I. Discuss the following questions.

a) How do we depend on gases? What gases do you know?

b) What is air pollution? What are the causes and possible consequences of air pollution?

II. Listen to the conversation and say what you have learnt about the industrial gases.

Teacher: Pavel! Where are Nick and Olga?
Pavel: I'm afraid they are late.
Teacher: I insist on both of them coming on time. We can't work like this.
Pavel: And what are we going to do today, I wonder?
Teacher: We'll speak about some **industrial gases** and their properties.
Pavel: And what are industrial gases?
Teacher: Well, these gases are used in industry in making various products.

Pavel: Are these gases **natural**?

Teacher: Well, some of them, such as **oxygen**, **nitrogen** etc. are found in **free state** in the air. Others are man-made, like freon, which is used in welding.

Pavel: I suppose they have a very wide range of applications.

Teacher: You are quite right. The importance of using them can hardly be **overestimated**. However, gases are not only part of the industrial process. They also pollute the environment. Do you know what problems air pollution causes?

Pavel: Certainly. I've heard a lot about **acid rains**, the **greenhouse effect**, the ozone **layer depletion**.

Teacher: Very good. Well, Nick, here you are at last.

Nick: Sorry for being late, sir.

III. Complete the dialogues.

a) – Olga, ...?
– It's past 12, sir. I'm sorry for ...
– It's OK, but I insist on ...
– ...

b) – ..., I'd like to know?
– First, I'm going to tell you ...
– It sounds interesting. Are they used for ....?
– ...

c) – Do industrial gases pollute the environment?
– ...
– What problems ...?
– Well, the hottest problems are ...

IV. Match a line in A with a line in B.

A

1. I'm sorry for being late.
2. I insist on your coming on time.
3. Scientists object to chlorofluorocarbons being used in industry.
4. Where is helium used?
5. Are all pollutants man-made?
6. How does the excess of nitrogen in the air influence the ecosystems?

B

a) It results in destructing the biological balance of the soils and water (eutrophication).
b) They have serious reasons.
c) I hear of natural pollutants being sent into the atmosphere for billions of years.
d) Sorry, sir.
e) In arc welding.
f) It's OK.

Language Practice

Vocabulary

I. Match the words with the opposite meaning.

the same	to clean
natural	non-flammable
colourful	man-made
flammable	abundant
toxic	dioxide
to pollute	non-toxic
monoxide	colourless
rare	different

II. Make all possible word combinations.

industrial	rain
natural	effect
solar	gases
combustible	state
air	radiation
fossil	pollution
acid	pollutants
greenhouse	fuels

III. Find in each line the derivative from the first word.

1. perform – performance, form, super, robot
2. exact – object, extra, exactly, react
3. object – inject, subject, objection, substance
4. danger – development, average, discovery, dangerous
5. experience – science, experiment, inexperience, excess
6. pollute – populated, pollutant, depletion, protective
7. measure – metallurgy, absorption, measurement, damage

Grammar: Gerundial Constructions

IV. Join two sentences into one. Pay attention to the use of prepositions.

EXAMPLE: *Nitrogen is used in metal industry. We know that.*
We <u>know of nitrogen being used</u> in metal industry.

1. Silver and copper are very good conductors of electricity. We are aware of that. 2. Freon destroys the ozone layer. We are afraid of that. 3. Robots will replace men. The idea of that goes back to ancient times. 4. Alice was making that hologram without any help. I was surprised at that. 5. The students should study the properties of carbon. The professor insists on that. 6. Radioactive carbon should be used to date ancient things. The scientists recommend that.

V. Rephrase the following questions and let your friend answer them. Use the prepositions where necessary.

EXAMPLE: *Do you mind if I use your computer?*
– Do you mind my using your computer?
– No, I don't. You can use it whenever you want.

1. Would you mind if they create an intelligent robot? 2. Do you mind if I make a report on air pollution? 3. Do you insist that we should sign the Clean Air Act? (on) 4. Will they object if I use the laser without asking for their permission? (to) 5. Do you believe that we will restore the ecological balance on the planet? (in) 6. Are you sorry that you are late? (for)

VI. Open the brackets and use the gerund in the Active or Passive Voice.

1. Nobody is surprised at his (to receive) the Nobel prize for his discoveries in optics. 2. We are interested in new technologies (to develop). 3. Environmentalists insist on our (to cut) releases of CO_2 into the atmosphere. 4. We hear of gases (to apply) to produce the flame temperature of 6,000 °F. 5. I object to acetylene (to mix) with air in the workshop. 6. We are against transport (to pollute) the atmosphere. 7. The inventor made a report on the laser (to use) in surgery.

VII. Restore the original sentences.

1. being cheap, the air, used, is, because of, in welding
2. steel, oxygen, being used, we know of, in making
3. has the merit of, the device, being reasonably up-to-date
4. does not mind, the student, being helped
5. our, objects to, the professor, carrying out the experiment
6. aircraft, is capable, lifting, helium, of

VIII. Correct mistakes in the following sentences.

1. Do you believe in life exist on other planets? 2. Would you mind my lating? 3. We insist their buying this robot. 4. He spoke about distant galaxies be observed through a telescope. 5. They are interested in materials producing

without losses of energy. 6. If you do not observe the readings, you will result in the device being break. 7. I don't mind be helped if you do not mind helping me.

IX. Translate the following sentences paying attention to different forms of the gerund.

1. I require thermal power stations being closed because of their damaging the environment. 2. We hear of biosilk having been invented. 3. Newspapers report of acid rains having destroyed life in several Swiss lakes. 4. Global warming will cause polar ice melting. 5. It is difficult to imagine robots having explored ocean depths autonomously. 6. I know of toxic gases having been used during the last experiment. 7. I am sure of having read this article earlier. 8. Safety rules insist on acetylene being stored in the liquid state under pressure.

X. Translate the sentences into English using your active vocabulary.

1. Он не возражает против того, чтобы роботы выполняли эту опасную работу. 2. Мы знали, что воздух используется в металлургии. 3. Крупные фирмы настаивают на том, чтобы роботы заменили человека. 4. У студентов возникли трудности при определении свойств фреона. 5. Он отвечает за то, чтобы работа была закончена своевременно. 6. Вы можете рассчитывать на то, что он дает вам точную информацию. 7. Он жаловался на то, что я очень медленно работаю. 8. То, что он составил программу так быстро, было приятным сюрпризом.

Reading and Speaking

I. Practise reading these words.

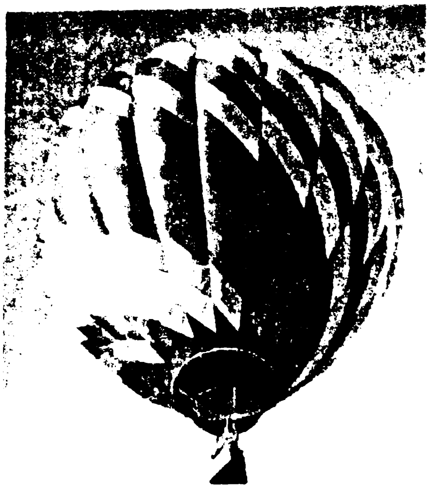
nitrogen ['naɪtrɪdʒən]
ultraviolet ['ʌltrə'vaɪəlɪt]
dioxide [daɪ'ɒksaɪd]
chlorine ['klɔ:ri:n]

II. Our manufacturing industry strongly depends on gases. Look through the text and enumerate the industrial gases, mentioned there.

III. Read the text attentively for more information about industrial gases.

Industrial Gases

We know of many gases used in industry for making various products. They are called **industrial gases**. Some of them are **man-made** and some are found in their natural state. Let us consider the most important ones.



Colourless, **odourless**, **tasteless**, **non-toxic**, and **non-flammable**, **nitrogen** has many uses, including glass making, food conserving, preventing semiconductors from oxidation.

Oxygen is the second largest volume industrial gas used in producing steel, building bridges and making electric equipment.

Being the most **abundant** element (98%) in the universe hydrogen has almost as many industrial uses as nitrogen and oxygen. It is needed in metal industry, in food industry for preparing margarine and in oil processing. Also, power stations depend on hydrogen cooling their high-speed turbine generators.

Can you imagine your life without eating ice-cream, spraying deodorants, drinking sodas, and fire fighting devices? All these things are possible due to carbon **dioxide**.

Some people believe that balloon flying is for children. Still, helium is a serious gas capable of rays detecting and aircraft lifting. It is also used in arc welding.

It is impossible to imagine present-day life without air conditioning, refrigerators, spraying aerosols, and **packaging foam** for the TV or VCR. However, freon, necessary for making these common things, is found **depleting** the **ozone layer,** which protects us from the **destructive** solar ultraviolet radiation. That is why scientists all over the world **insist on** fluorocarbon **refrigerants** being **banned**.

Argon is a noble gas comprising 0.98% of the atmosphere and forming unknown chemical **compounds**. Colourless, odourless, tasteless and non-toxic, argon is mainly used in producing high-quality welding in stainless steel and aluminium industry.

Chlorine gas is very toxic; nevertheless it protects us from falling ill by purifying drinking and swimming water. It also takes part in making many chemicals, including **solvents**, plastics, rubbers and pesticides.

Water-based paints and vinyl records are made with the help of acetylene, which has many other applications. Stored in a liquid state it is also used as a fuel producing a large amount of heat and the highest flame temperature (about 6,000°F, or 3,300°C) of any known mixture of **combustible** gases. When burnt with the correct amount of air, acetylene gives a pure white light. For this reason it was once used for illuminating places where electric power was not available.

The air itself is used as an industrial gas. It acts as a protective **envelope** for metals during the welding process because it does not react chemically with these metals or other elements.

IV. Try to complete the table without looking into the text. Compare your table with that of your partner.

Gas	*Properties*	*Application*
...	...	...

V. Complete the sentences with suitable words from the box.

rubbers	foam	acetylene	toxic
helium	dioxide	man-made	noble
non-flammable	air	oxygen	odourless

Gases used in industry for making all kinds of products are known as industrial gases. They can be classified as natural and ... . The examples of natural gases are nitrogen, ..., and hydrogen. The first largest industrial gas is nitrogen. It is colourless, tasteless, ..., ... and non-toxic. Breathing and combustion are impossible without oxygen. Hydrogen is the most abundant gas in the universe. Carbon ... is used in producing lemonades and conserving food. Balloons are normally filled with ... . The gases depleting the ozone layer are known as fluorocarbons. They are necessary in air conditioning, refrigeration and making packaging ... . Argon is a ... gas applied in welding. Chemicals, such as solvents ..., plastics, and pesticides are available due to chlorine, which is a very ... gas. Water-based paints and vinyl records are made with the help of ... that is also known for producing an extremely hot flame. Even the ... is used as an industrial gas because it will not react chemically with any elements.

VI. Devise a questionnaire on the topic "Industrial Gases". See if your friend can answer all the questions.

VII. What data does the text provide? Have you learnt any new things? Do you think the use of fluorocarbons should be reduced? Is it possible to reduce it?

Further Reading

I. Practise reading these words.

volcanoes [vɒl'keɪnəuz]
eutrophication ['jutrəfɪ'keɪʃən]
consequence ['kɒnsɪkwəns]
depletion [dɪ'pli:ʃən]

II. These words are taken from the text. Use the dictionary to find out their meanings.

ash, n	soil, n
stir, v	vegetation, n
rot, v	chlorofluorocarbons, n
blanket, v	face, v
far-reaching, adj	prospect, n

III. Discuss the following questions with your partner.

1. Why is air pollution considered a global problem today?
2. What are the consequences of air pollution?
3. Is it possible to minimize the bad consequences of air pollution? If so, how?
4. Are all air pollutants man-made? Give examples.
5. Is there a problem of air pollution in your country?

IV. Gases are not only a component of the industrial process. They are also its result. Unfortunately they often produce a damaging effect on the environment. Read the text attentively to learn more about air pollution.

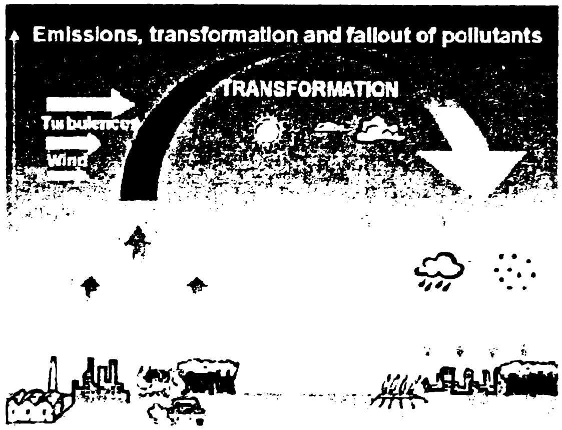
Air Pollution as the Major Problem of the Day

Since the 19th century we are getting increasingly worried about industry polluting breathing air in **densely populated** cities where the great majority of people live.

Not all air **pollutants** are **man-made**. For billions of years the air has been polluted by volcanoes throwing out tons of ash and smoke, dust stirred by the wind, gases given off by growing plants or by rotting animal and vegetable matter, salt particles from the oceans, etc. However, having discovered fire man added much to **natural** pollutants by burning fossil fuels. Sherlock Holmes for example, observed London *pea-soupers*[1], blanketing the city for days. That's because Londoners used soft coal for heating their houses.

Let us review what we know about combustion. All fossil fuels naturally contain hydrogen, carbon and sulphur, **present** in plants and animals. Uniting with oxygen during combustion these gases **result in** forming water and **releasing** carbon monoxide, carbon dioxide and sulphur dioxide. Besides, oxides of nitrogen are produced in the air whenever there are high temperatures, *be it*[2] a car spark or a lightning stroke. These natural processes have **far-reaching consequences**.

The oxides **reacting** with water in the air produce carbonic, nitric, nitrous, sulphurous and sulphuric **acids**. **Acid rains** have damaging effects on materials and the **environment**. An excess of nitrogen in the air, greater than the ecosystems are able to absorb results in destroying the biological balance of the soils and water (**eutrophication**). In the layers of the air close to the ground photochemical (photo-oxidizing) pollution causes the formation of 'bad ozone', called so because of its destructing effect on human health and vegetation. And vice versa, the 'good ozone' protecting us from solar **ultraviolet** (UV) radiation in the stratosphere is being depleted by NO (mainly from traffic) and by chlorofluorocarbons. The **ozone layer depletion** has damaging effects on human health and environment.The **greenhouse effect consists in** atmospheric gases (CO_2, CH_4, O_3, N_2O, CFCs) absorbing **infrared** (IR) radiation, reflected from the surface of the earth. When not reflected back into space the energy is absorbed and transformed into heat. Without the natural greenhouse effect the **average** temperature on the earth *would be*[3] –18 °C. However, since the industrial revolution, he concentration of greenhouse gases proves increasing. Thus, today we are facing the prospect of global warming with all its unpleasant consequences.



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[1]лондонские желтые туманы, [2]будь то, [3]была бы.

V. Say if the following statements are true or false. Correct the false statements.

1. Everybody is concerned with air pollution today.
2. Large cities seem to be the most highly polluted places.
3. All air pollution is due to man's activities.
4. A 'pea-souper' is the name for a person who is fond of eating pea soups.
5. Smog means *smoke* + *fog*.
6. The process of oxidizing is known as combustion.
7. Combustion causes problems because of the oxygen released into the atmosphere.

VI. What environmental problems does air pollution cause? Fill in the table.

Problem	*Pollutants*	*Cause*	*Consequences*
...	...	...	...

VII. Complete these sentences with suitable words from the box.

1 dioxide	4 aircraft lifting	7 refrigerators	10 ordourless
2 helium	5 arc welding	8 orone layer	11 tasteless
3 des tructive	6 noble gas	9 radiation	12 rubbers

Can you imagine your life without eating ice-cream, spraying deodorants, drinking sodas, and fire fighting devices? All these things are possible due to carbon ... .

Some people believe that balloon flying is for children. Still, ... is a serious gas capable of rays detecting and ... . It is also used in ... . It is impossible to imagine present-day life without air conditioning, ..., spraying aerosols, and packaging foam for the TV or VCR. However, freon, necessary for making these common things, is found depleting the ..., which protects us from the ... solar ultraviolet ... . That is why scientists all over the world insist on fluorocarbon refrigerants being banned.

Argon is a ... comprising 0.98% of the atmosphere and forming unknown chemical compounds. Colourless, ..., ... and non-toxic, argon is mainly used in producing high-quality welding in stainless steel and aluminium industry.

Chlorine gas is very toxic; nevertheless it protects us from falling ill by purifying drinking and swimming water. It also takes part in making many chemicals, including solvents, plastics, ... and pesticides.

VIII. You are taking part in the conference on the environmental problems. Deliver a report on air pollution.

Activity

I. 'Friends of the Earth' have organized a summer camp for everybody interested in the environmental protection. The hot issue of the day is air pollution.

Student A: The air in your city is getting more and more polluted. You want to write an article on air pollution problems. Interview a member of the "Friends of the Earth" organization for more information about air pollution and its effect on the environment.

Student B: You possess up-to-date and interesting information on environmental problems and their solutions. Share your knowledge at the interview.

II. <u>Discussion.</u> The consequences of air pollution may be fatal that is why we must take measures before it is too late. Can anything be done? What exactly? Read this information and do the task below.

Most of the classic atmospheric pollutants (CO_2, CO, O_3, lead and other particles), often found in the form of smog, are sadly known for affecting human health, ecosystems and buildings. Clean air laws are aimed at reducing air pollution.

Since the 1950s when the Clean Air Acts were introduced in Britain, we are sure of the atmosphere improving slowly. Local authorities insist on companies receiving integrated pollution licenses reducing the amount of gases they release. These licenses are strictly controlled to avoid limits being exceeded. Special detectors are placed around the factories with the purpose of monitoring the amount of oxides sent to the atmosphere...

In groups, analyze the condition of air in your city/country. Is it satisfactory? Work out several Clean Air Laws for improving the situation. Report on the problem and offer your suggestions.

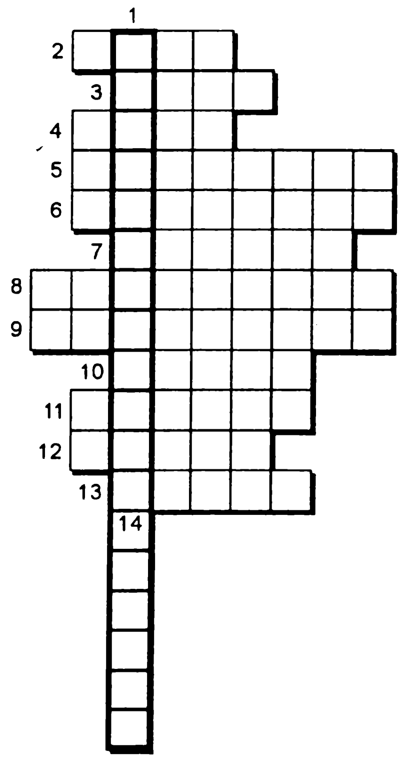
III. Solve the crossword.

Down:

1. CFC (man-made chemical, that is used in sprays, fridges, air-cooling systems; it destroys the ozone layer)
14. a chemical element; diamonds and coal are made of it

Across:

2. H_2SO_4, HNO_3, ...
3. People burn coal to ... their homes.
4. not quick
5. science, studying robots
6. copper has a valuable ... of corrosion resistance
7. to disagree, be against sth
8. uneasy
9. substance that pollutes the environment
10. to bring together
11. up-to-date
12. a noble industrial gas
13. a compound of oxygen and another chemical element



Writing

I. The Government is going to build a thermal power station in your district. This power station will burn waste to produce electricity. Send them a letter expressing your carefully considered and reasoned objection to the project.

You may begin like this:

> Dear Prime Minister,
>
> We are addressing you on the subject of a thermal waste-to-energy power station being designed in our district.
>
> We believe that this project has certain advantages but they are outnumbered by disadvantages...
>
> ...
>
> We will appreciate your prompt response.
>
> Sincerely yours,
>
> Friends of the Earth

SCIENTIFIC EXPLORATION

Section A. Optical Devices

Lead-in

I. Discuss the following questions.

a) How do scientists explore micro- and macroworlds?
b) What means of scientific exploration do you know?
c) Do you believe we can contact alien civilizations? How?

II. Listen to the students' conversation and learn about an unusual application of the laser telescope.

Peter: Pavel, have you heard about artificial **stars**?
Pavel: Not yet, but I'd like to know about them more, anyway.
Peter: Well, this article says they are created with the help of a laser telescope. One of these experiments is described here.
Pavel: Really? And what was the result of the experiment?
Peter: The reporter claimed that a bright **sodium** star, as big as about a natural star, had been **generated**.
Pavel: That sounds **fascinating**! How was the experiment carried out?
Peter: Oh, it was said in the article that the Solar Vacuum Tower Telescope had launched a 4-watt laser beam to the atmosphere and recorded the return light from the generated artificial star at the same time.
Pavel: Why do you think this artificial star has been created?
Peter: Well, there may be other reasons but I'm sure the star will serve as a model for further research of the universe.
Pavel: Oh really? May be in this way we'll be able to **establish interstellar communication**?
Peter: That's a good idea, but the scientists will have to carry out a number of experiments to prove that.

III. Complete the dialogue.

– How are artificial stars ...?
– As far as I know, a laser telescope is ....

– And ... about any successful ...?
– Yes, yesterday I found out ...
– ... interesting. ... carried out?
– ...
– I wonder why ...
– Well ...
– Do you suppose ...?
– ...

IV. Match a line in A with a line in B.

A	B
1. Would you like to know more about artificial stars?	a) An unusual application of a laser telescope.
2. What are the means of scientific exploration?	b) They believed radio waves were the most energy-efficient way of sending signals across the space.
3. What does the article deal with?	c) A telescope and a microscope, for example.
4. What did the reporter claim?	d) Of course, I would!
5. The scientists hope they'll contact distant civilizations with the help of a laser.	e) He maintained that an artificial sodium star had been generated.
6. Why did scientists look for radio signals from aliens?	f) That sounds fascinating!

Language Practice

Vocabulary

I. Find in B the English equivalents to the Russian words in A.

A	B		
1. рассматривать	a) to scan	b) to look for	c) to detect
2. длиться	a) to search	b) continuous	c) to last
3. весь, целый	a) to limit	b) entire	c) efficiently
4. удаленный	a) distant	b) currently	c) present
5. глазок	a) lens	b) detector	c) eyepiece
6. увеличивать	a) to modify	b) to magnify	c) to multiply
7. множество	a) variety	b) practible	c) modification
8. постоянный	a) single	b) similar	c) permanent

II. Make up all possible word combinations.

laser	signals
radio	telescope
alien	intelligence
artificial	star
interstellar	communication
ultraviolet	microscope

III. Find in each line the derivative from the first word.

1. record — accordingly, dimension, recorder, reward
2. modify — model, method, melting, modification
3. suggest — suggestion, supposition, substance, researcher
4. achieve — intelligent, achievement, reflection, reach
5. part — multitude, precise, partial, compound
6. change — charge; chain, suggestion, exchange
7. apply — amplify, allowance, empty, application
8. signify — sign, single, insignificant, similarity

Grammar: Reported Statements

IV. What opinion did these people express?

EXAMPLE: *Laser operation is based on a simple behaviour of atoms. I knew it.*
I knew that laser operation was based on a simple behaviour of atoms.

1. Optical devices are hardly used in the scientific research. They announced it. 2. The Sun moves around the Earth. People believed it. 3. The microscope is used for observing stars. He said so. 4. Robots do not possess intelligence. I was sure. 5. Materials engineers do not synthesize new materials. She supposed it. 6. Any scientific research takes a lot of time and patience. The engineer thought so.

V. The researchers reported about an important experiment. What did they say? Use the verbs *to say, to report, to announce, to state, to point out, to claim.*

EXAMPLE: *The research was carried out successfully. (to announce)*
They announced that the research had been carried out successfully.

1. We studied the possibilities of laser communication. 2. Miniature multifunction telescopes were developed for scientific observations. 3. The instruments were adapted to imaging and communication applications on Earth. 4. The multifunction telescope served three purposes: space navigation, communication and infrared spectrometry. 5. A prototype device was built and tested to demonstrate two of these functions. 6. The prototype instrument was assembled mostly from commercially available parts.

VI. Explain the difference between these sentences.

1. a) He said that the object was badly illuminated.
   b) He said that the object had been badly illuminated during the experiment.
2. a) They noticed that the microscope was significantly modified.
   b) They noticed that the microscope had been modified to increase magnification.
3. a) The observers reported that they recorded laser signals by means of a telescope.
   b) The observers reported that they had recorded laser signals from the universe.

VII. Say what the scientists predicted long ago.

EXAMPLE: *Man will invent artificial intelligence. (to be certain)*
The scientists <u>were certain</u> that man <u>would invent</u> artificial intelligence.

1. A superpowerful microscope will produce images. (to be sure). 2. We will contact an alien civilization by means of a laser telescope. (to suggest). 3. Air pollution will cause the global warming of the climate. (to predict). 4. Energy will be obtained from alternative sources. (to assume). 5. Fascinating achievements will be made in the area of biotechnology. (to suppose). 6. Mars will be explored by completely autonomous robots. (to believe)

VIII. Open the brackets and use the verb in the right form.

1. We learnt that laser communication (to be) practicable in the near future. 2. The engineers were surprised to see that modified robot (to move) like a human. 3. She was sure that she (to find) the most energy-efficient way of sending signals soon. 4. He found out that properties of a substance (to depend) on its structure. 5. I was afraid that she (to damage) the microscope objective lens. 6. Peter told me that he (to see) the William Hershel Telescope in operation.

IX. Correct mistakes.

1. We thought that those parts are combined to form a microscope. 2. He realized that he spotted a distant planet. 3. I was told that he takes part in

the research. 4. It was announced that engineers object to applying this technology. 5. He said that an artificial star was created with a laser telescope. 6. We supposed that the new approach will be more fruitful. 7. The investigators announced that they obtained a powerful microscope soon.

X. Translate the sentences into English using your active vocabulary.

1. Сообщалось, что ученые разработали телескоп, который будет внимательно следить за небом. 2. Раньше предполагали, что радиоволны являются самым эффективным способом передачи сигналов в межпланетном пространстве. 3. Некоторые ученые считали, что технически развитые цивилизации попробуют установить контакт с помощью лазера. 4. Руководитель проекта заявил, что его лаборатория уже провела около 20 000 наблюдений. 5. Исследователи были уверены, что сверхчувствительный микроскоп позволит им сделать важное открытие. 6. Он узнал, что существует огромное множество разнообразных оптических устройств. 7. Изобретатель доказал, что его модифицированный микроскоп значительно расширяет возможности исследований.

Reading and Speaking

I. Translate these compound nouns.

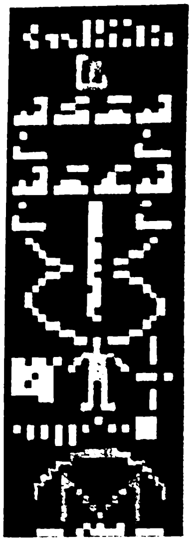
alien intelligence	alien laser beam
energy-efficient	laser light
radio telescope	the Nobel prize winning scientist
pulsed laser beam	light year
laser pulse signal	interstellar laser communication

II. Is there life on Mars? Look at the pictures and the headline. What can the article be about? Skim it quickly to check your guess. What does the first picture mean?

III. Read the article attentively and learn how scientists try to establish interstellar communication.

BBC News Online

A telescope designed to search for laser signals from **alien** intelligences is to start **scanning** the skies next year. The 1.8-metre (6ft) Optical SETI (Search for Extra-Terrestrial Intelligence) Telescope is currently being built in Harvard.



For more than 40 years, scientists have looked for radio signals from aliens on the understanding that radio waves provide the most energy-efficient way to send a signal across **interstellar** distances. But despite using the world's largest radio telescopes with highly sensitive detectors, no **sign** of a signal has been found in space as yet.

Several years ago some astronomers said it was **hardly** surprising that no radio signal had been **detected** yet. They **maintained** that researchers might be looking for the wrong kind of message. It was assumed that a technologically **advanced** race might be more likely to communicate using pulsed laser beams rather than radio. The new approach was hoped to be more **fruitful**.

Searching for laser pulse signals was first suggested by the Nobel prize winning scientist Charles Townes in 1961 and was, according to its supporters, met with 'more interest than enthusiasm'. It was thought that a high-powered laser coupled with a large telescope could send a signal **across** many light years of space. Scientists believed that an alien laser beam would be pulsed to encode a signal.

William Herschel's telescope with which he discovered Uranus. It is of Newtonian design: there is a parabolic mirror at the bottom of the tube; you peer in through the eyepiece on the side near the top to see the image. The thin tube is a smaller telescope for viewfinding.

During the pulse, **lasting** perhaps less than a millionth of a second, the laser light could be much brighter than the light from the star in the system from which the signal is being sent. The new SETI Telescope will look for these **brief** pulses of laser light, scanning the **entire** northern sky once every 200 clear nights. It will have a special camera fitted with an array of 1,024 ultra-fast detectors that can **spot** flashes as short as a billionth of a second.

According to the researchers, using only the Earth 2001 technology we can now generate a beamed laser pulse that appears 5,000 times **brighter** than our Sun, as seen by a **distant** civilization. In other words, interstellar laser communication is altogether **practicable** with the new Optical SETI Telescope searching the sky for such signs of intelligent life elsewhere in the galaxy.

IV. Say if the following statements are true or false. Correct the false statements.

1. Scientists believe in the possibility of discovering alien intelligence with the help of a microscope. 2. The Harvard telescope has been designed spe-

cially for interstellar communication. 3. Radio waves are said to be efficient for sending signals across space. 4. Radio telescopes are reported to be out of date. 5. No alien life has been found as yet because the search is being done in the wrong direction. 6. The idea of looking for laser signals from space has proved inapplicable. 7. Aliens are supposed to decode their signals with a laser. 8. Laser light is much brighter than the light of a star. 9. The laser is equipped with sensitive ultraviolet detectors.

V. Find in the article the information related to the following.

a) SETI (Search for Extra-Terrestrial Intelligence) project
b) radio telescopes
c) alien civilizations
d) Charles Townes
e) laser light
f) northern sky
g) detectors
h) the Earth 2001 technology
i) interstellar laser communication

VI. Produce a radio programme on the problems of interstellar communication. Then make a report on this programme using Reported Speech.

The host of the programme: introduce shortly the topic and the guest – an outstanding scientist taking part in the SETI Project.

The guest: describe the latest developments in the area of interstellar communication using year project.

Listeners: telephone to the studio and ask the guest questions.

Further Reading

I. Microscopy is a relatively young science but it uses a lot of words from 'old' languages — Latin and Greek. Find these words in the text.

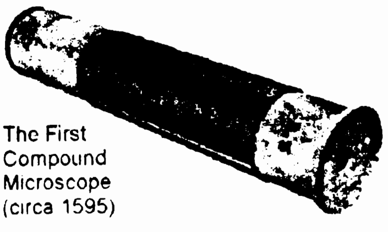
II. Man is expanding the sphere of exploration not only outwards but inwards as well. Why are we so interested in the micro world? Look at the picture and the title of the text and say what the text is about.

III. Scan the text to find answers to these questions.

1. What is microscopy?
2. When was the microscope invented?
3. How do microscopes differ?
4. What types of microscopes are mentioned in the text?

IV. **Read the text attentively for more information about microscopy.**

Imaging Atoms



The First Compound Microscope (circa 1595)

Observing and studying objects that range in size from millimeters to nanometers intrigues everyone. This fascinating science is called **microscopy**, currently applied to every field of science and technology from biology and chemistry to physics and engineering.

Many scientists today are working with single atoms or molecules. To do their work they have to be able to 'see' molecules and atoms in some way. Optical instruments used for producing a **magnified** image of a small object are known as microscopes. The first **compound** microscope containing an **objective** lens system and an **eyepiece** system was created by a Dutch spectacle-maker Zacharias Janssen in 1595. It was simply a tube with lenses at each end. Having been modified and improved this microscope is most commonly used today giving us the possibility of viewing individual cells, even living ones, in two dimensions. Compound microscopes are light illuminated. Their high **magnification** is achieved by passing light reflected from the object through a combination of magnifying lenses. Unfortunately the possibilities of light microscopes are limited by the **resolution** of the lenses being about 0.2 micrometer.

The resolving power can be **significantly** increased by using other types of microscopes. They come in a wide range of forms and use a **multitude** of illumination sources (light, electrons, ions, **X-rays** and mechanical probes) and signals to produce an image. An electron microscope, for instance, produces images by using electrons and electron lenses. A microscope similar to it in principle but using a beam of protons instead of electrons is known as a proton microscope. A device for viewing very small particles by observing the light from an intense beam scattered by them is called an ultraviolet microscope. The results of the observation are recorded with the help of a photomicrograph – a photograph of the image obtained with the help of a microscope. This enables a **permanent** record to be kept and also enables ultraviolet radiation to be used for the illumination of the specimen. All modern powerful microscopes are combined with computers.

A microscope can be as simple as a **handheld** magnifying lens and as complex as a multimillion-dollar research instrument. Using these tools, a microscopist explores the relationship of structure and properties of a wide variety of materials in order to more fully understand the reasons why a particular **item** behaves the way it does.

V. Say if the following statements are true or false. Correct the false statements.

1. Microscopy studies measure units ranging from millimeters to nanometers. 2. Microscopy is not applied to mechanical engineering. 3. It is impossible to see an atom with a naked eye. 4. Modern microscopes do not have an objective lens system and an eyepiece system. 5. The first compound microscope was created in Holland in the 16th century. 6. Janssen's original microscope is widely applied today. 7. The light microscope has a high magnification but a low resolution. 8. The sample can be illuminated by light, electrons, ions, X-rays and mechanical probes. 9. The results of the observation are recorded with the help of a microphotograph. 10. A simple microscope is a multimillion-dollar research instrument.

VI. Expand these sentences with the information from the text.

1. Microscopy is fascinating. 2. Microscopy is useful. 3. The microscope is an instrument. 4. Zacharias Janssen was an inventor. 5. Microscopes vary. 6. A microscopist studies materials.

VII. Several types of microscopes are mentioned in the text. What are they? Fill in the table with their description.

Microscope	*Principle of Work*
...	...

Activity

I. Your friend is crazy about microscopes and wants to become a materials engineer. You do not see what is so special about this profession. Ask your friend for information. Report to the class what you have found out. Start like this:

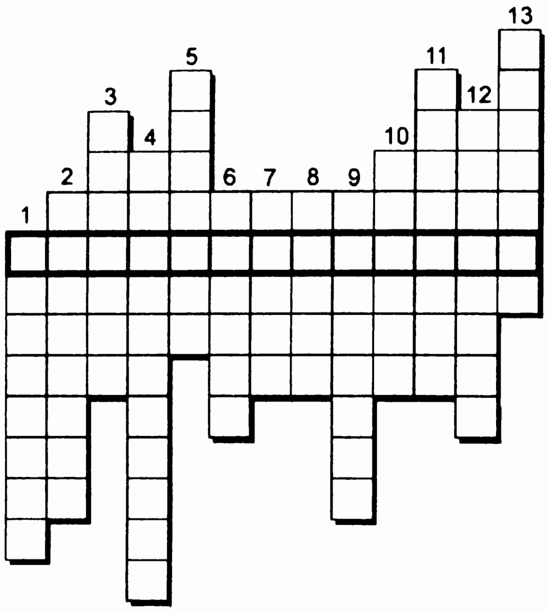
– Hello, Denis, what are you busy with?
– Oh, hi. I'm studying ...

II. The Science Museum in your city is going to open a new gallery – 'Optical Devices'.

a) You are experts in the field of optics, specializing in telescopes and/or microscopes. Design the gallery in groups. What items will be exhibited? Why? What information on these items will be supplied?

b) Act as a guide in the gallery and describe it to the class. Choose the best project.

III. Solve the crossword.



Across:

1. ... ?

Down:

1. part of a modern microscope
2. to spot a distant planet the telescope must be very ...
3. an instrument for scanning
4. the place where a telescope is placed
5. not capable to increase or improve
6. opposite to 'encode'
7. a creature from another world
8. a sudden quick bright light
9. microscopes range from complex to ...
10. the science studying light
11. part of a microscope or a telescope
12. an instrument for recording
13. opposite to 'near' or 'close'

Writing

I. Write an article about interstellar communication for the newspaper column 'In Brief'.

Section B. Space Shuttles

Lead-in

I. Discuss the following questions.

a) How many events from the history of cosmonautics can you remember? Make a list and compare it with that of your partner.
b) What is a space shuttle? What is it used for?

II. Listen to the conversation and say what you have learnt about space shuttles.

Astronaut: **Shuttles** are fascinating vehicles. They appeared only in the 1980s and have already become **irreplaceable**.

Olga: Are they different from **spaceships**?

Astronaut: Certainly! They are reliable, **recoverable** and therefore **reusable** and less expensive. The hundredth successful **launch** was in October 2000.

Olga: Could you tell us how shuttles work?

Astronaut: Of course. At the **take-off** the **boosters** and the **orbiter**'s engines have to **initially** provide about 30 MN of **thrust** to **lift** a 2,000 tonne shuttle **off**.

Olga: This must be very hard on the crew.

Astronaut: Indeed, during the take-off the crew can **experience** forces up to 3 times their own weight. When they are in orbit, however, they feel **weightless**.

Olga: And how does the shuttle find its way when in **space**?

Astronaut: Using the global positioning system (GPS), of course. Pilots **essentially** run the computers, which fly the shuttle.

Olga: How interesting! But how is electrical power supplied to all on-board systems of the orbiter?

Astronaut: Electricity is generated by fuel cells. They **combine** oxygen and hydrogen to make electricity for on-board systems and water for cooling.

Olga: What is the major role the shuttle plays today?

Astronaut: Well, it is used for building the International Space Station by delivering components built on the Earth and attaching them to existing modules in space.

III. Complete the dialogue.

– ...?
– Well, they combine the features of a rocket, a spaceship, and an airplane.

– And do shuttles differ ...?
– Of course they do! ...
– I wonder how much power is necessary to ...?
– ...
– What does the crew experience ...?
– ...
– Do you know how shuttles navigate in space?
– ... . They use ...
– Is the electricity for the on-board systems provided by batteries?
– ...
– Shuttles are very important for building ...?
– ...

IV. Match a line in A with a line in B.

A	B
1. Do you know when shuttles appeared?	a) Without any doubts.
2. Did he tell you what he experienced at the take-off?	b) Water.
3. I wonder how the on-board computers fly the shuttle.	c) From the GPS satellites.
4. Where do the flight computers get the information about the position and the speed of the orbiter?	d) They talk to each other and vote to settle arguments.
5. What did he say was the byproduct of the fuel cell?	e) He felt his body thrice as heavy.
6. I wonder if tourists will fly to space in the near future.	f) Sure. In the 1980s.

Language Practice

Vocabulary

I. Match the words with the similar meaning.

sputnik	unique
spacecraft	transport
concept	spaceship
deliver	fire

essentially	fuel
ignite	satellite
irreplaceable	idea
propellant	basically

II. Find eight pairs of words with the opposite meaning.

external, reusable, reliable, entry, to disconnect, connected, disposable, finally, internal, initially, unsafe, to land, separate, exit, to attach, to take off

III. Find in each line the derivative from the first word.

1. ship – sheep, spacecraft, spaceship, shopping
2. to boost – establish, obstacle, stability, booster
3. to combine – combination, connection, cavity, invention
4. to deliver – driver, delivery, despite, drastically
5. to ignite – initially, introduction, existence, ignition
6. load – leader, payload, launch, loudly
7. use – ultrasonic, successful, reusable, fusion
8. weight – width, weightless, widely, well-known

Grammar: Reported Questions

IV. What does (did) the student want to know? Report his special questions.

EXAMPLE 1: *How do they increase the speed of the spacecraft? (to ask)*
He asks how they increase the speed of the spacecraft.
He asked how they increased the speed of the spacecraft.

1. How does a shuttle differ from a spaceship? (to wonder). 2. What properties does the shuttle tile have? (to ask). 3. What components does the shuttle consist of? (to be interested). 4. When is the rocket booster ignited? (to want to know). 5. Where are shuttles applied? (to wonder)

EXAMPLE 2: *What did you experience at the take-off? (to ask)*
He asks what I experienced at the take-off.
He asked what I had experienced at the take-off.

1. How did the engineers reduce the weight of the orbiter? (to ask) 2. How did the ceramic tile protect the shuttle during the re-entry? (to be interested) 3. Why did they change the design of the external fuel tank? (to want to know) 4. When was the first satellite placed in orbit? (not to know) 5. What materials are used in making the components of a shuttle? (not to be sure)

EXAMPLE 3: *When will tourists fly into space? (to ask)*
He asks when tourists will fly into space.
He asked when tourists would fly into space.

1. How will the engineers improve the living conditions of astronauts? (to wonder) 2. Why will any meteorite burn in the atmosphere? (to question) 3. What payload will the shuttle deliver to the space station? (to inquire) 4. In what way will the innovations influence the performance of the engines? (to ask) 5. When will spaceships develop the speed of light? (to be interested)

V. What general information does (did) the student want to know? Report his questions. Use the verbs to ask, *to inquire, to be interested, to question, to wonder.*

EXAMPLE 1: *Is the external fuel tank made of aluminium?*
He asks if (whether) the external fuel tank is made of aluminuim.
He asked if (whether) the external fuel tank was made of aluminuim.

1. Is it difficult to become an astronaut? 2. Are there good living conditions aboard the spaceship? 3. Does the shuttle develop the speed of light? 4. Does the crew feel weightless when in space? 5. Have the astronauts repaired the damaged satellite?

EXAMPLE 2: *Were there any difficulties during the mission?*
He asks if (whether) there were any difficulties during the mission.
He asked if (whether) there had been any difficulties during the mission.

1. Was the re-entry successful? 2. Were there any failed missions? 3. Did the first astronauts wear space suits inside the spaceship? 4. Did the re-entry temperatures exceed 1200 °C? 5. Did the main engines generate the maximum thrust at the launch?

EXAMPLE 3: *Will future shuttles carry more weight in payload?*
He asks if (whether) future shuttles will carry more weight in payload.
He asked if (whether) future shuttles would carry more weight in payload.

1. Will rocket scientists create a 100%-recoverable spaceship? 2. Will space stations be placed in orbit at Lagrange points? 3. Will artificial gravity allow to create space colonies? 4. Will the solid rocket boosters be processed and re-used? 5. Will the shuttle programme be shut down?

VI. Fill in the gaps with the suitable linking words (*if / when/why*, etc.).

1. I'd like to know ... heating influences the shuttle tile. 2. She asked ... the launch had been successful. 3. The teacher inquired ... the students could explain the difference between a shuttle and a spacecraft. 4. I was interested ... the International Space Station would be built. 5. They were not sure ... the main engines failed. 6. Could you tell me ... the space shuttle delivers the satellites?

VII. Correct mistakes in these sentences.

1. The student asks whether the first spaceships had been recoverable. 2. They wondered if did we observe the launch of the shuttle. 3. Nick was interested what components did the space shuttle consist of. 4. He wanted to know why isn't the fuel tank painted white. 5. I was asked did I specialize in insulating materials. 6. My friend inquired if I will graduate from the University soon. 7. We wonder how have they obtained the required propellant. 8. She asked did I know anything about the global positioning system. 9. They were interested if space tourism will develop in the near future. 10. The engineers knew where was the space station.

VIII. What are the questions the teacher actually asked?

After our meeting with the famous astronaut the teacher asked whether we had liked the conversation. Then he asked what interesting information we had obtained about the life at the space station. He inquired where the astronauts lived, what they ate and how they felt in microgravity. He was interested what tasks the astronauts performed in space. The teacher wondered if electricity was generated aboard the shuttle. He also wanted us to explain why the shuttle didn't burn during the re-entry. The last question was when we would be able to travel in space.

IX. Translate the sentences into English using your active vocabulary.

1. Он спросил меня, что такое 'шатл'.

2. Она поинтересовалась, влияет ли невесомость на свойства вещества.

3. Студентам было интересно, как уменьшили вес внешнего топливного бака.

4. Скажите, пожалуйста, может ли космический корабль развить скорость света?

5. Профессор объяснил, почему были созданы космические корабли многоразового использования.

6. Я хотел узнать, какое топливо используют ракеты-носители.

Reading and Speaking

I. When the Soviet Union's 'Sputnik I' was successfully launched and orbited the earth in 1957 the Space Age began. A lot of significant events have taken place since that time. Do you know all of them? Match the event with the appropriate year.

1. The first space shuttle was launched.	*1957*
2. Alexei Leonov made the first walk in space (i.e. left his spacecraft).	*1961*
	1963
3. Yuri Gagarin orbited the Earth.	*1965*
4. The Apollo programme sent the first people (Neil Armstrong, Buzz Aldrin and Michael Collins) to the Moon.	*1969*
	1981
5. The Soviet Union sent the first living creature into space. It was a dog, Laika by name.	
6. 'Vostok 6' carried the first woman into space. Her name was Valentina Tereshkova.	

II. These words are taken from the text. Use the dictionary to find out their meanings.

fiction, n	astronaut, n
pharmaceuticals, n	one-shot, adj
place, v	mission, n
compartment, n	lifetime, n
recreation, n	undergo, v
dock, v	refit, n
one-shot, adj	safe, adj

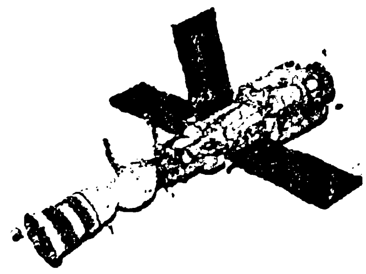
III. Look at the picture and the title and try to guess what the text deals with. Skim the text to see if you were right.

IV. Read the text attentively and say what you have learnt about space shuttles.

A Brief History of the Space Shuttle

From the early days of science fiction and space exploration, we have dreamed of space stations. For some, space stations are a place to do scientific research. For others, space stations are a place for business, where unique materials (crystals, semiconductors, pharmaceuticals) are manufactured in better forms than on the Earth. Still others want to use space stations in order to travel to other planets and stars.

The Russians were the first to place a space station, called Salyut 1, in orbit in 1971. It was about 49ft (15 m) long and held three main compartments that **housed** dining and recreation areas, food and water **storage**, a toilet, control stations, exercise equipment and scientific equipment. (See the picture of the Salyut-4 space station docked to a Soyuz spacecraft.) Are you interested how people get to space stations?



At that time, the rockets used to place astronauts and equipment in **outer space** were one-shot **disposable** rockets. The idea of a reliable, less expensive, **recoverable** and **reusable "space shuttle"** that could **launch** like a rocket but deliver and **land** like an airplane was **appealing** and would be a great technical achievement. However, nobody knew how that idea could be **put into practice**.

Design, cost and engineering studies on a space shuttle began. The concepts varied greatly but in 1972, it was decided that the shuttle would consist of an **orbiter** attached to solid rocket **boosters** and an external fuel tank because this design was considered safer and more cost-effective. The space shuttle is the world's first reusable **spacecraft**, and the first spacecraft in history that can carry large **satellites** both to and from orbit. The shuttle launches like a rocket, **maneuvers** in the Earth orbit like a spacecraft and lands like an airplane.

Finally, after many years of construction and testing (i.e. orbiter, main engines, external fuel tank, solid rocket boosters), the shuttle was ready to fly. Four shuttles were made (Columbia (1979), Discovery (1983), Atlantis (1985), Challenger (1991) and each of them was designed to fly at least 100 missions. The first flight with the space shuttle Columbia in 1981 was quite successful. But in 1986 one of the shuttles in operation (Challenger) **disintegrated** shortly after its launch killing the crew. It had been the only failed mission till February 2003 when Columbia disintegrated before landing. So far the launch of the shuttles has been suspended but they plan to start operating them in the nearest future. The space shuttles have flown about one-fourth of their expected lifetime and now the scientists are working at making numerous refits and design changes to make them safer.

V. Say if the following statements are true or false. Correct the false statements.

1. Since ancient times people have dreamed of space stations. 2. Space stations serve numerous important purposes. 3. The Russians were the first to build a space shuttle. 4. Early rockets could be used once only. 5. The shuttle consists of main engines attached to solid rocket boosters and a fuel tank. 6. The fuel tank is situated inside the shuttle. 7. The shuttle is a rocket, a

spacecraft and an airplane combined. 8. Columbia, Discovery, Atlantis, Challenger are operating quite successfully at present. 9. Modern shuttles have become safer and more efficient in operation.

VI. Explain why ...

a) space stations are created,
b) first spaceships were not cost effective,
c) shuttles were developed,
d) shuttles are considered a unique means of transport,
e) shuttles have undergone many refits and design changes.

VII. April 12 is the International day of Cosmonautics. The first shuttle, Columbia, was also launched on April 12, 1981. Your friend has just found it out and is very surprised. He has come to you for more information about shuttles. Answer your friend's questions about the history of shuttles and explain to him why and how shuttles are constructed.

VIII. Make a list of ways in which achievements in space engineering may be used nowadays and in the future. Compare your list with that of your groupmates.

Further Reading

I. These words are taken from the text. Use the dictionary to find out their meanings.

awesome, adj	ratio, n
take off, v	vapour, n
shut down, v	nozzle, n
aft, adj	gimbals, n
fuselage, n	mount, v
remainder, n	feed, n
pad, n	tail, n

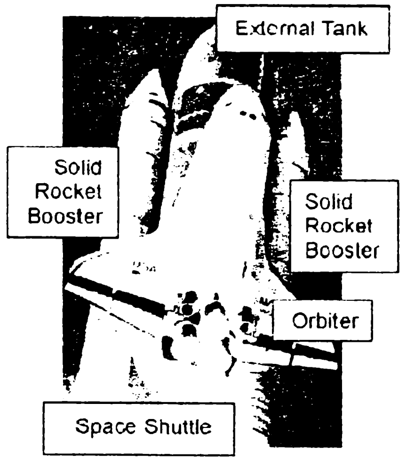
II. Scan the text to find answers to these questions.

1. How much does the shuttle weigh?
2. What parts does the shuttle consist of?
3. What fuel do the rocket boosters use?
4. Why is it impossible to shut down the boosters after they are ignited?
5. Where are the orbiter's main engines located?
6. What exhaust gases do the orbiter engines emit?

7. How is the forward direction of the rocket controlled?

8. What does the work of the orbital maneuvering systems'engines depend on?

III. Read the text attentively and learn how the shuttle works.



The launch of a space shuttle is one of the most awesome spectacles of our time.

In order to get into orbit 115–400 miles (185–643 km) above the Earth, the 2,000 tonne shuttle uses the following components:

– two solid rocket boosters (SRB) – critical for the launch;

– external fuel tank (ET) – carries fuel for the launch;

– orbiter – carries astronauts and payload; three main engines and orbital maneuvering system (OMS).

Let's look at these components closely. The SRBs are solid rockets that provide most of the thrust (71 %) needed to take off. The SRBs carry rocket motors, solid propellant (atomized aluminum), flight instruments, parachutes and self-destruction mechanism. As the SRBs are solid rocket engines, once they are ignited, they cannot be shut down. Therefore, they are the last component to light at the launch.

The orbiter has three main engines located in the aft fuselage. They provide the remainder of the thrust (29 %) to lift the shuttle off the pad and into orbit. The engines burn liquid hydrogen and liquid oxygen, which are stored in the ET, at the ratio of 6:1. The fuel is partially burned in a pre-chamber to produce high pressure by hot gases that drive the fuel pumps. The fuel is then fully burned in the main combustion chamber and the exhaust gases (water vapour) leave the nozzle at approximately 6,000 mph / 10,000 km/h. The rate of thrust can be controlled from 65 % to 109 % maximum thrust. The engines are mounted on gimbals that control the direction of the exhaust, which controls the forward direction of the rocket.

As mentioned above, the propellant (about 526,000 gallons/ 2 million litres) for the main engines is stored in the ET. The ET is made of aluminum composite materials. It has two separate tanks inside, one for oxygen and the other for hydrogen, separated by an intertank region. The fuel flows from each tank through a 17 in. (43 cm) diameter feed line out of the ET into the shuttle's main engines. During the first few shuttle missions, the ET was painted white, but this was stopped to reduce the weight.

The two orbital maneuvering systems' (OMS) engines are located on the aft section of the orbiter, one on either side of the tail. These engines are used to place the shuttle into final orbit, to change the shuttle's position from one orbit to another, and to slow the shuttle down for the re-entry. Either one or both of the OMS engines can fire, depending upon the orbital maneuver. Now let's put these pieces together and see how the shuttle will lift off!

IV. Choose the correct option to complete the sentences.

1. The space shuttle has ... major components.
   a) three b) four c) five
2. Most of the thrust (71 %) for the take-off is provided by ... .
   a) the rocket boosters b) the orbiter's main engines
   c) the OMS engines
3. The rocket boosters consume solid ... .
   a) propeller b) propane c) propellant
4. As the SRBs cannot be shut down after the ignition they are the ... component to light at the launch.
   a) first b) next c) last
5. The orbiter's main engines run on ... oxygen and hydrogen.
   a) solid; b) liquid; c) gaseous
6. The orbiter's engines burn liquid hydrogen and liquid oxygen at the ratio of ... .
   a) 1:6 b) 6:1 c) 6:1:6
7. The exhaust gases leave the ... at approximately 6,000 mph / 10,000 km/h.
   a) nozzle b) aft c) combustion chamber
8. The external fuel tank is for storing ... .
   a) atomized aluminum b) liquid hydrogen and liquid oxygen
   c) water vapour
9. Liquid hydrogen and liquid oxygen are stored in ... tanks.
   a) the same b) similar c) separate
10. The external fuel tank is not painted white in order to ... the weight.
    a) increase b) reduce c) conserve
11. The two orbital maneuvering systems' engines are used to ... the shuttle for the re-entry.
    a) slow down b) speed up c) shut down

V. Complete the table with the data from the text.

Acronym	*Component*	*Function*
SRB	...	...
ET	...	...
OMS	...	...
–	orbiter	...
–	...	to provide the thrust (29 %), ...
–	gimbals	...
–	...	to control the forward direction of the rocket
–	an intertank region	...

VI. Give a title to the text.

Activity

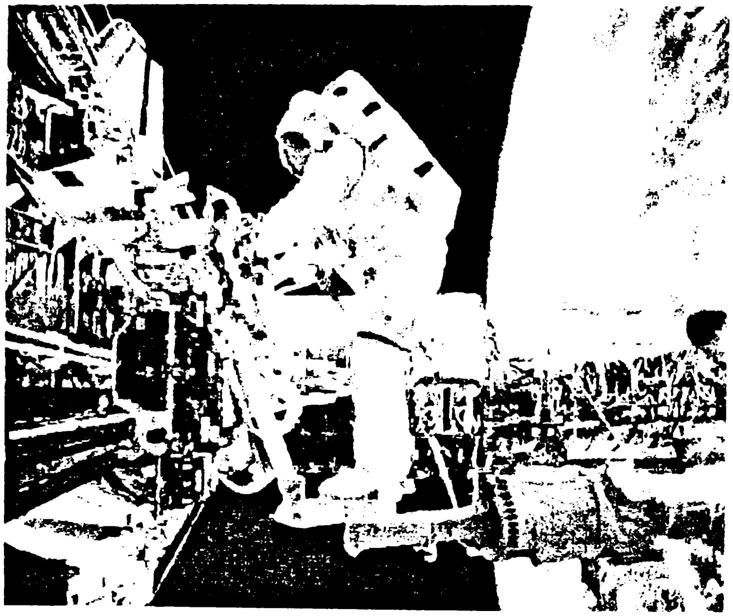
I. Your space shuttle 'Belarus' has just successfully landed and you have been asked to give a lecture at the Technical University about the work of your shuttle. Describe your previous shuttle flight and show the pictures. Be ready to answer the students' questions.

II. The year 2001 saw an unprecedented event when the first tourist had a chance to travel into space. What do you think about the future of cosmonautics? Discuss this problem with your groupmates. Give your reasons. The phrases below will help you.

– space tourism will develop
– anybody will have a chance to travel to another planet
– there will be cities on other planets
– in schools children will study a new subject "Rules of behaviour in space"
– we will not have bicycles or cars, everybody will travel in jet aircraft
– ...

Writing

I. You have been given the photo (below) and the task to write a short article for the Day of Cosmonautics. In the article express your opinion on the past and the future of space travel.



CHECK YOUR PROGRESS

Grammar Check

I. Infinitive

I. Find Infinitives or Infinitive constructions in the following sentences.

1. I wanted you to help me to weld these two pieces by an electric arc.
2. He suddenly felt the electrode touch the surface of the workpiece.
3. Robots are supposed to facilitate people's work.
4. The short circuit is reported to have caused a lot of damage.
5. To drive safely it is important to check the brake system regularly.
6. All this makes me think that it is fascinating to experiment with lasers.
7. You are likely to spot distant planets if you know about Doppler's effect.
8. Ecologists would not like CFCs to be used as industrial gases.
9. The material to be investigated is of great value.
10. The need to develop stronger alloys forces the experiments to be continued.

II. Insert *to* where necessary.

1. You should ... recharge your car battery directly.
2. He made me ... use protective clothing during welding.
3. We would like you ... show us how the actuator works.
4. The function of a thermometer is ... measure the temperature.
5. ... obtain an alloy, one must ... mix metals with non-metals.
6. The distance ... be measured is between these two points.
7. Professor watched the students ... quench a steel bar in oil.
8. Don't let children ... play with matches.
9. Domestic appliances are supposed ... consume plenty of electricity.
10. It is obviously necessary ... demonstrate the properties of this substance to the researchers.

III. Translate the following sentences into English.

1. При проведении дуговой сварки, необходимо правильно пользоваться инструментом и соблюдать технику безопасности. 2. Прибор, который нужно использовать, имеет совершенно новую конструкцию. 3. Целью данной статьи является описание преимуществ использования электрических автомобилей. 4. Такая система позволяет генериро-

вать мощный электрический ток. 5. Возможно, автомобиль имеет серьезные повреждения. 6. Сообщается, что экспериментальный микроскоп работает достаточно эффективно.

II. Participle

I. Find Participles or Participial constructions in the following sentences.

1. You have come early. The experiment is still being carried out.
2. When carried out, the experiment was discussed with great interest.
3. Being translated into many foreign languages, her works are read with great interest all over the world.
4. Having studied the properties of the alloy the engineer made a report on the subject of his research.
5. The hologram having been made, we switched off the laser.
6. The results received were of great importance for further investigations of artificial stars.
7. Having been taught by a good teacher, I know Geodesy well.
8. When burnt, coal produces not only heat but polluting gases as well.
9. They tried to repair the engine trouble following the instructions of a mechanic.
10. The professor delivering a lecture on nanotechnology mentioned interesting facts.

II. Choose the right option.

1. The canal *связывающий* the two seas is being built now.
   a. having linked **b.** linking **c.** linked
2. The explanation *данное* is not complete.
   a. given **b.** being given **c.** giving
3. *При нагревании* metals expand.
   a. when heating **b.** when heated **c.** when having been heated
4. *Work done*, you have fun.
   a. сделанная работа **b.** когда работа сделана **c.** делая работу
5. *Анализируя* elements Mendeleev divided them into 9 groups.
   a. studying **b.** having studied **c.** studied
6. *Получив* good results we stopped the research.
   a. being received **b.** having received **c.** receiving
7. Life *existing* on other planets is no longer under question.
   a. существуя **b.** существовавшая **c.** существующая
8. *Being built* on time the bridge was opened for public use.
   a. будучи построенным **b.** построив **c.** строящийся

9. *Having been shown* the design I found the fault quickly.
   a. показав **b.** показывая **c.** после того, как мне показали

10. While *calculating* the speed the student made a mistake.
   a. вычисляющий **b.** вычисляемый **c.** вычисляя

III. Translate the following sentences into English.

1. Проверив электрическую цепь, он начал наблюдать за показаниями приборов. 2. При проведении исследований мы использовали этот микроскоп. 3. Полученное оборудование устанавливают в данный момент в нашей лаборатории. 4. Занимаясь исследованиями, он пришел к выводу о возможности применения нового материала в электронике. 5. Воспользовавшись мощным лазером, мы создали голограмму, видную издалека.

III. Gerund

I. Find Gerunds or Gerundial constructions in the following sentences.

1. The teacher insists on our coming on time.
2. We don't know much of the Challenger having failed its mission.
3. The value of his having discovered natural lasers is not realized completely yet.
4. The idea of connecting these wires was not mine.
5. Using renewable resources can significantly reduce the amount of air pollution.
6. I don't mind your reading science magazines in the reading room.
7. We hear of the up-to-date equipment being bought for your lab.
8. He was sure of repairing the ignition system without anybody helping him.
9. Exploring other worlds by means of robots soon will become a reality.
10. Seeing is believing.

II. Choose the right option.

1. ... heavy units is not easy.
   a. assembling **b.** assembled **c.** being assembled
2. The teacher does not know of the students ... the apparatus.
   a. damaging **b.** being damaged **c.** having damaged
3. New possibilities for ... atomic energy open up.
   a. applying **b.** having applied **c.** applied
4. The projects of ...waste-to-energy plants cause fierce opposition.
   a. constructing **b.** having constructed **c.** being constructed

5. Instead of ... the old air-filter they replaced it with a new one.
a. having cleaned b. cleaned c. cleaning
6. You can improve your work efficiency by ... modern technologies.
a. applying b. having applied c. applied
7. What device do taxi-drivers use for ... passengers?
a. charged b. being charged c. charging
8. They are talking about the shuttle ... already.
a. launched b. being launched c. having been launched
9. He always operates the apparatus without ... safety regulations.
a. observed b. observing c. having observed
10. They insist on the short circuit ...
a. being avoided b. avoiding c. having avoided

III. Translate the following sentences into English.

1. Составление новой компьютерной программы было нелегкой задачей. 2. Решение данной проблемы невозможно без проведения серии экспериментов. 3. Вы можете рассчитывать на то, что компьютер выдаст вам точную информацию. 4. Роботы способны выполнять тяжелую работу не уставая. 5. Мы осведомлены о том, что он сейчас исследует свойства нового сплава.

IV. Reported Speech

I. Correct mistakes and translate the sentences into Russian.

1. They announced that the new vehicle will be widely used in the future.
2. The article said that rain forests are badly damaged by acid rains.
3. She asked Denis if when the Science Museum had been opened in London.
4. We are all interested is there life on Mars.
5. The student answered that he never heard of the Doppler effect.
6. The student was asked that to enumerate advantages of personal computers.
7. I was interested if were actuator robots more mechanically efficient.
8. They wondered why were those devices made of quenched steel.
9. The engineer said to us not to touch the wire while the power was on.
10. Can you tell me how does a power plant generate electricity?

II. Choose the right option.

1. It was reported they ... their research 2 days before.
a. had carried out b. would carry out c. carried out

2. The inventors were interested who ...finance the further research.
a. would **b.** will **c.** -

3. The miners did not know what ... the explosion.
a. causes **b.** caused **c.** had caused

4. She asked how often ... in various scientific projects.
a. did you participate **b.** you did participate **c.** you participated

5. The instructor advised us ... driving during rush hours.
a. to avoid **b.** that we avoided **c.** avoid

6. They were certain they *would win* the race.
a. выиграли **b.** выиграют **c.** выигрывают

7. He said the device *needed no* improvement.
a. не нуждается **b.** не нуждался **c.** не будет нуждаться

8. That article said that the hail *had damaged* many cars.
a. повредит **b.** повреждает **c.** повредил

9. We were asked if we *believed* in artificial and alien intelligence.
a. поверим ли **b.** верили ли **c.** верим ли

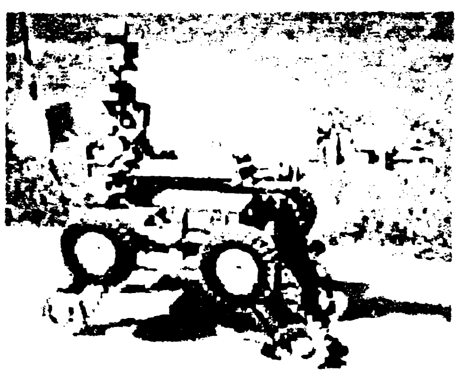
10. They wanted to know ... the fault had been found.
a. – **b.** if **c.** who

III. Translate the following sentences into English.

1. Он сказал, что эти пластины делают из закаленной стали. 2. Как вы думаете, что вызвало данный эффект? 3. Они поинтересовались, экспериментирую ли я со сплавами. 4. Ученые объявили, что с помощью биотехнологий они создали новый сверхпрочный материал, свойства которого они сейчас изучают. 5. Сообщалось, что существует возможность создания искусственного разума.

Translation Check

Choose one of the paragraphs and translate it in writing. Use the dictionary if necessary

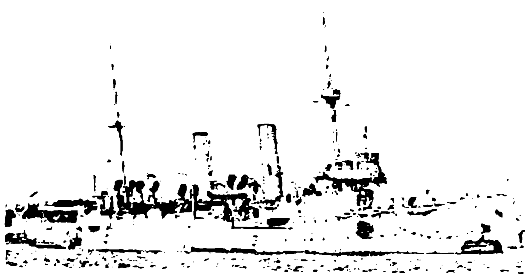


1. ***Bomb Buster.*** The Mini-Androsis is used by bomb squads across the country to locate and dispose of bombs. About three feet long, the Mini-Androsis looks something like a small armoured tank with eight wheels on four 'legs' that extend for climbing stairs. Its movable arm can lift objects weighing up to 15 pounds and place them in bombproof boxes. Detachable accessories allow the Mini-Androsis to break windows, to see in the dark, and to defuse or detonate bombs directly, either by blasting them with water, firing at them with a shotgun, or placing other smaller bombs nearby.

2. There is a lot of debate at present about the best way of ***disposing of the domestic waste*** we generate. In the past it was dumped in holes in the ground – old quarries and sand or gravel pits. Such landfill sites are limited in number. They also have to be prepared and managed carefully to prevent chemicals from the waste polluting underground water, streams and rivers. Where organic waste is disposed of to landfill and then decomposes it is known to produce methane gas, with explosive consequences. What are other options for waste disposing? Alternatives to landfill are generating less waste, recycling (including not only useful materials such as tins, paper and glass but also organic matter that can be composted) and burning waste.

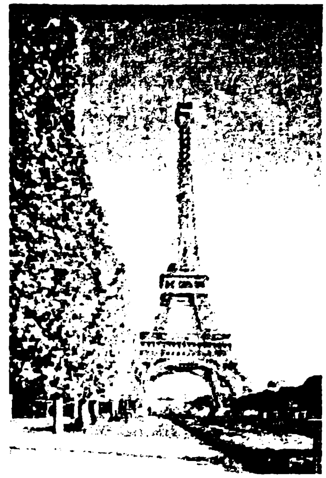
3. ***Burning domestic waste*** in order to reduce its amount and to release useful energy is being much discussed today. A lot of such waste-to-energy plants proposed across the UK are causing strong opposition. The engineers developing and managing these plants work within much tighter guidelines and restrictions than was once the case. Although recycling is uncontroversial and many people support well-organized schemes, there is concern about the potential dangers of such power stations. The Environmental Protection Agency has published a report on problems arising from incinerating waste. It claimed that such projects were perhaps more dangerous than it was thought. One person's waste-to-energy plant is another's incinerator.

4. ***Making high-quality alloy products*** is a complex process including many stages.



a) Quenching is defined as rapid cooling by placing in oil or water, of a metal object from the high temperature at which it is shaped. This is usually done to maintain mechanical properties that will be lost with slow cooling. Quenching is commonly applied to harden steel objects. On the contrary, ***tempering*** is known as heat treating of metal alloys, particularly steel, to impart specific properties. For instance, heating hardened steel to 752°F (400 °C) and holding it for a time before quenching in oil decreases its hardness and brittleness and produces strong and tough steel. Quench-and-temper heat treating is applied at many different cooling rates, holding times, and temperatures, and is a very important means of controlling the properties of steel.

b) Casting is the process of pouring molten metal into a mold, where it solidifies into the shape of the mold. The process was well established in the Bronze Age, when it was used to form bronze pieces now found in museums. It is particularly valuable for the economical production of complex shapes, ranging from mass-produced parts for automobiles to one-of-a-kind production of statues, jewelry, or massive machinery. Most steel and iron castings are poured into silica sand. For metals of lower melting point, such as aluminium or zinc, molds can be made of metal or of sand.



5. *Home-made Electricity?* Two wires of different metals (e.g. iron and copper), an alcohol / gas flame and an earphone are needed for the experiment. Try connecting the wires to the earphone and rubbing their ends in the flame. This will let you hear sounds caused by a small electric current being produced in the heated wires. Can you explain how it works? Each metal has its own natural rate for losing electrons. The contact being made, heat forces a more active metal to loose some electrons from its surface to a less active metal. This transfer of the electrons is the electric current. Try putting the ends of the wires into salt water and rubbing them together while in the solution. This will allow electricity to be produced, not by heat but by chemical action.

6. *Natural infrared lasers* are very rare in space. However, it was reported that a powerful ultraviolet laser beam, several million times brighter than our Sun, shooting toward Earth from a super-hot 'death star' located 8,000 light-years away had been observed with NASA's Hubble Space Telescope. The astronomers identified a gas cloud acting as a natural ultraviolet laser, near the huge, unstable superstar called Eta Carinae – one of the most massive and energetic stars in our Milky Way Galaxy. The ultraviolet laser in Eta Carinae shines in the same way as artificial optical lasers and similar, microwave devices called masers. The discovery will provide scientists with a new tool for studying how monster interstellar lasers actually work.

Writing

a) Read these advertisements below and choose the one you like most.

Design Engineer

We are a long established large engineering company specializing in mechanical equipment and require to appoint a design engineer for our design office. The applicant should be aged between 24-36 and must have a sound and practical engineering background. He/She should have experience in lorry attachments and conveyor systems; must be able to work on his/her own initiative and be very active. This is an extremely responsible position with good prospects for further advancement.

Please reply in own handwriting with your CV to:

Minsk Tractor Works
29 Dolgobrodskaya street
220668 Minsk, Belarus
tel/fax: 2272166

Quality Engineer

The Instrument-Making Plant now has an opening for a Quality Engineer to take full responsibility for ensuring quality-related activities.

Educated to at least BA degree level in mechanical engineering, experience in quality improvement in instrument-making industry will be a distinct advantage. A working knowledge of problem-solving techniques is essential. There will be excellent opportunities for career development as the company continues to grow.

To apply, please send a CV to:

Sergei Levashov,
Instrument-Making Plant
31 Kulman street
220310 Minsk, Belarus

Deadline is Friday April 25

Analyst Programmer

Salary $ Negotiable

A growing company requires an analyst programmer with at least two years' "C+" or "Java" experience.

You will need excellent interpersonal and communication skills and be able to work effectively as a member of a team.

We offer an attractive range of benefits and prospects to our employees, including life assurance, permanent health insurance and the company car.

Apply in writing enclosing your CV to:

Alexey Petrov
IBA
10 Yakub Kolas Sq.
220015 Minsk, Belarus

b) Write your CV and a letter of application for the post you've chosen.

SUPPLEMENTARY READING

TEXT 1

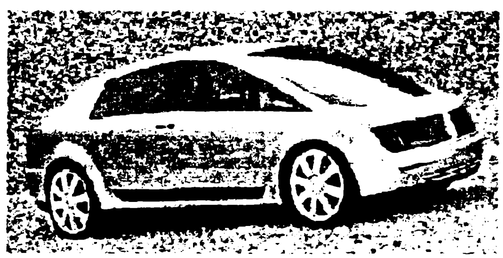
I. Scan the text to find answers to these questions.

1. Is the function of the car very complicated?
2. What features affect the car design today?
3. How does the Hy-wire differ from the conventional car?
4. Why is there no engine compartment in the Hy-wire?
5. Where is all the equipment positioned?
6. How is the Hy-wire operated?
7. What are the major problems of the Hy-wire to be solved in the near future?

II. Read the text attentively for more details about the unusual car.

How GM's Hy-wire Works

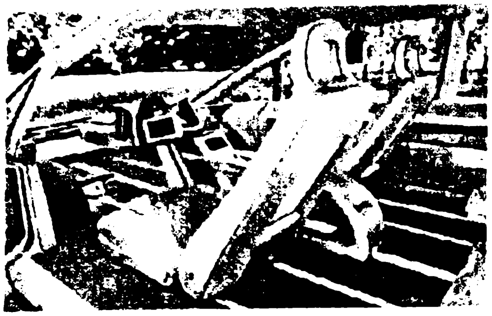
Cars are very complicated machines with an incredibly simple job of turning wheels. The overall function of the car being so basic, does it actually need all those complex heavy devices? Most likely, a lot of us will be driving radically different vehicles within 20 years.



GM's sedan model Hy-wire

Two basic elements dictating car design are the internal combustion engine and mechanical and hydraulic linkages. The defining feature of the Hy-wire is that it has neither of them. The engine is replaced with a fuel cell stack, which powers an electric motor connected to the wheels. A computer-based drive-by-wire system substitutes the linkages.

These changes result in a very different car - and a very different driving. There are no pedals, no steering wheel and no engine compartment. In fact, all the equipment moving the car is housed in an 11-inch-thick aluminium chassis at the base of the car. The main computer in the chassis sends electronic signals to the motor control unit to vary the speed, the steering mechanism to maneuver the car, and the braking system to slow the car down.



Everything above the chassis serves only to driver control and passenger comfort, but the coolest thing in this design is the possibility to switch from a van to a sports car just by replacing the car body.

The driver's control unit (X-drive) looks like a video game joystick having two ergonomic grips, to the left and right of a small monitor replacing an instrument panel and giving you a rear view from video cameras (in place of mirrors). Buttons on the controller let you switch easily from neutral to drive to reverse, and a starter button turns the car on. As it doesn't directly drive any part of the car, the X-drive controller can be moved freely in the passenger compartment. A second monitor provides stereo, climate control and navigation information.

There are no ideal cars as yet. Safety is a big concern with drive-by-wire cars since electrical failure means the total loss of control. The other burning issue is developing energy-efficient methods of supplying hydrogen for the onboard fuel-cell stacks. Assuming that GM can tackle the major fuel and safety issues satisfactorily, the highway will see some major changes within the next few decades.

III. Choose the correct option to complete the sentences.

1. The simple job of the car consists in ... .
   a) turning wheel; b) showing video-film;
   c) having complex devices.
2. The major characteristic of the Hy-wire design is the absence of ... .
   a) the internal combustion engine; c) both.
   b) mechanical and hydraulic linkages;
3. The driving system operated by the computer receiving and sending electronic signals is also known as a ... system.
   a) 'fly-by-wire'; b) 'drive-by-wire'; c) 'fuel cell'.
4. The main computer is installed ... the passenger compartment.
   a) in; b) under; c) above.
5. Speed, mileage and fuel level information are available to the driver ... .
   a) on the monitor of the X-drive; b) on a video camera;
   c) on the instrument panel.
6. The Hy-wire is started by ... .
   a) pushing a button on the X-drive; b) turning a grip;
   c) observing the monitor.

7. While operating the Hy-wire you do not use your ... .

a) hands; b) feet; c) head.

8. To mass-produce the Hy-wire car General Motors will have to solve the problems of ... .

a) passengers; b) highways; c) safety and fuel supply.

IV. Translation Check. Use the dictionary if necessary.

Zero-pollution Cars

The electric car is an environmentally friendly alternative to gasoline-powered vehicles. It performs like a conventional car with one important difference – it is nearly silent and pollution-free. The electric car is propelled by an electric motor powered from a controller, which in its turn gets its power from rechargeable batteries. However, the batteries need replacement every 20,000 miles. Fuel cells solve the battery problem.

A fuel cell is an electrochemical energy conversion device that converts hydrogen and oxygen into water, producing electricity and heat in the process. Unlike a battery, you can continually recharge a fuel cell by adding chemical fuel – hydrogen from an onboard storage tank and oxygen from the atmosphere. The proton exchange membrane fuel cell (PEMFC) seems to be one of the most promising technologies. A single fuel cell produces about 0.7 volts. To get this voltage up many separate fuel cells are combined to form a fuel cell stack.

Zero-pollution cars are also designed to run on compressed air using the concept of the steam engine. Liquid nitrogen stored at –320 °F serves as the propellant for the LN2000's cryogenic engine. Air moving around the vehicle heats the liquid nitrogen to the boiling temperature and causes it to turn to gas pushing on the engine's pistons. The only emission being nitrogen (which makes up 78% of the atmosphere), the air-compressed car fully justifies the name of its manufacturer – Zero-pollution Motors.

TEXT 2

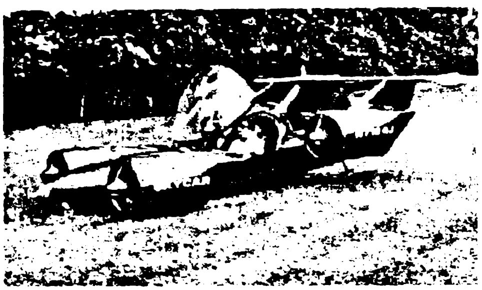
I. Scan the text to find answers to these questions.

1. When was the first flying car designed?
2. What models of flying cars have already been designed?

3. What speed can the Skycar develop?
4. Is the Skycar fuel-efficient?
5. What is a 'fly-by-wire system'?
6. How does the CityHawk differ from the Skyrider?
7. Why are flying cars designed as an alternative to road cars?

II. Read the text carefully and say what you have learnt about the new breed of cars.

Flying Cars



Just a decade and a half after the Wright Brothers took off in their airplane over the plains of Kitty Hawk, N.C., in 1903, other pioneering men started dreaming of a flying car. The attempt to develop a gliding horse cart in the 18th century, to no great surprise, failed. Numerous flying cars are being invented today. Moller's latest project, the Skycar M400, is designed to take off and land vertically, like a Harrier Jet, in small spaces. Having a range of 900 miles, it will cruise at around 350 mph with the top speed of 400 mph using petrol, diesel, alcohol, kerosene and propane as fuel. The fuel mileage of the Skycar will be comparable to that of a medium-sized car, getting 20 miles to the gallon. To make the Skycar safe and available to public, it will be completely controlled by computers using the Global Positioning System (GPS) satellites – a so-called 'fly-by-wire system'. In an emergency the vehicle will release a parachute and airbags, internally and externally, to cushion the impact of the crash. The cost of a Skycar is estimated to be $60,000 if mass-produced.

MACRO Industries' SkyRider X2R will use the same fly-by-wire system to safely transport passengers. Drivers will simply get in, turn on the power and enter the address or phone number of the desired destination, with the SkyRider doing the rest. MACRO said that the system would be fully automatic, but allowing some manual control. Commands will be entered just by telling the car what you want it to do.

Similarly to Skycars and SkyRiders, CityHawks also take off and land vertically. However, there are some key differences. The CityHawk will be powered by fans driven by four internal combustion engines. This number of engines will allow the vehicle to land even if one of the engines is lost. The CityHawk will have cruising speeds of 90-100 mph. The car is likely to be used as an air taxi, for news gathering and for traffic control.

The mass availability of flying cars can be very scary. Yet, if proper safeguards observed, flying cars will not only cut rush hours and traffic jams, but also they will allow us to live hundreds of miles farther from work and still make it to the office in no time.

III. Choose the correct option to complete the sentences.

1. The Wright Brothers' invention started the idea of flying ... .
   a) horse carts; b) airplanes; c) cars.
2. The first developments of flying cars in the early 1900s were ... .
   a) surprising; b) ineffective; c) successful.
3. The Skycar takes off and lands ... .
   a) vertically; b) horizontally; c) spirally.
4. Without refuelling the Skycar can fly ... miles.
   a) 350; b) 400; c) 900.
5. The Skycar uses as much fuel as ... ..
   a) the Harrier Jet; b) a medium-sized car; c) a GPS satellite.
6. The function of the Skyrider is ... .
   a) to safely transport passengers; b) to sky fight;
   c) to control traffic.
7. The CityHawk will be propelled by ... .
   a) funs; b) fans; c) fins.
8. Flying cars will create problems of ... .
   a) traffic jams and rush hours; b) safety;
   c) moving away from polluted cities.

IV. Translation Check. Use the dictionary if necessary.

A New Form of City Transport?

Just don't call it a high-tech scooter! The Segway is the world's first self-balancing human transporter. It is quite stable on two wheels and runs on ordinary household electricity at the speed of 12 mph having the range of 15 miles. Four major elements of the Segway include the wheel and motor assembly, the sensor system, the circuit board brain and the operator control system. Balancing is controlled by a solid-state silicon gyroscope* system, which passes all tilt information to the two electronic controller circuit boards comprising 10 onboard microprocessors, which in total are three times as powerful as a typical PC. Their function is to adjust the speed of several electric motors according to the stability information. The motors, powered by a pair of rechargeable nickel metal hydride (NIMH) batteries, can turn each of the wheels independently at variable speeds. When the vehicle leans forward or backward, the motors spin both wheels forward or backward accordingly to keep from tilting over. When the rider operates the handlebar control to turn left or right, the motors spin one wheel faster than the other, or spin the wheels in opposite directions, so that the vehicle rotates. The machine is unlikely to replace the car but it is a superior option for the city.

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*A basic gyroscope is a spinning wheel inside a stable frame. A spinning object resists changes to its axis of rotation. As the point of applied force moves along with the object itself, it ends up applying force on opposite ends of the wheel – the force balances itself out and the gyroscope maintains the stable position.

TEXT 3

I. Scan the text to find answers to these questions.

1. What is a car?
2. Does the car have many applications?
3. What did the mass production of cars result in?
4. Is the car an efficient means of urban transportation?
5. What problems has the car caused?
6. How do environmentalists suggest improving transportation?
7. What fuel will the cars run on in the future?

II. Read the text attentively to learn more about the questions the cars pose.

Cars: Passion or Problem?

For many people, cars are more than a convenient form of transportation; they are a source of passion and pleasure. Yet cars can also be a source of many problems.

In 1903, Ford Motors became the first to mass-produce cars. This made the car available to large numbers of people. It has brought people much closer to places of work, study, and entertainment. Many people also work in car-related industries: fixing cars, washing cars, advertising cars and selling car products such as stereos and cellular phones.

Many Americans buy a new car every six years. In fact, there are more cars than people in the United States. In New York City, 2.5 million cars move in and out of the city each day. In this traffic, the average speed is sometimes 8.1 miles per hour. This speed could be easily reached by riding a horse instead of driving a car.


The 2000 Honda Insight hybrid electric car

Environmentalists dream of turning parking lots into parks and replacing cars with bicycles. They insist on developing public transportation and point out that it saves fuel and does not damage the environment that much. Many people around the world are unhappy with car traffic and pollution but they cannot imagine their life without driving.

Still, there is an important question that must be answered: What kind of fuel will be used when gasoline is no longer available? To solve this problem, car companies in Korea, Japan, Europe, and the US develop electric cars that will not require gasoline at all.

The electric car is not a new idea. Being pollution-free, quiet and easy to start, it had a success with women in the 1900s. But gasoline-powered cars were faster and soon became much more popular. In the 1970s, when there were serious problems with the availability of oil, car companies began to plan for a future without gasoline again.

Today's new interest in the electric car is partly related to a passion for speed and new technology. In 1987 a solar-powered car won a 2,000-mile race in Australia. Air-compressed cars, fuel cell cars, flying cars are currently under development. However, the importance of cars will not decrease, no matter how they change in the future.

III. Choose the correct option to complete the sentences.

1. The major function of the car is to serve as ... .
   a) a means of transportation; b) a source of entertainment;
   c) a source of problems.
2. The mass production of cars made the cars ... .
   a) large; b) practical; c) available.
3. The New Yorkers move at approximately 8.1 mph because they ... .
   a) like horse riding; b) are not in a hurry;
   c) stop in traffic jams.
4. Environmentalists object to ... .
   a) replacing cars with bikes; b) polluting the environment;
   c) developing public transportation.
5. The topical question of the day is ... .
   a) what fuel will replace gasoline; b) how much fuel will cost;
   c) when electric cars will appear.

6. Electric cars are being developed because conventional fuel will soon become ... .

a) expensive; b) unavailable; c) inefficient.

7. Electric cars lost popularity in the 1920s because they were ... .

a) pollution-free, quiet and easy to start; b) slow;

c) driven by women.

8. Even if the cars totally change in the future, their importance will not ... .

a) increase; b) decrease; c) change.

IV. Translation Check. Use the dictionary if necessary.

Why Bicycle?

A public bus trip here in Greifswald costs 1.50 Euro, the taxi is much more expensive. And it is environmentally dangerous! (Don't forget that Germany is one of the 'greenest' countries in Europe). Maybe that's why most people here prefer a healthy, pollution-free, cheap and convenient vehicle – the bicycle. Indeed, it's as difficult to imagine Greifswald without this kind of 'public transport' as it is hard to imagine this city without students!

The bicycle in Greifswald is a dream of every newcomer. Some of them are lucky to obtain it from their friends, but there are still those who are sadly looking at the daily bike traffic along the streets and go to their workshops on foot. According to unofficial statistics here in Greiswald every person has a bicycle or even two. It's as natural as eating sausages for breakfast. The average commercial price of an average make of a bicycle is around 200 Euro. The average price of a stolen bike at the local 'black market' is much lower – 30 – 50 Euro. Here you even have a chance to buy your own bike, stolen last week, though already coloured from pink to blue. If you even don't have a Ferrari, having a new 'Adventure' (probably one of the best makes of a bicycle in Greifswald), sounds quite cool.

P.S.: One thing that every owner of a bike ought to remember: LOCK IT!!!

TEXT 4

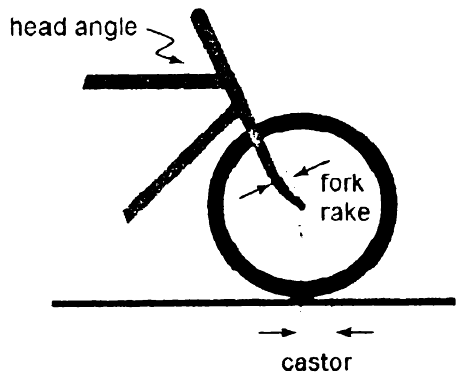
I. Scan the text to find answers to these questions.

1. What is bicycle riding compared to?
2. What forces make the bicycle fall over?
3. What force prevents you from falling when cornering?
4. How is riding 'hands off' possible?

5. Why is a slowly moving bicycle stable?
6. How does the bicycle rider balance?
7. What should we consider in order to make the bicycle stable and easy to ride?

II. Read the text attentively to learn more about bicycle riding laws.

Riding a Bicycle



Why is riding a bicycle so much easier than tight-rope walking if in both cases you are in contact with the ground through two very small areas? This is how physicists explain it.

The bicycle doesn't stay up on its own. It falls over under the influence of the weight (mg) acting vertically downwards through the centre of mass and the reaction (R) from the ground acting vertically upwards. Some extra forces to keep the bicycle up are clearly needed.

Steering into the direction of fall makes the bicycle travel in a curve. The resulting centrifugal force experienced by the bicycle and the rider pushes them upright again, so correcting the fall. This simple theory of balancing explains why the bicycle cannot be ridden with the front fork locked. However, it does not explain why it is possible to ride 'hands off'.

The rotating wheel is observed to be much more stable than the stationary wheel as spinning stabilizes the motion due to the conservation of angular momentum. Also, the precession of the front wheel automatically steers even the riderless bicycle to keep it upright.

At slow walking speed the gyroscopic forces are definitely too weak and riding is controlled by the steering geometry of the bicycle concerning the head angle (the angle of the axis of rotation with the ground) and the fork rake (it shows the relations of the wheel axle and the rotation axis). They control two important features to do with the bicycle stability. The first is the castor of the front wheel showing how far the point of contact with the ground is behind the steering axis. It determines how strongly steering is self-centering and stable. The second feature is the lowering of the centre of mass by means of turning the handlebars.

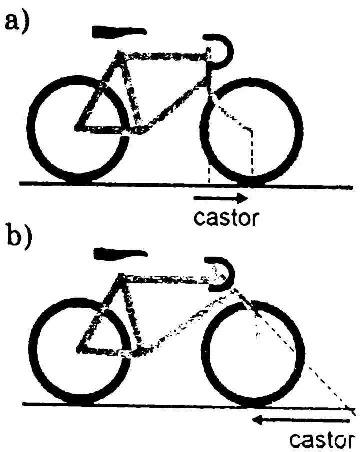
This addition to the theory of balance works as follows. As the bicycle begins to overbalance while moving, the handlebars automatically turn in the direction of lean to lower the potential energy. This makes the bicycle travel in the right sort of curve to correct the lean. The castor of the front wheel stops the handlebars from turning too far and forces them to straighten up when the bicycle is upright again. A combination of centrifugal force, gyroscopic action and correct steering geometry gives us a stable bicycle that is easy to ride.

III. Choose the correct option to complete the sentences.

1. Tight-rope walking is ... bicycle riding.
   a) much easier than; b) as easy as; c) more difficult than.
2. The bicycle falls over under the influence of ... .
   a) the center of mass; b) mg and R; c) some extra forces.
3. The centrifugal force pushes the rider ... .
   a) towards the centre; b) away from the centre;
   c) along the circle.
4. The front fork locked ... .
   a) causes the centrifugal force; b) makes riding impossible;
   c) improves your balance.
5. Angular momentum and gyroscopic action make the bicycle ... .
   a) stable; b) rotating; c) stationary.
6. At slow walking speed the stability of the bicycle is controlled by ... .
   a) gyroscopic forces; b) the head angle and the fork rake;
   c) the handlebars.
7. The negative castor means that the bicycle is ... .
   a) very unstable; b) super-stable; c) lying flat on the ground.
8. Handlebars are used to ... .
   a) increase the potential energy; b) raise the centre of mass;
   c) correct the lean.

IV. Translation Check. Use the dictionary if necessary.

Bike Extremes



Understanding how a bicycle balances allows us to design the two extremes – an unridable bicycle and a super-stable bicycle. The first will have a very steep head angle and an enormous fork rake (a). This ensures a negative castor and the centre of mass rises when the handlebars are turned towards the lean. That is, the handlebars will try to turn in the wrong direction when the bicycle leans over. This bicycle is very difficult to ride. All your skill is needed just to stay upright, and you certainly couldn't ride hands off.

Just by reversing the design we could also make a super-stable bicycle. All we need is a small head angle combined with a negative fork rake as seen in picture (b). This bicycle is so stable that it will travel riderless until it almost stops. However, it is awful to ride. It is too stable to be steered in any direction desired and only an inert rider with no balancing reflexes and no sense of direction would be happy on such a machine.

The bicycles we normally ride are between these two extremes. For a bicycle to be maneuverable, it should not be too stable, but for safety and ease of use, it should not be unstable. Cycling connoisseurs get their frames handmade to their own measurements. You can see now how steering geometry will affect the feel and the handling of the bicycle.

TEXT 5

I. Scan the text to find answers to these questions.

1. What is the carbon content of steel?
2. How does adding carbon influence the properties of steel?
3. How is tool steel produced?
4. Why are thick tools often soft inside?
5. What drawbacks do carbon steel tools have?
6. Do cooks use knives and other cutlery made of strong carbon steel?
7. In what ways is the quality of steel improved?

II. Read the text attentively to learn more about the developments in steel making.

Steel Quality

In order to understand tool quality, remember that steel is basically iron with a carbon content of 1.7 percent or less. Adding carbon makes the metal harder, but also more brittle, less malleable and less resistant to stress and shock. As tools differ, steel is matched with a suitable carbon content for each tool.

Tool-quality steel must have at least 0.6 % of carbon content. This insures that the steel can be heat-treated. Traditionally, heat treating involves heating the metal to about 1,350 °F and then plunging it in to cool water. This abrupt cooling technique, called quenching, changes the carbon particles in the metal into hard carbide crystals. Heat treating produces a hard edge on tools. However, it only penetrates about 1/8" into the metal and thick tools retain a soft center.

Obviously, the quality of each tool depends on the skill of the smith, but many old tools are still in use today. These 'water-hardened steel' tools are made of carbon steel and hold a very keen edge. Yet, they have two serious drawbacks. These tools tend to rust easily and to lose their temper and edge at high temperatures: e.g. carbon-steel drill bits will dull quickly when used in an electric drill; a carbon-steel turning chisel, for use on a lathe, loses its edge when subjected to the friction of the rotating wood.

In order to make better steel, metallurgists experiment with various alloy ingredients. For example, adding tungsten or molybdenum results in high-speed steel resisting a great heat build-up. When buying drill bits, be sure to look for ones made of high-speed steel. Chromium and nickel make steel stainless or rustproof. Early stainless steel knives had one major drawback however; they could not hold a sharp edge the way carbon steel knives could. Chefs and serious cooks preferred carbon steel knives (even though they were prone to rusting) for this reason. Metallurgists gradually improved the quality of stainless steel having developed a grade for cutlery that is rust-resistant and can hold a keen edge.

In addition to creating alloys, manufacturers also improve the techniques of steel making. They have developed special heat-treating ovens and slow-quenching methods so that temper and hardness could be accurately controlled.

III. Choose the correct option to complete the sentences.

1. Basic steel contains ... 1.7 percent of carbon.
   a) exactly; b) no more than; c) no less than.
2. Steel with a high carbon content is ... .
   a) hard and brittle; b) malleable; c) shock and stress resistant.
3. Different tools are made from steels with ... carbon content.
   a) the same; b) different; c) similar.
4. Heat treating produces a hard edge on tools as a result of carbon ... .
   a) heating; b) quenching; c) crystallizing.
5. 'Water-hardened ' or carbon steel tools have the advantage of being ... .
   a) wear-proof; b) rustproof; c) temperature-proof.
6. The best drill bits are likely to be made of ... steel.
   a) carbon; b) stainless; c) high-speed.
7. Earlier chefs and serious cooks preferred carbon steel knives because they were ... .
   a) sharp; b) rusty; c) stainless.
8. The new techniques in steel making aim at ... .
   a) creating special heat-treating ovens;
   b) developing slow-quenching methods;
   c) controlling temper and hardness accurately.

IV. Translation Check. Use the dictionary if necessary.

The Rims of Steel

Ancient metal smiths realized that tools would last longer if the hard shell could somehow be inserted in the core of the metal. In Damascus they developed the technique of folding the metal again and again, then hammering it into a solid piece of laminated steel. This method was so successful that Damascus steel became prized throughout the ancient world. The lamination technique was perfected to manufacture samurai swords and continues today in tool making in Japan. However, the Damascus process took time. Each piece had to be tested for quality and there were many rejects. The process was eventually replaced by a less complicated technique. The smith shaped the tool, heated it in the forge, and then quenched it. By carefully limiting the thickness of the tool, the blacksmith could create a tool with the right combination of toughness and hardness.

Are modern tools superior to those of past generations? In general yes, but there are cheap exceptions. Such tools are case-hardened so that the hard exterior is only a fraction of an inch thick. When the tool is sharpened, the hard exterior is ground off; and the tool cannot hold an edge. Some tools look like stainless steel, but they are only nickel-plated. As soon as the plating wears off, the tool begins to rust. You get what you pay for. When it comes to tools, it pays to buy good quality products.

TEXT 6

I. Scan the text to find answers to these questions.

1. What is weathering?
2. What are the main chemical weathering processes?
3. Are there any chemical weathering agents more active than pure water?
4. How does hydrolysis work?
5. Can limestone dissolve in pure water?
6. What role does water play in weathering?
7. What form of weathering is dominant in the desert areas?

II. Read the text attentively and say what new things you have learnt about weathering.

Weathering

Weathering is the general term used to describe the breakdown and alteration of materials near the Earth's surface into products that are more in bal-

The Giants' Causeway

ance with the physical and chemical conditions experienced there. No rock material can escape the impact of weathering.

Considering the processes that alter rock at the Earth's surface, we usually distinguish chemical and physical weathering, with water playing the major role. The main chemical processes include solution, hydrolysis, carbonation, oxidation and chelation.

Solution is the process in which minerals simply dissolve in water. It is controlled by the amount of water available and the solubility of material. Although some minerals will dissolve in pure water, the weak acids formed when certain substances (e.g. sulphur dioxide) dissolve in water are more effective weathering agents – remember acid rains!

Hydrolysis describes the direct reaction between water and a mineral in which the material is replaced by hydrogen from water.

Carbonation occurs as follows. Small quantities of carbon dioxide can be dissolved by rainwater to form weak carbonic acid. Additional carbon dioxide can be picked up as water drains through the soil. Carbonic acid is a very effective solvent of carbonate-rich rocks such as limestone, which are only slightly soluble in pure water.

Oxidation of iron, common in most rock minerals, creates characteristic reddish weathering profiles.

Biological processes (e.g. the decomposition of plant matter) can extract metal cations that would otherwise be insoluble. This process is called chelation.

The chemical processes involved in rock breakdown are complex, but the dominant factor is the supply of water. In desert environments chemical weathering is limited by the lack of available moisture.

Physical, or mechanical, weathering involves changing in volume of within the rock mass causing the pressure release, which normally results in breaking off blocks of the rock. It is evident that physical and chemical weathering processes are closely interrelated.

III. Choose the correct option to complete the sentences.

1. Weathering is the process of breaking and ... materials near the Earth's surface.

   a) creating; b) changing; c) developing.

2. Weathering influences ... rock materials.

   a) all; b) some; c) no.

3. Solution, hydrolysis, carbonation, oxidation and chelation are ... weathering processes.

   a) physical; b) chemical; c) mechanical.

4. Acid rains are the result of ... of certain gases in water.

   a) solution; b) chelation; c) hydrolysis.

5. Carbonic acid is a very effective solvent of ... .

   a) carbon; b) rocks; c) limestone.

6. Reddish weathering profiles are produced by the oxidation of ... .

   a) sulphur; b) iron; c) carbon-rich rocks

7. ... is the main component of all chemical weathering processes.

   a) solution; b) balance; c) water.

8. Physical, or mechanical, weathering normally results in ... pieces of rock.

   a) breaking off; b) pressing; c) releasing.

IV. Translation Check. Use the dictionary if necessary.

The Influence of Weathering

Given that all the rocks are heading towards breakdown, weathering poses a number of opportunities and problems for humans. The breakdown of rock material is essential for the operation of other processes at the Earth's surface. Weathering produces materials, which are then transported by rivers, rain or wind. It also releases minerals from rocks, which are essential in the soil formation. The layer of altered rock created by weathering (termed regolith) contains various minerals that can be concentrated to become economically workable for mining. Bauxite deposits, which are a major source of aluminium ore, are created by tropical chemical weathering. At the same time weathering can create problems for human activity, especially through the damage it causes to building materials. The conservation of our architectural heritage requires action against the effects of weathering. In natural landscapes too, weathering can impose hazards, particularly where it is responsible for weakening rock so that it becomes dangerous. And yet, although the 'breakdown' may imply a negative impact but in fact weathering is the adjustment of materials to more stable states. As such, weathering is an essential link in the cycle of Earth surface materials.

TEXT 7

I. Scan the text to find answers to these questions.

1. What qualities are given to spiders in legends?
2. What are the properties of spider silk?
3. How is the super-strength of spider silk proved?
4. What is silk made of?
5. Where do spiders obtain amino acids?
6. Is the structure of the cobweb homogeneous?
7. Why is the spider's spinning technique environmentally friendly?

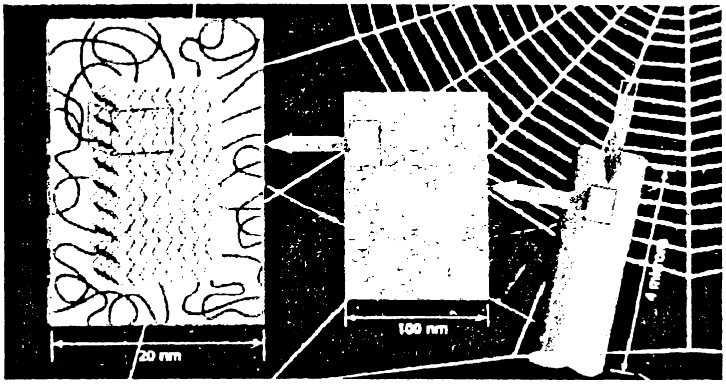
II. Read the text attentively to learn more about the secrets of spiders.

Spiders' Webs

In myths and legends, spiders and their silk webs have equally fabulous properties. Today scientists are trying to solve the secrets of spider silk. Their discoveries may eventually lead to the biosynthesis of a new generation of materials.

Spider silk has extraordinary properties. The web of the garden spider is so fine that we only see it when covered with dew. However, the threads of spider silk are estimated to be much stronger than steel threads of identical thickness. Experimenting proves that if the web were scaled up, with threads as thick as a pencil, it would be certain to stop a Boeing 747 in full flight. The cobweb is not only strong; it is also able to absorb the energy of the flying object without giving it back. If they did, the web would behave like a trampoline. Instead the recoil is buffered by a mechanism built into the fibre. Engineers could make very good use of a fibre with such amazing qualities. The secret must lie in the structure of silk.

Silk is a protein. Its molecules are made up of long chains of amino acids covalently linked together. Spiders are known to feed on insect protein, which they break down by digestion to amino acids used in the synthesis of silk. Each particular protein has a unique sequence of amino acids. Some chains of protein form nanocrystals making silk fibres smooth and strong. Between the crystals, other lengths of the protein chain form a mass of coils



making the web soft and rubbery in order to stretch and absorb the energy of an impact.

Chemists envy the spider's spinning technique because, unlike the processes for making artificial fibres, it is environmentally friendly. Kelvar, the high-tech fibre used in body armour, is spun from concentrated sulphuric acid heated almost to the boiling point. By contrast, spider protein produced as a water jelly by the glands inside the spider is somehow turned into a water-insoluble fibre at the temperature of the spider's surroundings. Besides, the web being broken easily, the spider often has to create a new one. Always efficient, it recycles the protein by eating the old silk and proposing researchers another mystery to be solved.

III. Choose the correct option to complete the sentences.

1. The secrets of spider silk ... .
   a) have fabulous properties; b) haven't been solved yet;
   c) are kept well.
2. Spider silk has extraordinary properties of being ... .
   a) fine and invisible; b) strong and non-resistant;
   c) like a trampoline.
3. Steel threads are ... spider silk threads.
   a) as strong as; b) much stronger than; c) far less stronger than.
4. The web does not behave like a trampoline because ... .
   a) it absorbs the energy of an impact;
   b) it can stop a Boeing 747 in full flight;
   c) it is made of protein.
5. Spider protein consists of ... .
   a) dead insects; b) silk; c) amino acids.
6. The web is a complex structure of nanocrystals combined with ... .
   a) amino acids; b) coils; c) flying objects.
7. The function of a disorderly mass of coils is to make the web ... .
   a) strong and shiny; b) absorb the energy of the impact;
   c) tangled.

8. The spider's ability to produce silk at the temperature of its surroundings and to recycle the web later proves its spinning techniques to be ... .

a) very mysterious; b) artificial; c) environmentally friendly.

IV. Translation Check. Use the dictionary if necessary.

Biosilk

The demand for super-strong materials forces scientists to imitate Nature. They found out that biotechnology made synthetic silk protein possible. Research proved that a synthetic gene with the blueprint for a silk protein could be inserted into the genome of a bacterium. The gene of the spider Nephila clavipes was used because this silk is unusually strong. It was expected that the bacteria with that gene would make silk protein. The bacteria were reported to be cultured in a fermenter where they grew and multiplied, producing large amounts of silk protein. However, to form a fibre the silk protein had to be dissolved and spun.

As the production of milk and silk are basically similar, there is also the possibility of obtaining silk from transgenic goats. Researchers are known to have recently transferred the synthetic silk-producing gene to the milk-producing cells of a goat. The silk protein dissolved in goat milk is likely to be easier to spin into fibre than that produced by bacteria.

The question is how soon the scientists will invent an efficient method of spinning silk. It was predicted long ago that if biosilk became a reality it would find many uses including bullet-proof vests, commercial fishing nets, tethering satellites. Have you any other ideas?

TEXT 8

I. Scan the text to find answers to these questions.

1. When and where was paper invented?
2. How did the invention of paper influence the development of the mankind?
3. Does paper have any advantages over computers?
4. Are there any disadvantages of using paper?
5. What is the objective of creating E-Ink?
6. How does E-Ink beat current display technology?
7. Will environmentalists mind applying E-Ink on a large scale?

II. Read the text attentively and say what new things you have learnt about E-Ink.

E-Ink – A Revolution in Information Technology

With a world full of electronic displays made with liquid crystals, light-emitting diodes and gas plasma, you probably don't think of paper as being a revolutionary display technology, but the Chinese invention of paper in 105 A.D. forever changed the way the world communicates. Without it, books might still be printed on silk rolls, making literacy an expensive skill. It would be nearly impossible to live one day without coming into contact with paper in some form. This year, for example, the world will consume an estimated 280 million tons of paper.

For nearly 2,000 years, ink on paper was the only way to display words and images, and it still beats computer displays when it comes to portability and price. Paper also doesn't require an external power supply. Yet it does have some limitations: once printed on paper, words cannot be changed without at least leaving some marks, and it is also difficult to carry around a large number of books.

Scientists are developing a revolutionary technology that could replace paper, called electronic ink. It will allow you to carry a whole library in one book. E-Ink technology aims at creating a digital book that can type-set itself and that readers could leaf through just as if it were made of regular paper. Such a book could be programmed to alternate between up to 10 books stored on the device. Just as electronic ink could radically change the way we read books, it could change the way you receive your daily newspaper. Simply pressing a button on the delivery computer will simultaneously update thousands of electronic newspapers each morning.

E-Ink has several advantages over current display technology, including: low power usage, flexibility and readability. Electronic ink uses 50 to 100 times less power than liquid crystal displays because it only needs power when changing the display. E-Ink can be printed on any surface, including walls, product labels and T-shirts. You will soon be able to change your digital wallpaper by sending a signal to the electronic ink painted on the walls. Another advantage electronic ink has over traditional computer displays is its readability. It looks more like printed text, so it's a lot easier on the eyes. And it saves trees by cutting the demand on paper!

III. Choose the correct option to complete the sentences.

1. The invention of paper changed the world communication by making books ... .

   a) expensive; b) available; c) impossible.

2. For nearly 2,000 years words and images were displayed by means of ... .

   a) ink and paper; b) portable computers; c) books.

3. E-Ink technology will eventually create ... .
    a) paper; b) newspapers; c) a digital book.
4. The digital book will look like ... .
    a) a computer display; b) a common book; c) a silk roll.
5. Liquid crystal displays consume ... E-Ink.
    a) more energy than; b) less energy than;
    c) as much energy as.
6. Electronic ink needs power in order to ... .
    a) change the display; b) alternate between the books stored;
    c) show pictures.
7. Digital wallpaper, T-shirts and glass prove E-Ink to be ... .
    a) energy-efficient; b) readable; c) flexible.
8. Good readability of E-Ink means that the text is ... .
    a) harmless for the eyes; b) easy to understand;
    c) weighs very little.

IV. Translation Check. Use the dictionary if necessary.

How Electronic Ink Will Work

Electronic ink is a new material that will have far-reaching impact on how society receives its information. This patented material is processed into a film for integration into electronic displays. The principal components of electronic ink are millions of tiny microcapsules, about the diameter of a human hair. Each microcapsule contains positively charged white particles and negatively charged black particles suspended in a clear liquid.

Cross-Section of Electronic-Ink Microcapsules

When a negative electric field is applied, the white particles move to the top of the microcapsule where they become visible to the user. This makes the surface appear white at that spot. At the same time, an opposite electric field pulls the black particles to the bottom of the microcapsules where they are hidden. By reversing this process, the black particles appear at the top of the capsule, which now makes the surface appear dark at that spot. To form an E-Ink electronic display, the ink is printed onto a sheet of plastic film that is laminated to a layer of circuitry. The circuitry forms a pattern of pixels controlled by a display driver. These microcapsules are suspended in a liquid 'carrier medium' allowing them to be printed onto any surface, including glass, plastic, fabric and even paper. In the long run, electronic ink may have a multibillion-dollar impact on the publishing industry.

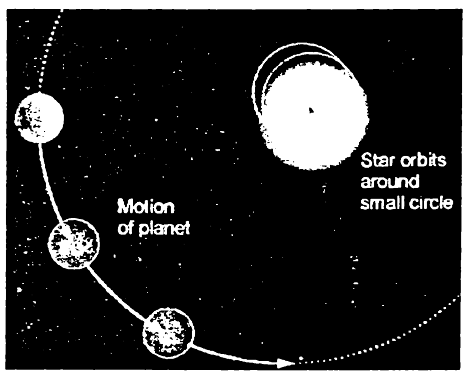
TEXT 9

I. Scan the text to find answers to these questions.

1. How many planets of the solar system are invisible to the naked eye?
2. What planets were discovered last?
3. What are the two methods of spotting distant planets today?
4. Are the stars fixed?
5. Why do stars wobble?
6. What is the Doppler effect?
7. What is the problem with the newly-discovered planets?

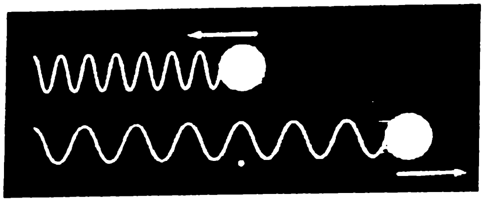
II. Read the text attentively to learn more about space exploration.

Discovering New Worlds



Nine planets of our solar system orbit round the Sun, six of them being visible to the naked eye. To see the other three (Uranus, Neptune and Pluto) you need a telescope, and you need to know where to point it. The two outermost planets were discovered because of the effect of their gravitational pull on the orbit of Uranus. From the speeding up and slowing down of Uranus, astronomers could work out where the unseen planets were.

Now the gravitational pull of planets on stars has allowed us to find giant planets in orbit around stars far from this solar system. Think about a large



planet orbiting close to the star. Both move around, the planet following a large circle, with the star moving in a smaller circle. Both turn around their common centre of gravity. This causes the star to wobble slightly in space.

How can this help in spotting a new planet? A distant star is moving towards us for half the time and moving away for the other half. This has an effect on the light we receive from the star. As the star moves towards us, its light waves are compressed, shortening their wavelength so that they look bluer ('blue shift'). As it moves away, its waves are stretched out and look redder ('red shift'). This is the Doppler effect observed for any form of wave. Identifying a star, the frequency of whose light shifts back and forth along the spectrum, first towards blue and then towards red, the scientists interpret this as showing that the star is wobbling in its orbit, as a result of the gravitational pull of a large planet.

Distant planets are almost impossible to see, as they do not shine by their own light. However, they reflect the light of their star. Moreover, moving around its orbit such a planet will periodically block the star's light giving the scientists more proofs of its own existence.

There is a problem with the newly-discovered planets. They seem to be massive. Their orbiting around the stars at high speed means that they are very close to the stars, and therefore very hot. Our ideas of how planets form do not fit very well with this. Jupiter-sized planets are expected to be gassy giants, far from their stars, where it is cold enough for gases such as carbon dioxide and ammonia to freeze solid. The theorists have some explaining to do.

III. Choose the correct variant to complete the sentences.

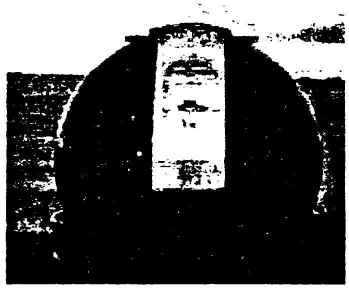
1. Six planets of the solar system are visible... .
   a) through a telescope; b) without a telescope; c) with a laser.
2. Neptune and Pluto were discovered due to ... .
   a) the invention of a telescope: b) their influence on Uranus;
   c) the skill of astronomers.
3. Scientists do not look for ... in order to spot a distant planet.
   a) laser flashes; b) wobbling stars; c) blocked star light.
4. The star being orbited by a large planet is ... .
   a) fixed; b) shining brightly; c) wobbling.
5. The 'blue shift' means that the star moves ... .
   a) around its gravity center; b) away from us; c) towards us.
6. The pitch of the police siren becoming lower (the sound waves are stretched out) means the police car moving ... .
   a) around you; b) away from you; c) towards you.

7. Distant planets are difficult to spot as they do not ... .
   a) shine; b) reflect the light of the star;
   c) block the star's light.
8. According to our theories of planet formation giant planets must be ... .
   a) fast and hot; b) massive and gassy;
   c) cold and far from their star.

IV. Translation Check. Use the dictionary if necessary.

Life Beyond?

Planets beyond the solar system are known as exo-planets. In 1999 British astronomers reported they had detected a reflected light of a giant exo-planet orbiting the star Tau Bootis, 50 light years away, using the William Hershel Telescope in the Canary Islands.



When astronomers look at the light coming from distant exo-planets, they hope to find signs of life. They use a diffraction grating to split the light up into its different wavelengths – in other words they make a spectrum. From this, they can identify the elements present. In the 19th century it was argued that we would never be able to discover what stars are made of. However, examination of the spectra of light from stars soon showed that they were made of the same elements as those on the Earth, mostly hydrogen and helium.

The Earth is different from the other planets in the solar system. Its atmosphere contains oxygen, and that shows up in its spectrum. Oxygen is a sign of life as most plants and animals need it for breathing. But the Earth's atmosphere has not always contained oxygen. It is estimated to have been around only since the first algae produced it by photosynthesis, 2.5 billion years ago. So oxygen isn't simply a sign that life could exist on a distant planet – it is a sign that it almost certainly *does* exist. Astronomers are still looking.

ACTIVE VOCABULARY

Unit 1

accountant, n бухгалтер
architect, n архитектор
be, v быть
to be afraid of sth бояться чего-л.
to be good/bad at sth хорошо/плохо разбираться в чем-л.
to be tired of sth/ sb устать от чего-л./кого-л.
to be busy with sth быть занятым чем-л.
to be surprised at sth удивляться чему-л.
to be impressed by sth/sb быть под впечатлением от чего-л./ кого-л.
to be bored with скучать от
to be fed up with быть сытым по горло от
to be interested in интересоваться
to be fond of любить
to be crazy about сходить с ума по
to be proud of гордиться
to be eager сильно (очень, страстно) желать
to be in the 1st (2nd, etc.) year быть на первом (втором, ...) курсе
carpenter, n плотник
chemist, n химик
department, n факультет, отделение
correspondence department заочное отделение
economist, n экономист
electrician, n электрик
engineer, n инженер
engineering, n техника, конструирование, строительство
civil engineering гражданское строительство
mechanical engineering машиностроение
power engineering энергетическое строительство
electrical engineering электротехническое строительство
electronic engineering электроника
freshman, n первокурсник
graduate, n выпускник
joiner, n столяр
junior, n третьекурсник
mathematician, n математик
mechanic, n механик
metrologist, n метролог
physician, n терапевт
physicist, n физик
postgraduate, n магистрант, аспирант
senior, n студент последнего курса
sophomore, n второкурсник
student, n студент

Unit 2

Section A

also, adv также
alternator, n генератор переменного тока
although, adv хотя
as так как
axis (axes, *pl*), n ось
horizontal axis горизонтальная ось
vertical axis вертикальная ось
charge, v заряжать(ся)

recharge, v перезаряжать(ся), повторно заряжать
discharge, v разряжаться(ся)
choose, v выбирать
draw, v рисовать, чертить
enough, adv достаточно
evenly, adv равномерно, одинаково
fast, adj быстрый; adv быстро, часто
graph, n график, диаграмма
indication, n показание
investigate, v изучать, исследовать
label, v помечать, отмечать
move, v двигать(ся), передвигать(ся)
number, v нумеровать
operate, v приводить(ся) в движение, управлять(ся), работать
operation, n работа; *мат.* действие, (технологическая) операция
panel, n панель
record, v записывать, регистрировать
repair, v чинить
slowly, adv медленно
solve, v решать
to solve problems решать примеры
strong, adj сильный
turn, v вращать(ся)
variable, n переменная (величина)
dependent variable зависимая переменная
independent variable независимая переменная

Section B

accelerate, v разгонять, ускорять(ся)
amount, n величина, количество
carry out, v выполнять, проводить
circuit, n цепь
clip, n зажим, клемма
crocodile clips зажимы типа "крокодил"
conductor, n проводник
connect, v соединять
decrease, v уменьшать(ся)
definite, adj определенный
determine, v определять
electricity, n электричество
flow, v течь; n поток
increase, v увеличивать(ся)
lead, n провод
look for, v искать
multimeter, n мультиметр
observe,v наблюдать
prepare for, v готовиться к
probe, n щуп
range, n диапазон, интервал, предел
resistance range диапазон (изменения) сопротивления
relationship, n отношение
resistance, n сопротивление
switch, n переключатель
switch function selector переключатель функций
unit, n элемент, единица
value, n значение, величина, показатель, число
voltage, n напряжение

Unit 3

Section A

accept, v принимать; допускать, признавать, соглашаться
access, n доступ
to have access to иметь доступ к
according to, prep согласно, в соответствии с

accurately, adv точно
add, v складывать
available, adj доступный; имеющий-ся в распоряжении
calculation, n вычисление
to do calculations производить вычисления
calculating machine устройство для вычислений
communicate, v сообщать, передавать; общаться
compile, v компилировить
compile a programme составлять программу
CPU (Central Processing Unit) центральный процессор
data, n данные, факты, информация
decision, n решение
to make a decision принимать решение
define, v определять, устанавливать значение
display, v выводить данные на экран; n дисплей
divide into, v делить
drive, n дисковод
dull, adj скучный; монотонный
embrace, v включать, заключать в себе, содержать
employ, v применять, использовать
encoding, n кодирование
fail, v повреждаться, выходить из строя, отказывать
floppy, n гибкий (магнитный) диск
floppy disc гибкий диск
hardware, n аппаратное обеспечение
input, n ввод
keyboard, n клавиатура
make up, v составлять, комплектовать
memory, n память
mouse, n мышь (*устройство указания*)
multiply, v умножать
network, n вычислительная сеть
output, n вывод
owing to, prep по причине, вследствие, благодаря
peripheral, n периферийное устройство; adj периферийный
permanent, adj постоянный, неизменный, долговременный
powerful, adj сильный, могучий, мощный
precisely, adv точно
primarily, adv прежде всего, главным образом
process, v обрабатывать
to process information обрабатывать информацию
processor, n процессор
remain, v оставаться, пребывать в прежнем состоянии
replace, v заменять, замещать
screen, n экран
software, n программное обеспечение
storage, n запоминание; хранение
storage device устройство хранения информации
store, v хранить
subtract, v вычитать
supply, v поставлять, доставлять, давать; n поставка
transmit, v отправлять, посылать, передавать
user, n пользователь
with the help of с помощью

Section B

advantage, n преимущество
basic, adj основной

branch, n отрасль, ветвь
branch of industry отрасль промышленности
branch of science отрасль науки
capability, n возможность, способность
capable, adj способный, возможный
come out, v выходить, появляться
concept, n понятие, идея, общее представление, концепция
consume, v потреблять, расходовать
contain, v вмещать, содержать в себе
count, v подсчитывать, считать
deal with, v рассматривать вопрос, иметь дело (*с чем-л.*)
depend on, v зависеть от
develop, v развивать, разрабатывать, создавать
development, n развитие
devise, v создавать, разрабатывать
disadvantage, n недостаток
frame, n рама, корпус
general-purpose, adj универсальный
generation, n поколение
go on doing sth продолжать делать что-л.
improve, v улучшать
in comparison with, prep в сравнении с
intelligent, adj умный
invent, v изобретать, создавать
invent the abacus изобрести счеты
invention, n изобретение
inventor, n изобретатель
link, v связывать, соединять; n связь; соединение
occupy, v занимать (*пространство*)
power, n способность, возможность, мощность
reduce, v уменьшать, снижать
reduce possibility уменьшить вероятность
remarkable, adj замечательный, удивительный
save, v сохранять, беречь, спасать
save time экономить время

Unit 4

Section A

actuate, v приводить в действие; запускать; включать
actuator, n привод, исполнительный механизм
advance, n успех, прогресс, улучшение
although, adv хотя
apply, v применять, употреблять
bend, v сгибать(ся), изгибать, гнуть
capacity, n возможность
carry, v нести, перемещать, переносить
cause, v вызывать, приводить (*к чему-л.*)
complex, adj сложный, трудный
create, v создавать
degree, n степень
discover, v открывать
discovery, n открытие
essential, adj необходимый, важный
even, adv даже
experience, n опыт работы
extend, v увеличивать(ся), растягивать(ся)
field, n сфера, область (*исследования, применения*)
in the field of в области
force, n сила, усилие
gear, n механизм, устройство, прибор
industrial, adj промышленный
manipulator, n манипулятор
muscle, n мускул, мышца

pick up, v поднимать, подбирать
place, v помещать, устанавливать; n место, пространство
plant, n завод, фабрика
production, n производство, изготовление; продукция
production line производственная линия, технологическая линия
provide, v предоставлять, обеспечивать
recently, adv недавно
reduce, v уменьшать, снижать
robotics, n = **robot engineering** роботостроение, робототехническая промышленность
sequence, n серия, последовательность, ряд
sequence of operations серия операций
series, n ряд, серия
spring, v пружинить; n пружина
straighten, v выпрямлять, разгибать
stretch, v растягивать(ся), натягивать

Section B

achieve, v достигать
achievement, n достижение
begin, v начинать
certain, adj определённый
consist of, v состоять из
effector, n исполнительный орган
end effector рабочий орган (*робота*)
efficient, adj эффективный, действенный
finish, v заканчивать
grip, n захват, захватное устройство; v захватывать
gripping device захватное устройство
handle, v справляться, выполнять
hazardous, adj опасный
install, v устанавливать, монтировать
to install equipment устанавливать оборудование
monotonous, adj монотонный
motion, n движение
put, v положить; приводить
to put into operation приводить в действие
relieve, v облегчать, ослаблять, уменьшать
repetitive, adj без конца повторяющийся, скучный
research, n исследование; изучение; изыскание
to carry out research выполнять, проводить изыскания
research work исследовательская работа
sensor, n датчик; чувствительный элемент, сенсор
start, v начинать
switch on, v включать
switch off, v выключать
widen, v расширять(ся)
to widen one's possibilities расширить возможности

Unit 5

Section A

accelerator, n акселератор, ускоритель
brake, n тормоз
brakes (*pl*) тормозная система
burn, v гореть, сгорать
carburettor, n карбюратор

chamber, n камера; отсек; отделение
combustion chamber камера сгорания
chassis, n ['ʃæsɪ]-*sing*, ['ʃæsɪz]-*pl* шасси
combustion, n сгорание, сжигание
internal combustion engine двигатель внутреннего сгорания
compose, n составлять
compress, v сжимать, подвергать сжатию
drive, v вести, управлять; приводить в движение; n привод, передача
equip, v оборудовать, оснащать
feed, v поддерживать; снабжать (*топливом, водой, сырьём*), питать
gear, n передача, шестерня
ignite, v возгорать(ся); зажигать(ся)
intake, n поступление, приток; впускное устройство
air intake воздухозаборник
locate, v размещать, располагать
mix, v смешивать; перемешивать
piston, n поршень
pump, n насос
fuel pump топливный насос
refer to, v относиться к
separate, adj отдельный
situated, adj расположенный
be situated располагаться
steering, n рулевое управление
suspension, n подвеска
independent suspension независимая подвеска
system, n система, комплекс, установка
automatic braking system система автоматического торможения
fuel system топливная система
lubrication system система смазки
cooling system система охлаждения
tank, n бак; цистерна
fuel tank топливный бак
venturi, n трубка Вентури

Section B

adjust, v настраивать, регулировать
arise, v возникать, появляться
attention, n внимание
pay attention to обращать внимание на
comfortable, adj удобный, комфортабельный, уютный
considerably, adv значительно
construct, v строить, сооружать, конструировать
design, v проектировать, разрабатывать, конструировать; n проект, разработка, конструкция
detect, v обнаруживать
distance, n расстояние
ensure, v обеспечивать, гарантировать
feature, n признак, свойство, характерная особенность, характерная черта
feed, v подавать, питать, снабжать
gasoline, n бензин
gearbox, n коробка передач, коробка скоростей
highway, n магистраль
automated highway автоматизированная магистраль
in time, adv вовремя
introduce, v внедрять, вводить
monitor, v контролировать, управлять
passenger, n пассажир

place, v помещать; размещать; n место, пространство
power, v снабжать энергией, приводить в действие
respond, v реагировать, срабатывать
space, n место, пространство
stability, n стабильность, устойчивость, стойкость, прочность
steam, n пар
successful, adj успешный, удачный
unless, prep если не, пока не
workload, n нагрузка

Unit 6

Section A

acoustic, adj акустический
acoustic system акустическая система
cab, n кабина
cleanliness, n очистка
condition, n условие
under good condition при хороших условиях
control, n контроль, система управления, рычаг управления
demand, v требовать; n требование
due to, prep благодаря
enable, v давать возможность
enhance, v увеличивать, повышать
exist, v существовать
filter, n фильтр
oil filter маслофильтр
climate control filter фильтр климатического контроля
flat, adj плоский
illustrate, v иллюстрировать, пояснять
incorporate, v внедрять, вводить, устанавливать
involve, v включать в себя
level, n уровень
light, n свет, фара
work light фара
maintain, v обслуживать, содержать в исправности, поддерживать в хорошем состоянии
manufacture, v производить, изготовлять, обрабатывать
mount, v устанавливать, собирать, монтировать, крепить
noise, n шум
opportunity, n возможность
outstanding, adj выдающийся, знаменитый
performance, n производительность, функционирование, эффективность
productivity, n продуктивность, производительность
protect against, v защищать от
purpose, n цель
quality, n качество
high quality высокое качество
low quality низкое качество
refinement, n улучшение, (у)совершенствование
reliable, adj надежный
require, v требовать
requirement, n требование
to meet requirements соответствовать требованиям
specifications, n технические характеристики
time-consuming, adj отнимающий много времени
torque, n вращающий момент, крутящий момент
transmission, n привод, коробка передач, трансмиссия

truck, n грузовой автомобиль, (грузовая) тележка
trust, v доверять
wear, n износ
works, n завод

Section B

casing, n кожух, чехол, корпус
changer, n переключатель, механизм смены (*инструментов, валков* и т. п.)
fixture, n приспособление, арматура
lathe, n токарный станок
machine, n станок
cylindrical machine цилиндрический станок
prismatic machine призматический станок
milling machine фрезерный станок
drilling machine сверлильный станок, бурильная машина
grinding machine шлифовальный станок, заточный станок
boring machine расточный станок, сверлильный станок, бурильная машина
multi-purpose machine многоцелевой станок
machining centre многоцелевой станок
numerical control числовое программное управление, ЧПУ
computer numerical control (CNC) ЧПУ типа CNC
direct numerical control (DNC) станок с централизованным программным управлением
remove, v удалять, снимать
shape, v формировать
simultaneously, adv одновременно

tool, n орудие (производства); инструмент
hand tool ручной инструмент
machine tool станочная (автоматизированная) система
cutting tool режущий инструмент, резец
metal-cutting tool металлорежущий инструмент

Unit 7

Section A

ability, n способность; возможность
able, adj способный, умелый, умеющий
to be able to уметь, мочь, быть в состоянии / в силах
alloy, v сплавлять, легировать
annually, adv ежегодно
appliance, n электроприбор
domestic appliances предметы домашнего обихода
brass, n латунь, жёлтая медь
bronze, n бронза
constituent, n составная часть, компонент
decoration, n отделка, украшение
ductile, adj ковкий, тягучий; вязкий (*о металле*)
estimate, v оценивать
evidence, n свидетельство
except, prep исключая, кроме
extract, v извлекать
functional, adj конструктивный
heat, n тепло, теплота
lead, n свинец
machine, v обрабатывать на машине или станке

mine, v разрабатывать, добывать
ore, n руда
copper ore медная руда
plumbing, n водопроводно-канализационная сеть
pure, adj чистый, беспримесный
rate, n скорость, степень
recover, v восстанавливать
recycling, n повторное использование, утилизация
resource, n ресурс; *мн.* запасы
run out, v истощаться, кончаться
scrap, n отходы
surface, n поверхность
tin, n олово
tremendous, adj огромный, громадный
turnings, n (*pl*) токарная стружка
uniform, adj единообразный, однообразный, однородный
workability, n способность подвергаться обработке, обрабатываемость

Section B

account for, v объяснять, отвечать, являться причиной
add, v добавлять, присоединять
beside, prep кроме, помимо
cast, v лить, отливать
chromium, n хром
comprise, v включать, содержать, состоять из
content, n содержание, доля
corrode, v ржаветь; подвергаться действию коррозии
especially, adv особенно, главным образом
exceptionally, adv исключительно, крайне
furnace, n печь
harden, v закаливать(ся), повышать прочность; твердеть
ingot, n слиток, чушка
iron, n железо, чугун
pig iron передельный чугун, чушковый чугун
malleable, adj ковкий; тягучий
melt, v расплавлять(ся), плавить(ся)
modify, v видоизменять, модифицировать
ornamental, adj декоративный
particular, adj особый
percentage, n процентное содержание
purify, v очищать(ся)
range from... to... колебаться в пределах от... до...
refine, v улучшать, (у)совершенствовать
resistivity, n (электрическое) удельное сопротивление
rust, v ржаветь
steel, n сталь
alloy steel легированная сталь
carbon steel углеродистая сталь
tool steel инструментальная сталь
stainless steel нержавеющая сталь
molten steel расплавленная сталь
strength, n прочность
strengthen, v усиливать, упрочнять
superior, adj лучший, превосходный, высшего качества
temper, v закалять
treat, v подвергать (технологической) обработке, обрабатывать
work, v обрабатывать
working, n обработка

Section C

absorption, n поглощение
account, n внимание, расчёт
to take into account принимать во внимание
additive, n добавка, примесь
anisotrophic, adj анизотропный
bakelite, n бакелит
cause, v вызывать
chain, n цепь, цепочка
characteristic, n характерная черта, особенность, свойство
combine, v объединять, сочетать
compare, v сравнивать
composite, n композиционный материал
conclusion, n вывод, заключение
convert, v превращать, переделывать
define, v определять
detailed, adj детальный, подробный, обстоятельный
draw up, v составлять (*документ*), оформлять
durability, n прочность; стойкость; долговечность
fabrication, n изготовление, сборка
fail, v провалиться, потерпеть неудачу
failure, n авария, повреждение, неудача, провал
fibre, n волокно
glass fibre стекловолокно
carbon fibre углеволокно
impact, n воздействие, влияние
incineration, n сжигание (*отходов*)
include, v включать, содержать
insulation, n изоляция
keep, v сохранять
laminate, n слоистый материал
limit, v устанавливать предел, ограничивать
material, n материал
materials engineering материаловедение
nylon, n нейлон
object, n объект (*изучения* и *т. п.*), задача
obtain, v получать, приобретать
peculiarity, n характерная черта, особенность
plastics, n пластмассы
thermosetting plastics термореактивные пластмассы
thermoplastics термопластические смолы
polymer, n полимер
polythene, n полиэтилен
procedure, n процедура, процесс
properly, adv должным образом; как следует; правильно
prove, v доказывать
report, n отчет
resin, n полимер, смола
phenolic resin фенолоальдегидный полимер
shock, n удар, толчок
smooth, adj ровный, гладкий
solid, adj твердый; n твердое тело
stiff, adj негнущийся, жёсткий
sufficient, adj достаточный
synthetic, adj синтетический
while, cj пока, в то время как

Unit 8

Section A

affect, v влиять
apron, n фартук
arc, n электрическая дуга
attach, v прикреплять(ся); присоединять(ся)

bead, n сварной шов
boot, n ботинок
brush against, v слегка задевать
by means of посредством
clothing, n одежда
protecting clothing защитная спецодежда
conventional, adj =**ordinary** обычный, общепринятый
crack, n трещина
currently, adv действующий в настоящее время
damage, v повреждать; n повреждение
decade, n десятилетие
desirable, adj желанный
despite, prep несмотря на
drastic, adj коренной, радикальный
effect, n влияние
electrode, n электрод
establish, v устанавливать
exhibit, v показывать, проявлять
follow, v придерживаться, следить
fuse, v плавить(ся), сплавлять(ся)
fusion, n плавка, слияние
glove, n перчатка
helmet, n шлем, каска
hence, prep следовательно
holder, n ручка, рукоятка
join, v соединять
joint, n стык
latter, adj последний (*из двух названных*); *противополож.* **the former**)
location, n местоположение
neither... nor... ни... ни...
nevertheless, cj тем не менее
overall, n спецодежда
owing to, prep по причине, вследствие, благодаря

penetration, n глубина проплавления
response, n реакция (*на воздействие*); срабатывание
rod, n стержень, прут
rule, n правило
safe, adj безопасный
safety rules правила безопасности
significant, adj значительный, важный, существенный
soften, v размягчать; смягчать
strike, v ударять; зажигать дугу
surface, n поверхность
tensile, adj прочный на разрыв
the same, adj одинаковый
tip, n кончик
transformer, n трансформатор
unique, adj единственный в своём роде; уникальный
wear, v быть одетым (*во что-л.*); носить (*одежду и т. п.*)
weld v сваривать; n сварной шов
welding, n сварка
widespread, adj широко распространённый

Section B

allow, v позволять, разрешать
block, v заклинивать(ся), засорять(ся)
both... and... и...и ...
clean, v чистить
coil, n спираль
coil spring цилиндрическая (винтовая) пружина
condition, n условие, состояние
consequently, adv следовательно
consume, v потреблять, использовать

consumption, n потребление
contract, v сжиматься
convenient, adj удобный, подходящий; пригодный
cool, v остывать
deliver, v поставлять; доставлять; снабжать
ease, v ослаблять, освобождать, облегчать
even, adj одинаковый; тот же самый
exact, adj точный
expand, v расширять(ся); увеличивать(ся) в объёме
expansion, n увеличение в объёме, расширение
gauge, n измерительный прибор
fuel gauge топливный расходомер
fit, v устанавливать, монтировать
function, v действовать; n функция
immediately, adv немедленно
inside, prep внутри
leading, adj ведущий; передовой
light, n свет
warning light предупреждающий световой сигнал
load, v нагружать; n нагрузка
means, n средство, способ
means of transport средство передвижения
overhaul, v ремонтировать; n ремонт
particle, n частица
fine particles мелкие частицы
prevent, v не допускать, препятствовать
quantity, n количество, величина
sensitive, adj чувствительный
stress, n нагрузка
supervision, n наблюдение
thermostat, n термостат
wax, n воск

Unit 9

Section A

abbreviate, v сокращать
alteration, n изменение
bulb, n лампочка
burn out, v выгорать, перегорать
capacitor, n конденсатор
cell, n батарейка, (фото)элемент
fuel cell топливный элемент
charged, adj заряженный
circuit, n цепь
closed circuit замкнутая цепь
condenser, n конденсатор
core, n стержень, ядро
coursework, n курсовая
current, n ток
direct current прямой ток
alternating current переменный ток
dielectric, n непроводник
electricity, n электричество
expect, v предполагать, ожидать
filament, n нить накала
force, v вынуждать
frequency, n частота
gap, n зазор, промежуток
air gap воздушный зазор
generate, v вырабатывать, генерировать
glow, v гореть, светиться
grid, n энергетическая сеть
transmission grid сеть электропередач
induce, v вызывать
insulator, n изолятор, непроводник
loss, n потеря; (*мн.*) потери
mica, n слюда
negative, adj отрицательный

notice, v замечать
notion, n понятие
power, n энергия
power plant электростанция
thermal power термическая энергия
nuclear power ядерная энергия
underground steam power энергия подземного пара
solar power солнечная энергия
kinetic power кинетическая энергия
chemical power химическая энергия
rectifier, n выпрямитель
reverse, v менять направление на противоположное
rotate, v вращаться
socket, n патрон, розетка
stand for, v символизировать, означать
supervisor, n научный руководитель
through, prep через, по
transformer, n трансформатор
step-up transformer повышающий трансформатор
step-down transformer понижающий трансформатор
turn, n виток (проволоки)
turn out, v вывёртывать
wind, v наматывать
winding, n обмотка
input winding входная обмотка
output winding выходная обмотка
primary winding первичная обмотка
secondary winding вторичная обмотка
wire, n провод
overhead conductor wire провод воздушной линии

Section B

absorb, v поглощать
account, n расчет, отчет
to take into account принимать во внимение
accumulate, v накапливать
array, n панель
cell, n элемент
photovoltaic cell фотоэлемент
circulate, v циркулировать
collect, v собирать
collector, n коллектор
solar collector солнечный коллектор
cover, v покрывать
divert, v отводить
excess, adj излишний
exhaust, v истощать
fossil, adj ископаемый
fossil fuel ископаемое горючее
furnace, n печь; топка
solar furnace солнечная печь
housing, n жилой фонд
housing development жилой массив
huge, adj огромный
inexhaustible, adj неистощимый
pollute, v загрязнять
pollution, n загрязнение
pollution-free, adj экологически чистый
run, v работать, действовать, приводить в движение
search for, n искать
solar-powered, adj приводимый в движение солнечной энергией
solution, n решение
sunlight, n солнечный свет

tackle sth, v пытаться найти решение
transfer, v передавать
variation, n изменение

Unit 10

Section A

constantly, adv постоянно
evident, adj очевидный
exhaust, v истощать
immensely, adv чрезвычайно
nearly, adv почти
option, n вариант
reason, n причина
reliable, adj надежный
resource, n ресурс
renewable resources, *pl* возобновляемые ресурсы
satisfy, v удовлетворять
satisfy needs удовлетворять нужды
sensible, adj разумный, ощутимый
shortage, n недостаток, нехватка
source, n источник
alternative energy sources альтернативные источники энергии
threaten, v угрожать
time, n раз
(...) times as much в (...) раз больше
turn into, v превращать
twice, adv дважды
usable, adj годный к употреблению

Section B

antifreeze, n антифриз
backwards, adv назад
common, adj обычный
coolant, n смазочноохлаждающая эмульсия
dirt, n грязь
dissipate, v рассеивать
dust, n пыль
emit, v выбрасывать, выделять
external, adj внешний
fault, n ошибка, неисправность
fill up, v заполнять, наполнять
flat, adj разряженный
flat battery разряженная батарея
fluid, n жидкость
foresee, v предсказывать, предвидеть
forwards, adv вперёд; дальше
gap, n искровой промежуток
hose, n шланг, гибкий трубопровод
impurity, n загрязнение, грязь
jam, v заедать, заклинивать(ся)
mixture, n смесь
fuel mixture топливная смесь
order, n порядок
in order в порядке
out of order не в порядке
overhaul, n (капитальный) ремонт
overheat, v перегревать(ся)
pipe, n труба
exhaust pipe выхлопная труба
plug, n пробка, заглушка
spark plug свеча зажигания
point, n точка
freezing point температура замерзания, точка замерзания
boiling point температура кипения, точка кипения
pull, v тянуть
pump, v подавать насосом, качать
push, v толкать
release, v освобождать, разблокировать

ring, n кольцо
piston ring поршневое (уплотнительное) кольцо
service, v обслуживать
service station станция техобслуживания
start, v заводить, запускать, включать; начинать
starter, n стартер (*устройство для пуска двигателя*)
thorough, adv основательный, тщательный
unobstructed, adj беспрепятственный, свободный

Unit 11

Section A

assure, v обеспечивать
award, v награждать
beam, n луч
reference beam опорный луч
object beam объектный луч
coat, v покрывать
coating, n покрытие, светочувствительный слой
colourful, adj красочный, яркий
dichromatic, adj двухцветный
direction, n направление
emboss, v чеканить
film, n пленка
foil, n фольга
hologram, n голограмма
holography, n голография
illuminate, v освещать
image, n образ, изображение
three-dimensional image трёхмерное изображение
multidimensional image многомерное изображение
imagine, v воображать, представлять
imperfect, adj несовершенный
indefinitely, adv неограниченно, неопределенно
intend, v предназначать, намереваться
interference, n взаимное влияние; интерференция
interference pattern интерференционная картина
lack, v испытывать недостаток, нуждаться, не иметь
lens, n линза, лупа
master, n мастер-модель, промодель
mirror, n зеркало
monochromatic, adj монохромный
numerous, adj многочисленный
opposite, adj противоположный
originally, adj первоначально
plate, n фотопластин(к)а
holographic plate голографическая пластина
power, n способность, (оптическое) увеличение
record, v записывать
reflect, v отражать
reflection, n отражение
respectively, adv соответсвенно
safelight, n неактиничный свет, безопасное освещение
separate, adj отдельный
single-colour, adj одноцветный
split, v разбивать
splitter, n разделитель
beam splitter расщепитель электронного луча
stable, adj устойчивый
stamp, v отпечатывать, оттискивать
the former, **the latter**, adj первый, последний *(из двух)*

vibration, n вибрация, колебание
view, v рассматривать
viewable, adj наблюдаемый
visible, adj видимый
whole, adj = **complete** целый

Section B

ability, n способность
act, v действовать
additional, adj дополнительный
approach, v приближаться, подводить; n подход
artificial, adj искусственный
conscious, adj сознательный
control, n управление
  remote control дистанционное управление
count (on), v рассчитывать
creature, n существо
definition, n определение
defuse, v взрывать
environment, n окружающая среда
eventually, adv со временем
explore, v исследовать
gather, v собирать
imitate, v имитировать
insert, v вставлять
intelligence, n разум, интеллект
linear, adj линейный
manipulate, v манипулировать
motor, n двигатель
  stepper motor шаговый (электро) двигатель
  servomotor серводвигатель, сервомотор
navigate, v управлять, направлять
neural, adj нейронный
  neural network нейронная сеть
qualify, v определять
respond, v реагировать, срабатывать
response, n реакция (*на воздействие*), срабатывание (*устройства*)
sense, v ощущать, чувствовать, понимать
solenoid, n соленоид
specific, adj определенный
stimulus, n сигнал возбуждения, стимул
suggest, v предлагать, советовать
supervise, v контролировать
surroundings, n окружающая среда
system, n система
  rule-based system экспертная система
ultrasonic, adj ультразвуковой

Unit 12

Section A

amplification, n усиление
amplifier, n усилитель
amplify, v усиливать
area, n область
back and forth, adv назад-вперёд
behaviour, n поведение
bounce, v отскакивать
cavity, n полость
coherence, n когерентность
concave, adj вогнутый
continuous, adj непрерывный
denote, v означать
directionality, n направленность
destruction, n разрушение
dozen, n дюжина
  in dozens of fields в десятках областей
excited, adj возбужденный

flash, n вспышка
flash lamp импульсная лампа, фотовспышка
flat, adj плоский
intense, adj интенсивный
inversion, n инверсия
population inversion инверсия заселённости (*энергетических уровней*)
majority, n большинство
mean, v значить
medium, n среда
monochromicity, n одноцветность, монохромность
oscillator, n генератор, осциллятор
partially, adv частично
pulse, v пульсировать
pulsed, adj пульсирующий
radiate, v излучать
reflective, adj отражающий
resonator, n резонатор
ruby, adj рубиновый
similar to, adj подобный, похожий
totally, adv полностью
transparent, adj прозрачный
treat, v обращаться
unlike, cj в отличие
upper, adj верхний, высший
variety, n разнообразие
via, prep через, посредством
wavelength, n длина волны

Section B

abundant, adj изобилующий
acid, n кислота
acid rain кислотный дождь
average, adj средний
ban, v запрещать
colourless, adj бесцветный
combustible, adj горючий
compound, n соединение
consequence, n последствие
consist in, v заключаться в
densely populated, adj густонаселенный
deplete, v истощать, разрушать
depletion, n истощение, разрушение
destructive, adj разрушительный
dioxide, n диоксид
envelope, n оболочка
environment, n окружающая среда
eutrophication, n эвтрофикация (*зарастание водоёма водорослями*)
far-reaching, adj далеко идущий
flammable, adj = **inflammable** легко воспламеняющийся, горючий
foam, n пенопласт
packaging foam упаковочный пенопласт
gas, n газ
industrial gas промышленный газ
natural gas природный газ
man-made gas искусственный газ
greenhouse, n парник, теплица
greenhouse effect парниковый эффект
infrared (IR), adj инфракрасный
insist on, v настаивать
layer, n слой
nitrogen, n азот
odourless, adj без запаха, непахнущий
overestimate, v переоценивать
oxygen, n кислород
ozone, n озон
pollutant, n загрязняющее вещество
present, adj присутствующий
react, v реагировать
refrigerant, n охладитель
release, v высвобождать

result in, v приводить к
solvent, n растворитель
state, n состояние
free state свободное состояние, несвязанное состояние
tasteless, adj безвкусный
toxic, adj токсичный
ultraviolet (UV), adj ультрафиолетовый

Unit 13

Section A

across, prep через
advanced, adj развитый
alien, adj внеземной
brief, adj краткий
bright, adj яркий
communication, n связь, коммуникация; система связи
compound, adj составной, сложный
detect, v замечать, находить, обнаруживать
distant, adj удаленный
entire, adj весь
establish, v устанавливать
eyepiece, n глазок
fascinating, adj увлекательный
fruitful, adj плодотворный
generate, v создавать
handheld, adj карманный
hardly, adv едва
interstellar, adj межзвездный
item, n предмет
last, v длиться
magnification, n увеличение
magnify, v увеличивать
maintain, v утверждать, заявлять
microscopy, n микроскопия
modify, v видоизменять
multitude, n множество
objective, n объектив
permanent, adj постоянный
practicable, adj осуществимый
resolution, n разрешение
scan, v наблюдать
sign, n знак, признак
significantly, adj значительно
spot, v находить
star, n звезда
sodium star натриевая звезда
X-rays, n рентгеновские лучи

Section B

appealing, adj привлекательный
booster, n ракета-носитель
combine, v сочетать(ся)
disintegrate, v распадаться
disposable, adj одноразового использования
essentially, adv по существу
experience, v испытывать
gimbal, n универсальный шарнир
house, v размещать
initially, adv сначала, изначально
irreplaceable, adj незаменимый
land, v приземляться
launch, v запускать
lift off, v взлетать
locate, v размещать, устанавливать
maneuvre, v маневрировать; n маневр
orbiter, n орбитальная ступень, многоразовый транспортный космический корабль
payload, n полезный груз
practice, n практика; применение; осуществление на практике

put into practice осуществлять
propellant, n ракетное топливо
rate, n интенсивность
recoverable, adj восстановимый
re-entry, n вхождение в атмосферу
reusable, adj многоразового пользования
satellite, n спутник
separate, v отделять(ся), разделять(ся); adj отдельный
shuttle, n многоразовый транспортный космический корабль, МТКК
space, n космическое пространство, космос
outer space космическое пространство вне земной атмосферы
spacecraft, n = **spaceship** космический корабль
storage, n резервуар; хранение; накопитель
store, v запасать; накапливать, хранить
take off, v взлетать
take-off, n взлет
thrust, n тяга, сила тяги, (реактивная) сила, толчок
weightless, adj невесомый

Unit 1

to be

The verb *to be* has the following forms in Present Simple.

Positive

I	**am**	a student. a disk.
He She It	**is**	
We You They	**are**	students.

Negative

I	**am not** **('m not)**	a student. a disk.
He She It	**is not** **(isn't)**	
We You They	**are not** **(aren't)**	students.

Questions

Am	I	a student? a disk?
Is	he she it	
Are	we you they	students?

Word Order

0. Place, time	1. Subject	2. Verb/Predicate	3. Object	4. Place, time
1. Now	we	are students		at University.
2.	The students	are fond of	English.	

Pronouns

Personal		Possessive
Subject	***Object***	
I	me	my
You	you	your
He	him	his
She	her	her
It	it	its
We	us	our
You	you	your
They	them	their

Demonstrative	
Singular	***Plural***
This is a wheel.	**These** are wheels.
That is a wheel.	**Those** are wheels.

EXAMPLES:

He is an architect.

I'm glad to meet **him**.

This is **his** wife.

There is / There are

a)

	There is		a ruler on the table.
	There is	not	
Is	there		a ruler on the table?

b)

	There are		rulers on the table.
	There are	not	
Are	there		rulers on the table?

c) Remember the structure of such questions: How many rulers <u>are there</u> on the table?

Prepositions

above

on

near | **in** | **at**

below

under

Degrees of Comparison

Comparatives of one-syllable adjectives (regular)

Positive	**Comparative**	**Superlative**
...	**... + er**	**... + est**
long	longer	the longest
wide	wider	the widest
big	bigger	the biggest
busy	busier	the busiest

EXAMPLES: This pipe is short.This pipe is shorter than that pipe.
This is the shortest pipe in the workshop.

Comparatives of longer adjectives (two/ three/ four syllables)

Positive	**Comparative**	**Superlative**
...	*more* + ...	*the most* + ...
powerful	**more** powerful	**the most** powerful
expensive	**more** expensive	**the most** expensive
elastic	**more** elastic	**the most** elastic

Positive	**Comparative**	**Superlative**
...	*less* + ...	*the least* + ...
practical	**less** practical	**the least** practical
difficult	**less** difficult	**the least** difficult
busy	**less** busy	**the least** busy

Irregular comparison

Positive	Comparative	Superlative
good	better	the best
bad	worse	the worst
much / many	more	the most
litlle	less	the least

Expressions of Quantity: "many, (a) few"/ "much , (a) little"

	Countable Nouns		Uncountable Nouns	
the quantity is large (много)	**many, a lot of**	wheels	**much, a lot of**	fuel
the quantity is small but enough (немного)	**a few** wheels		**a little** fuel	
the quantity is too small, not enough (мало)	**few** wheels		**little** fuel	

EXAMPLES: There are many nails in the toolbox.
There are a few nails in the toolbox. Take some.
There are few nails in the toolbox. Bring some more.
There is much cement in the box.
There is a little cement in the box. That's enough.
There's little cement in the box. I need some more.

Indefinite Pronouns "some /any / no"

some	positive	There is **some** petrol in the tank.
no	negative	There are **no** tools on the table.
(not) any	negative	There aren't **any** cars on the road.
any	question	Are there **any** computers in the classroom?

Remember the word order in the following questions:
Do you happen to know what engine it is?
Could you tell me where the Technical University is?

Unit 2

Present Progressive (Active)

Positive

I	am	studying.
He She It	is	
We You They	are	

Negative

I	am not ('m not)	studying.
He She It	is not (isn't)	
We You They	are not (aren't)	

Questions

Am	I	studying?
Is	he she it	
Are	we you they	

It is used to express

1) progressive actions that are going on now, at the moment of speaking.

I <u>am measuring</u> pressure right now.

2) progressive actions that are going on around now, not necessarily exactly at the moment of speaking.

I <u>am studying</u> Physics this semester at University.

Specific time expressions

right now, at the moment, today, this week, this month, this year, nowadays

Past Progressive (Active)

Positive

I He She It	was	working.
We You They	were	

Negative

I He She It	was not (wasn't)	working.
We You They	were not (weren't)	

It is used to express an action that was in progress at a specific time in the past.

Dima was reading a textbook at 7 o'clock yesterday.

Specific time expressions

at that time, at 6pm yesterday, the whole day, yesterday, from 3 to 5 o'clock yesterday

Future Progressive (Active)

Positive

I You He She It We They	**will be**	**watching.**

Negative

I You He She It We They	**will not be (won't be)**	**watching.**

Questions

Will	I you he she it we they	**be watching?**

It is used to express an activity that will be in progress at a specific time in the future.

I'll be working at the lab at 2 tomorrow.

Specific time expressions

at 5 o'clock tomorrow, from 2 to 3 tomorrow, at this time tomorrow, the whole day tomorrow

Unit 3

Present Simple (Active)

Positive

I You We They	**perform** **carry out**	different experiments.
He She It	**performs** **carries out**	

Negative

I You We They	**don't**	**perform** **carry out**	different experiments.
He She It	**doesn't**		

Questions

Do	I you we they	**perform** **carry out**	different experiments?
Does	he she it		

It is used

1) to state general facts in the present

   I <u>live</u> in Minsk. I <u>study</u> at the Technical University.

2) to state general rules or laws of nature

   Water <u>boils</u> at 100 °C.

3) to express habitual actions, regular routines

   My classes at University usually <u>begin</u> at 8am.

Specific time expressions

every day (month, year, ...), in the morning, usually, often, always, sometimes, seldom, rarely, on Sunday, at the weekend, as a rule, etc.

Past Simple (Active)

Positive

I You He She It We They	**invented** computer. **made** a discovery.

Negative

I You He She It We They	**did not** **(didn't)**	**invent** computer. **make** a discovery.

Questions

Did	I you he she it we they	**invent** **make**	computer? a discovery?

It is used to express

1) a completed action

He compiled a programme yesterday.

2) past habits or actions repeated in the past

When he was at school he often thought about becoming an engineer.

Specific time expressions

yesterday, the day before yesterday, last year (month, ...), in 1995, a year ago, etc.

Future Simple (Active)

Positive

I You He She It We They	**will**	**buy** computer.

Negative

I You He She It We They	**will not (won't)**	**buy** computer.

Questions

Will	I you he she it we they	**buy** computer?

It is used to express

1) a future act

The students will take their exams in June.

2) a future intention

I will call you tomorrow.

Specific time expressions

tomorrow, next week (year, ...), in September, in 2010, in a few days, etc.

Unit 4

Present Perfect (Active)

Positive

I You We They	**have** **('ve)**	**done** **performed**	an experiment.
He She It	**has** **('s)**		

Negative

I You We They	**have not** **(haven't)**	**performed**	an experiment.
He She It	**has not (hasn't)**		

Questions

Have	I you we they	**done** **performed**	an experiment?
Has	he she it		

It is used to express

1) an action that completed in the past but we are interested in its present result.
   I <u>have visited</u> many countries and I can tell you a lot about them.
2) an action that began in the past but is still going on in the present.
   I <u>have worked</u> as an engineer for 10 years.

Specific time expressions
just, already, yet, never, ever, lately, recently, since, for 2 years, etc.

Past Perfect (Active)

Positive

I You He She It We They	**had ('d)**	**prepared** **done**	the programme.

Negative

I You We They	**had not** **(hadn't)**	**done** **prepared**	the programme.
He She It			

Questions

Had	I you he she it we they	**done** **prepared**	the programme?

It is used to express an action in the past that happened before another action in the past or by some specific time in the past.

We <u>had completed</u> the test by 5 o'clock yesterday.

He <u>had written</u> a report before I called him.

Specific time expressions

by 2 o'clock yesterday, by the end of the year (week, ...), before + Past Simple, etc.

Future Perfect (Active)

Positive

I You He She It We They	**will have tested** the device.

Negative

I You He She It We They	**will not (won't) have tested** the device.

Questions

Will	I you he she it we they	**have tested** the device?

It is used to express a future action that will be completed before another future action or by a certain time in the future.

I will have finished the experiment by 5 o'clock tomorrow.

She will have prepared the necessary equipment before we begin the experiment.

Specific time expressions

by 2 o'clock tomorrow, by the end of the next year, before + Present Simple, etc.

Unit 5

The Passive Voice

A passive verb indicates that the subject of the sentence did not perform the action of the verb. It shows that someone or something else performed this action.

EXAMPLE: The Statue of Liberty was designed by a French engineer. =
= A French engineer designed the Statue of Liberty.

Present, Past and Future Simple Passive

<table>
<tr><th colspan="2">Present</th><th colspan="2">Past</th><th colspan="2">Future</th></tr>
<tr><td>am</td><td rowspan="3">constructed
built</td><td rowspan="3">was
were</td><td rowspan="3">constructed
built</td><td rowspan="3">will be</td><td rowspan="3">constructed
built</td></tr>
<tr><td>is</td></tr>
<tr><td>are</td></tr>
</table>

EXAMPLES: 1. Students are taught different subjects at University.
2. The first robot was designed in the 20th century.
3. New cars will be designed in the future.

Unit 6

Present, Past, Future Perfect Passive

Present			Past		Future	
have **has**	**been**	**constructed** **built**	**had been**	**constructed** **built**	**will have been**	**constructed** **built**

EXAMPLES: 1. A new chemical element has been discovered lately.
2. This road had been repaired by the time you came here.
3. The data will have been processed by the end of the day.

Unit 7

Modal Verbs

The modal verb **can** often has the meaning of ability, opportunity or permission to the verb.

	Positive	Negative	Question
Present	I **can** drive.	I **can't** drive.	**Can** you drive?
Past	I **could** drive.	I **couldn't** drive.	**Could** you drive?
Future	–	–	–

EXAMPLES: 1. He can compile difficult programmes. (*ability*)
2. At the Technical University students can get good knowledge in all spheres of engineering. (*opportunity*)
3. You can take this device now. (*permission*)

Another expression that shows ability is **be able to**. It has the following forms:

Present		Past		Future
am **is** **are**	**able to** drive	**was** **were**	**able to** drive	**will be able to** drive

EXAMPLES: 1. He is able to charge this battery.
2. He was able to solve the problem.
3. We'll be able to manufacture the new device.

May

The modal verb **may** often has the meaning of possibility and permission.

	Positive	Negative	Question
Present	You **may** go.	You **may not** go.	**May** I go?
Past	–	–	–
Future	–	–	–

EXAMPLES: 1. We may study the properties of metals at today's lesson. (possibility)
2. May I take that instrument? – Of course, you may. (*permission*)

Another expression that shows permission is **be allowed to**. It has the following forms:

Present		Past		Future
am **is** **are**	**allowed to** go	**was** **were**	**allowed to** go	**will be allowed to** go

EXAMPLES: 1. You are allowed to borrow the book.
2. He was allowed to test the machine.
3. We will be allowed to experiment with different metals.

Must/Have to

The modal verb **must** has the meaning of necessity and obligation.

	Positive	Negative	Question
Present	I **must** study.	I **mustn't** study.	**Must** I study?
Past	–	–	–
Future	–	–	–

EXAMPLES: 1. We must drive to our work. (*necessity*)
2. All students must attend this lecture. (*obligation*)

Another expression with the same meaning is **have to**.

	Present		Past	Future
Positive	I **have** He **has**	**to** work.	**had to** work.	I **will have to** work.
Negative	I **don't** He **doesn't**	**have to** work.	**didn't have to** work.	I **will not have to** work.
Question	**Do** I **Does** he	**have to** work?	**Did** I **have to** work?	**Will** you **have to** work?

EXAMPLES: 1. We didn't have to complete all the tests yesterday.
2. She will have to demonstrate the new machine tomorrow.

Remember the following structures:

1. You mustn't cross the road here. (=Don't cross it.)
2. You don't have to do it today. (=It is not necessary to do it today. You don't need to do it.)

Modal verbs can also be used with Passive verbs.

Remember:

can be done **may be broken** **must be built**

Remember the following constructions:

What is it called?	It is called a ruler. It is known as a ruler.
What is it for? What is it used for?	It is for measuring length. It is used for measuring length.

Remember the following constructions:

It is made of metal.				
	Is	it	made of	metal?
What	is	it	made of?	
What material	is	it	made of?	
Why	is	it	made of	metal?

Unit 8

The Infinitive

The Infinitive is the initial form of the verb. It is usually used with ***the particle to***.

Subject	**To explain** the rule is rather difficult.			
	It *is* It *was* It *will be*	rather quite very	difficult hard necessary essential important easy valuable, etc.	**to explain** the rule.

Adverbial Modifier of Purpose	To* explain the rule you should give examples. You should give examples in order to explain the rule.

* to = in order to (here)

Consider the difference:	1. **To explain** the rule is rather difficult.	1. Очень тяжело объяснить это правило.
	2. **To explain** the rule you should give examples.	2. Чтобы объяснить это правило, тебе следует привести примеры.

Predicative	The Its Their Olga's	aim duty idea function goal objective purpose, etc.	is was will be	**to measure** the temperature.

Attribute	The car **to be used** runs on solar power.	1. Машина, которая будет использоваться, работает на солнечной энергии. 2. Машина, которая должна использоваться, работает на солнечной энергии.

Unit 9

The Complex Object

The Complex Object (the objective infinitive construction) is translated into Russian with the help of an object clause beginning with words ***чтобы, что, как***.

subject	***predicate***	***object***	
		noun or pronoun in the objective case	***(to)*+ infinitive***
I/you/we/they Students	expect don't expect	me/you/him/her/ us/them the mechanic	to repair the car.
He/she/it Oleg	expects doesn't expect		

***Remember: to** is **never** used after **let, make, see, hear, feel, watch, notice, observe** in the Active Voice: e.g. We watched the engineer make a hologram. Then he let us experiment with a laser.

The Complex Object is used after the main verbs denoting:

wish	**mental activity**	**sense perception**	**awareness**	**inducement**
to want to wish to desire need I would like (=I'd like)	to suppose to expect to consider to assume to prove to believe to understand to think to find	to see to hear to feel to watch to notice to observe	to know to find to note to claim to state to declare to pronounce to announce to report	to make to cause to force to let to allow to permit to enable to ask to tell to order to command

We would like you **to** test the device.	Мы хотели бы, чтобы вы протестировали этот прибор.
I consider him **to** be a professional in his field.	Я считаю, что он профессионал в своей области.
She found the carburettor **to** be blocked.	Она обнаружила, что карбюратор засорился.
The engineer told us **to** stop the experiment.	Инженер сказал нам прекратить эксперимент.
The teacher makes us study hard.	Учитель заставляет нас усердно учиться.
He heard the engine start after a loud click.	После громкого щелчка он услышал, что двигатель заработал.

Remember: The Infinitive in the Complex Object is often used in the Passive Voice but it is translated into Russian in the Active Voice and is placed before the noun.

The engineer allowed the technology to be used.	Инженер разрешил использовать эту технологию.

The Complex Subject

The Complex Subject (the subjective infinitive construction) is translated into Russian with the help of a non-personal main clause followed by an object clause beginning with the word *что*.

Compare:	It is said that the car is broken. The car is said to be broken.	Говорят, что машина сломана.

Remember: Always begin translating sentences with the Complex Subject from the predicate rendering it as a non-personal main clause followed by an object clause with the word *что*.

subject	***predicate (the expressions, the Passive Voice)***		***subject (to + infinitive)***
I	am (not)	likely supposed	to know Physics well.
You/we/they Students	are (not)		
He/she/it Olga	is (not)		
	predicate (the Active Voice)		
You/we/they Students	seem don't seem		to know Physics well.
He/she/it Olga	seems doesn't seem		

The Complex Subject is used with the following:

expressions	**verbs in the Passive Voice**		**verbs in the Active Voice**
to be likely	to say	to consider	to seem / to appear
to be unlikely	to know	to assume	to prove / to turn out
to be sure	to think	to believe	to happen / to occur
to be certain	to report	to see	
	to suppose	to hear, etc.	
	to expect	(*see Complex Object*)	

The project is likely **to** be completed soon.	Вероятно, что проект скоро завершат.
The Sun is considered **to** provide us with all the energy we need.	Считается, что Солнце обеспечивает нас всей необходимой энергией.
We happened **to** work together for the same company.	Случилось так, что мы работали вместе в одной компании.

Forms of the Infinitive

Aspect / Voice	*Active*	*Passive*
Indefinite	He is likely **to design** a new car soon.	A new car is sure **to be designed** in the near future.
Continuous	He seems **to be designing** a new car now.	–
Perfect	He is said **to have designed** a new car recently.	A new car is reported **to have been designed** by our engineers.
Perfect Continuous	He proved **to have been designing** a new car for two years.	–

Unit 10

The Participle

The Participle is a non-finite form of the verb combining features of the verb, the adjective and the adverb. The two forms of Participles are Participle I and Participle II.

Attribute	***P I***	We installed a new **heating** system. Мы установили новую обогревательную систему. We installed a new system **heating** our house naturally. Мы установили новую систему, обогревающую наш дом природным способом.	***Active Voice***
		We live in a house **being heated** naturally at the moment. Мы живем в доме, обогреваемом сейчас природным способом.	***Passive Voice***
	P II	We live in a solar-**heated** house. Мы живем в доме, обогреваемом солнечной энергией. We live in the house **heated** by the Sun all the year round. Мы живем в доме, который обогревается солнцем круглый год.	

Adverbial Modifier	***P I***	**Building** solar houses we save energy. Строя дома на солнечных батареях, мы сохраняем энергию. **Having built** a new solar heating system the engineers started to test it. Построив новую солнечную отопительную систему, инженеры начали ее проверять.	*Active Voice*
		Being built in a new way the system offers many advantages. Будучи построенной новым способом, эта система имеет множество достоинств. **Having been built** completely the plant was thoroughly inspected. После того, как завод был полностью построен, его тщательно проверили.	*Passive Voice*
	P II	When **built** by skilled workers the experimental system worked well. Построенная опытными рабочими, эта система хорошо работала. If **built** on time the new power plant will start to work in May. Если новая электростанция будет построена вовремя, она начнет работу в мае.	

Unit 11

Participial Constructions

Compare:		*Participial Constructions*
	Active Voice	We observed *the teacher making* a hologram. Мы наблюдали, как учитель делал голограмму.
	Passive Voice	*The teacher* was observed *making* a hologram. Наблюдали, как учитель делал голограмму.
	Absolute Participial Constructions	The car *having been repaired*, the driver left the service station. После того, как починили машину, водитель уехал со станции техобслуживания. An experiment was carried out yesterday, new equipment *being used.* Вчера был проведён эксперимент, причём использовалось новое оборудование.

The Gerund

The Gerund is a non-finite form of the verb combining features of the verb and the noun. It is used independently and after the following words:

prepositions	*nouns + prepositions*	*adjectives + prepositions*	*verbs*
on after before without instead of against in spite of, etc.	the idea of the method of the way of the purpose of the necessity of the technique of the importance of, etc.	to be famous for to be sorry for to be sure of to be capable of to be tired of to be good at to be surprised at, etc.	to mind to result in to object to to use for to insist on to rely on to prevent from, etc.

Walking, talking and thinking like a human being will soon become possible for robots.
Without *gathering* data it is impossible to prove the theory.
The new technique of *compiling* new programmes accelerated our work a lot.
Robots are capable of *doing* difficult tasks.
People cannot prevent robots from *becoming* too clever.

Unit 12

Aspect / Voice	*Active*	*Passive*
Indefinite	We are against **polluting** the air.	We object to the air **being polluted**.
Perfect	We know of industry **having polluted** the air badly.	We have heard of the air **having been polluted** badly.

Compare:	*Gerund*	*Participle*
	Testing a laser takes time.	*Testing* a laser he made a discovery.
	Before *switching on* the laser we read the safety instructions carefully.	*Switching on* the laser we followed the safety instructions carefully.
	a *driving* license (= a license for driving)	a *driving* woman (= a woman that drives)

Compare:	*Gerundial Constructions*	
	Professor is interested in completing *the research.*	(he will complete it himself)
	Professor is interested in the *research being completed.*	(somebody will complete it)
	Professor is interested in *students completing* the research.	(students will complete it)
	Professor is interested in *our completing* the research.	(we will complete it)

Unit 13

Reported Statements

We **use** laser telescopes.	He says (that) they **use** laser telescopes. He said (that) they **used** laser telescope.	Он говорит, Он сказал, что они используют лазерные телескопы.
We **used** laser telescopes long ago.	He says (that) they **used** laser telescopes long ago. He said (that) they **had used** laser tele-scopes long before.	Он говорит, Он сказал, что они использовали лазерные телескопы уже давно.
We **will use** laser telescopes soon.	He says (that) they **will use** laser tele-scopes soon. He said (that) they **would use** laser telescopes soon.	Он говорит, Он сказал, что они скоро будут использовать лазерные телескопы.

Reported statements are introduced by these words: ***to say, to report, to announce, to inform, to point out, to consider, to assume, to suppose, to know, to believe, to state, to claim, to suggest, to predict, to think, to be sure, to be certain, to dream, etc.***

Reported Questions

Are you **studying** alloys now?	She wonders ***if*** we **are studying** alloys now. She wondered ***whether*** we **were studying** alloys then. She wonders ***if*** we **studied** alloys at the lesson yesterday.
Did you **study** alloys at the lesson yesterday?	She wondered ***whether*** we **had studied** alloys at the lesson the day before.
Will you **study** alloys next year?	She wonders ***if*** we **will study** alloys next year. She wondered ***whether*** we **would study** alloys the next year

Remember: if = whether.

What alloys **is** he **studying** now?	They ask ***what*** alloys he **is studying** now. They asked ***what*** alloys he **was studying** at that time.
When **did** he **study** alloys?	They ask ***when*** he **studied** alloys. They asked ***when*** he **had studied** alloys.
Why **will** he **study** alloys in future?	They ask ***why*** he **will study** alloys in future. They asked ***why*** he **would study** alloys in the future.

Reported questions are introduced by these words: ***to ask, to inquire, to question, to wonder, to want to know, to be interested, it is interesting, to know, to find out, not to be sure, etc.***

APPENDIX 1

Most Frequently Used Abbreviations

A, a	– ampere	ампер
ac	– alternating current	переменный ток
a-hr	– ampere-hour	ампер/час
C	– degree centigrade	градус Цельсия
dc	– direct current	прямой ток
dm.	– decimetre	дециметр
e.g.	– exempli gratia-for example	например
g	– gram	грамм
hi-fi	– high fidelity	высокая точность звуковоспроизведения
h.p.	– horsepower	лошадиная сила

Hz	– hertz	герц
i.e.	– id est = that is	то есть
j	– joule	джоуль
kg	– kilogram	килограмм
kW	– kilowatt	киловатт
kW-hr	– kilowatt-hour	киловатт/час
l	– (Lat. libra) pound	фунт
l	– litre	литр
m	– metre	метр
m	– milli-	милли-
mi	– mile	миля
min	– minute	минута
No; Nos	– number(s)	номер(-а)
pc., pcs	– piece(s)	штука(-и)
ppm	– parts per million	частей на миллион
psf	– pounds per square foot	фунтов на кв. фут
psi	– pounds per square inch	фунтов на кв. дюйм
Qnty	– quantity	количество
rpm	– revolutions per minute	оборотов в минуту
rps	– revolutions per second	оборотов в секунду
sc.	– scale	шкала
sec	– second	секунда
t	– ton	тонна
V	– volt	вольт
W, w	– watt	ватт
yd	– yard	ярд

APPENDIX 2

Units of Measurement

Linear Measures

Дюйм	inch	in	2.54 cm
Фут	foot	ft (12 in)	30.48 cm
Ярд	yard	yd (3 ft)	91.44 cm
Миля	mile	mi (1760 yd)	1609,33 m
Миля морская	nautical mile (knot)	naut.mi (6080 ft)	1853,18 m

Measures of Weights

Драхма	dram	dr	1,77 g
Унция	ounce	oz (16 or)	28.35 g
Фунт	pound	lb. (16 lz)	453.59 g
Стон	stone	st. (14 lb)	6.35 kg
Квартер	quarter	qr (28 lb)	12.7 kg
Центнер	hundred	hwt (112 lb)	50.8 kg
Тонна большая	weight ton	t (20 hwt)	1016.048 kg

Measures of Volume

Джилл	gill	–	0.14 l
Пинта	pint	pt (4 gills)	0.57 l
Кварта	quart	qt (2 pt)	1.14 l
Галлон	gallon	gal (4 qt)	4.55 l
Бушель	bushel	bsh (8 gal)	36.37 l
Квортер	quarter	qr (8 bsh)	290.94 l

Square Measures

Кв. дюйм	square inch	sq in	6.45 cm^2
Кв. фут	square foot	sq ft (144 sq.yd)	9.29 dm^2
Кв. ярд	square yard	sq yd (9 sq.ft)	0.836 m^2
Акр	acre	ac (4840 sq.yd) 0.4 hectare	2.59 km^2
Кв. миля	square mile	sq mi (640 ac)	259 hectares

Cubic Measures

Куб. дюйм	cubic inch	c in	16.39 cm^3
Куб. фут	cubic foot	c ft (1728 c in)	0.028 m^3
Куб. ярд	cubic yard	c yd (27 c ft)	0.76 m^3
Тонна регистровая	register ton	reg t (100 c ft)	2.33 m^3

APPENDIX 3

Conjunctions

1. Сочинительные союзы

and – и, а
as well as – так же как, а также
both... and – и ... и; как ... так
but – но, а
not only but also – не только ...., но и ...
either ... or – или ... или; либо ... либо
neither ... nor – ни ... ни
or – или, иначе

2. Подчинительные союзы

а) времени:

after – после того как
as – в то время как; когда; по мере того как
as long as – пока; до тех пор пока
as soon as – как только
before – перед тем как
since – с тех пор как; после того как
till, until – до тех пор пока ... не
while – в то время как

б) причины:

as – так как
because – потому что; так как
since – так как, поскольку

в) условия:

if – если
provided – при условии, если
unless – для того чтобы, чтобы

г) цели:

in order to – для того чтобы, чтобы

д) образа действия:

as –как
as if – как будто; как если бы
so ... that – так (такой) ... что
such ... that – такой ... что

е) сравнения:

as ... as – такой же ... как; так ... как
not so ... as - не так ... как; не такой ... как

than – чем

ж) следствия:

so that – так что

в) уступительные:

in spite of – несмотря на то, что
though (although) – хотя

since – поскольку

APPENDIX 4

Spelling

1. Words ending in **-y** (baby, carry, easy, etc.)
If a word ends in a *consonant* + **y** (-by/-ry/-sy, etc.):

y changes to **ie** before **-s**:
country/countries apply/applies
lorry/lorries study/studies try/tries
y changes to **i** before **-ed:**
hurry/hurried study/studied apply/applied try/tried
y changes to **i** before **-er** and **-est**:
easy / easier / easiest
heavy / heavier / heaviest
y changes to **i** before **-ly**:
easy/easily heavy/heavily temporary/temporarily

y does *not* change before **-ing:**
studyi**ng** applyi**ng** tryi**ng** employi**ng**
y does *not* change if the word ends in a *vowel* + **y** (**-ay/-ey/-oy/uy**):
enjoy/enjoys/enjoyed **play/plays/played** **alloy/alloys**
Note: say/**said** pay/**paid** lay/**laid**

2. Verbs ending in **-ie** (die, lie, tie)
If a verb ends in **-ie, ie** changes to **y** before **-ing:**
lie/lying **die/dying**

3. Words ending in **-e** (**smoke, hope, wide,** etc.)

Verbs

produce /**producing** use / **using** move /**moving**

Exceptions: **be/being**

Verbs ending in **-ee**: **see/seeing** **agree/agreeing**

produce /**produced** use / **used** move /**moved**

Adjectives and adverbs

wide/**wider**/**widest** late / **later** / **latest** large / **larger**/**largest**

polite / **politely** extreme / **extremely** absolute /**absolutely**

terrible/**terribly** probable/**probably** reasonable/**reasonably**

4. Doubling consonants (**stop/stopping/stopped, hot/hotter/hottest**, etc.)

We double the final consonant (**-pp-**, **-nn-**, etc.) of these words before **-ing**, **-ed**, **-er** and **-est**:

stop/stop**p**ing/stop**p**ed thin/thin**n**er/thin**n**est

plan/plan**n**ing/plan**n**ed hot/hot**t**er/hot**t**est

If the word has more than one syllable (**prefer, begin**, etc.), we double the final consonant only if the final syllable is stressed:

prefer/prefer**r**ing/prefer**r**ed

begin/begin**n**ing

Compare:

visit/visiting/visited

develop/developing/developed

Exception:

travel / travel**l**ing/travel**l**ed cancel / cancel**l**ing/cancel**l**ed

We do *not* double the final consonant if there are two vowel letters before it (**-oil, -eed, -ain**, etc.):

explain/explaining/explained quiet/quieter/quietest

cheap/cheaper/cheapest boil/boiling/boiled

APPENDIX 5

Word Formation

An English word can be divided into three parts: a prefix, a stem and a suffix. *Pre-* means 'before'; a prefix, therefore, is what comes before the stem. Prefixes usually change ie meaning of the word; for example, *un-* changes a word to the negative. *Unmagneti-ible* means 'not capable of being magnetized'. A suffix is what is attached to the end of ie stem. Suffixes, on the other hand, change the word from one part of speech to anoth-. For example, *-ly* added to the adjective *quick* gives the adverb *quickly*. Both prefixes and iffixes are referred to as affixes.

SUFFIXES

NOUNS	VERBS	ADJECTIVES	ADVERBS
-ance	-ize	-able	-ly
-ence	-ate	-ible	
-or	-fly	-less	
-er	-en	-ic	
-ist	-ify	-ical	
-ness		-ish	

Noun-forming suffixes

SUFFIX	MEANING	EXAMPLES
-ance	state	performance
-ence	quality of	independence
-er	a person who	programmer, operator
-or	a thing which	compiler, accumulator
-ation -tion	the act of	execution
-ist -yst	a person who	analyst, typist
-ness	condition of	cleanliness
-ion	action/state	conversion
-ing	activity	welding
-ment	state, action	measurement
-ity	state, quality	electricity
-ian	pertaining to	electrician
-ism	condition/state	magnetism
-dom	domain/condition	freedom
-ship	condition/state	relationship, partnership

Verb-forming suffixes		
SUFFIX	MEANING	EXAMPLES
-ize	to make	computerize
-ate		automate, activate
-fy		simplify
-en		harden, widen

Verb-forming suffixes		
SUFFIX	MEANING	EXAMPLES
-ly	in the manner of	electronically, logically

Adjective-formimg suffixes		
SUFFIX	MEANING	EXAMPLES
-al	have the quality of	computational, logical
-ar		circular
-ic		magnetic, automatic
-ical		electrical
-able	capable of being	comparable
-ible		divisible
-ous	capable of being	dangerous
-ious		religious
-ful	characterized by	helpful
-less	without	careless
-ish	like	yellowish
-ed	having	computed, punched
-ive	quality of	interactive
-ing	to make or do	processing, welding

PREFIXES

NEGATIVE AND POSITIVE	SIZE	LOCATION	TIME AND ORDER	NUMBER
un-	semi-	inter-	pre-	mono-
non-	mini-	super-	ante-	bi-
in-	micro-	trans-	fore-	hex-
dis-		ex-	post-	oct-
re-		extra-		multi-
		mid-		

Negative and positive prefixes

	PREFIX	MEANING	EXAMPLES
Negative	un-	not, not good enough	unmagnetized, unpunched
	in-		incomplete
	im-		impossible
	il-		illigal
	ir-		irregular, irrelevant
	non-	not connected with	non-programmable, non-impact
	mis-	bad, wrong	mispronounce
	dis-	opposite feeling	disagree
		opposite action	discount
	anti-	against	antisocial
	de-	reduce, reverse	demagnetize, decode
	under-	too little	underestimate
Positive	re-	do again	rearrange
	over	too much	overheat

Prefixes of size		
PREFIX	MEANING	EXAMPLES
semi-	half, partly	semiconductor
equi-	equal	equidistant
maxi-	big	maxicomputer
micro-	small	microcomputer
mini-	little	minicomputer
macro- mega-	large	macroeconomics megabyte

Prefixes of location		
PREFIX	MEANING	EXAMPLES
inter-	between, among	interface, interactive
super-	over	supersonic
trans-	across	transmit, transfer
ex-	out	exclude, extrinsic
extra-	beyond	extraordinary
sub-	under	subscheme
infra-	below	infra-red
peri-	around	peripheral

Prefixes of time and order		
PREFIX	MEANING	EXAMPLES
ante- pre-	before	antecedent prefix
prime-	first	primary, primitive
post-	after	postdated
retro-	backward	retroactive

Prefixes of numbers		
PREFIX	MEANING	EXAMPLES
semi-	half	semicircle
mono-	one	monochromatic
bi-	two	binary
tri-	three	triangle
quad-	four	quadrangle
penta-	five	pentagon
hex-	six	hexagon
septi-	seven	septivalent
oct-	eight	octagon
dec-	ten	decimal
multi-	many	multiprogramming

Other prefixes		
PREFIX	MEANING	EXAMPLES
auto-	self	automatic
co-	together	coordinate
neo-	new	neoclassical
pan-	all	panchomatic

APPENDIX 6

List of Most Frequntly Used Prepositions, Conjunctions and Adverbs

Prefixes of time and order

about	о, про, относительно
	около, примерно, вокруг
above	выше, над
above all	прежде всего
across	поперек, через, на другой стороне
after	после; за; после того как (*союз*)
after all	в конце концов
against	против
along	вдоль, по
among	среди
around (round)	вокруг
at	*при обозначении места:* в, на, у;
	при обозначении времени: в;
	при обозначении занятия: за
at last	наконец
at least	по крайней мере
before	*при обозначении места:* перед;
	при обозначении времени: до, перед; раньше (*наречие*);
	прежде чем (*союз*), до того как, перед тем, как
behind	позади, за
below	ниже, внизу
beside	рядом с
besides	помимо, кроме
between	между
by	*эквивалент русск. творит. падежа имени*
	существительного: посредством, путем; мимо;
	к (*о времени*)
by the way	кстати, между прочим
by no means	никоим образом
down	вниз по; вниз (*наречие*)
for	за, ради; для; в течение (*указывает длительность*);
	ибо, так как (*союз*)
from	из, с, у; от
in	в; через (*для обозначения времени*)

in this way	таким образом
into	в (*на вопрос «куда?»*)
of	*эквивалент русск. родит. падежа имени существительного:* из, о, про
of course	конечно
on=upon	на; по; о; *для обозначения времени; с днями и числами:* вперед, дальше
over	через (над); свыше
since	с, с момента; с тех пор как; поскольку; так как
through	через (внутри, по)
throughout	по всему, во всем
till=until	до; (до тех пор) пока ... не
to	*эквивалент русск. дат. падежа имени существительного;* к, в, на (*движение в направлении к чему-то*)
toward (towards)	к; по направлению к
under	под; при; по, согласно
until	*см.* till
up	вверх по; вверх (*наречие*)
up to	вплоть до
upon	*см.* on
with	*эквивалент русск. творит. падежа имени существительного;* с, со
within	в пределах; через (*о времени*)
without	без

APPENDIX 7

List of Irregular Verbs

Infinitive	*Past Simple*	*Past participle*	*Translation*
be	was/were	been	быть, находиться
beat	beat	beaten	бить
become	became	become	становиться
begin	began	begun	начинать
bend	bent	bent	сгибать
bet	bet	bet	держать пари
bite	bit	biten	кусать
blow	blew	blown	дуть
break	broke	broken	ломать
bring	brought	brought	приносить

Infinitive	*Past Simple*	*Past participle*	*Translation*
build	built	built	строить
burst	burst	burst	взрываться
buy	bought	bought	покупать
catch	caught	caught	ловить, схватывать
choose	chose	chosen	выбирать
come	came	come	приходить
cost	cost	cost	стоить
cut	cut	cut	резать
deal	dealt	dealt	иметь дело
dig	dug	dug	капать
do	did	done	делать
draw	drew	drawn	рисовать; тащить
drink	drank	drunk	пить
drive	drove	driven	водить, управлять
eat	ate	eaten	есть
fall	fell	fallen	падать
feed	fed	fed	кормить
feel	felt	felt	чувствовать
fight	fought	fought	бороться
find	found	found	находить
fly	flew	flown	летать
forbid	forbade	forbidden	запрещать
forget	forgot	forgotten	забывать
forgive	forgave	forgiven	прощать
freeze	froze	frozen	замерзать, замораживать
get	got	got	получать; становиться
give	gave	given	давать
go	went	gone	идти, ехать
grow	grew	grown	расти, выращивать
hang	hung	hung	висеть, вешать
have	had	had	иметь
hear	heard	heard	слышать
hide	hid	hidden	прятать
hit	hit	hit	поражать цель, ударять
hold	held	held	держать
hurt	hurt	hurt	повреждать, травмировать
keep	kept	kept	хранить

Infinitive	*Past Simple*	*Past participle*	*Translation*
know	knew	known	знать
lay	laid	laid	класть
lead	led	led	возглавлять, вести
leave	left	left	оставлять, уезжать
lend	lent	lent	давать взаймы, одалживать
let	let	let	позволять
lie	lay	lain	лежать
light	lit	lit	освещать
lose	lost	lost	терять
make	made	made	делать; вынуждать
mean	meant	meant	значить, подразумевать
meet	met	met	встречать, знакомиться
pay	paid	paid	платить
put	put	put	класть
read[ri:d]	read[red]	read[red]	читать
ride	rode	ridden	ездить верхом
ring	rang	rung	звонить, звенеть
rise	rose	risen	подниматься, вставать
run	ran	run	бежать
say	said	said	говорить, сказать
see	saw	seen	видеть
seek	sought	sought	искать
sell	sold	sold	продавать
send	sent	sent	посылать, отправлять
set	set	set	устанавливать, помещать
sew	sewed	sewn/sewed	шить
shake	shook	shaken	трясти
shine	shone	shone	сиять
shoot	shot	shot	стрелять
show	showed	shown	показывать
shrink	shrank	shrunk	сокращаться
shut	shut	shut	закрывать
sing	sang	sung	петь
sink	sank	sunk	тонуть
sit	sat	sat	сидеть
sleep	slept	slept	спать
speak	spoke	spoken	говорить, разговаривать

Infinitive	*Past Simple*	*Past participle*	*Translation*
spend	spent	spent	тратить, проводить время
split	split	split	расщеплять, раскалывать
spread	spread	spread	распространять
spring	sprang	sprung	пружинить, прыгать
stand	stood	stood	стоять, выдерживать
steal	stole	stolen	красть
stick	stuck	stuck	приклеивать
sting	stung	stung	жалить
stink	stank	stunk	вонять
strike	struck	struck	ударять; зажигать
swear	swore	sworn	клясться, ругаться
sweep	swept	swept	мести, подметать .
swim	swam	swum	плавать
swing	swung	swung	качать
take	took	taken	брать
teach	taught	taught	учить, обучать
tear	tore	torn	рвать
tell	told	told	сказать, рассказывать
think	thought	thought	думать
throw	threw	thrown	бросать
understand	understood	understood	понимать
wake	woke	woken	просыпаться, будить
wear	wore	worn	изнашивать, носить
win	won	won	выигрывать
wind	wound	wound	крутить, заводить (*часы*)
write	wrote	written	писать

Keys to the Crosswords

Unit 2. Section A

Across: 1. coulomb, 6. pascal. ***Down:*** 2. volt, 3. joule, 4. ampere, 5. watt.

Check Your Progress

Down: 1. essential, 2. quality, 3. fuel, 4. discovery, 5. polymer, 6. motion, 7. vehicle, 8. engine, 9. robot. ***Across:*** 10. copper, 11. alloy.

Unit 8. Section A

Down: 1. plate, 2. defect, 3. create, 4. deform, 5. joint, 6. property, 7. beam, 8. bead, 9. strong, 10. crack, 11. weld. ***Across:*** 1. performance.

Unit 9. Section A

Down: 1. transmit, 2. flow, 3. rectify, 4. open, 5. direct, 6. turn, 7. primary, 8. magnet, 9. glow, 10. circuit. ***Across:*** 11. alternator.

Unit 10. Section B

Down: 1. fan, 2. common, 3. charge, 4. carburettor, 5. fuel, 6. empty, 7. spark, 8. brake, 9. petrol, 10. horn, 11. service. ***Across:*** 12. accelerator.

Unit 11. Section A

Across: 1. viewer, 2. vibrate, 3. whole, 4. visibility, 5. consume, 6. coating, 7. application, 8. recorder, 9. original. ***Down:*** 1. evolution.

Unit 12. Section A

Across: 1. distance. ***Down:*** 2. solid, 3. cavity, 4. pulses, 5. particle, 6. oscillator, 7. concave, 8. excite, 9. reflect.

Section B

Down: 1. chlorofluorocarbon, 14. carbon. ***Across:*** 2. acid, 3. heat, 4. slow, 5. robotics, 6. property, 7. object, 8. difficult, 9. pollutant, 10. unite, 11. modern, 12. argon, 13. oxide.

Unit 13. Section A

Across: 1. constellation. ***Down:*** 1. computer, 2. powerful, 3. scanner, 4. observatory, 5. limited, 6. decode, 7. alien, 8. flash, 9. handheld, 10. optics, 11. eyepiece, 12. recorder, 13. distant.

CONTENTS

Учебное издание

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