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Metals, metalworking processes, metalworking machines (Металлы, металлообрабатывающие операции, металлообрабатывающие станки)

Методические указания по английскому языку
для практических занятий и самостоятельной работы студентов
направления подготовки 15.03.05
“Конструкторско-технологическое обеспечение
машиностроительных производств»
очной формы обучения

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Утверждены на заседании кафедры
Протокол № 55 от 28.01.2016
Рекомендованы к печати
учебно-методической комиссией
направления 15.03.05
Протокол № 10 от 20.04.2016
Электронная копия находится
в библиотеке КузГТУ

КЕМЕРОВО 2016

Предисловие

Методические указания по английскому языку для практических занятий и самостоятельной работы студентов направления подготовки 15.03.05 «Конструкторско-технологическое обеспечение машиностро-ительных производств» очной формы обучения составлены в соответствии с рабочей программой направления подготовки 15.03.05 и предназначены для студентов, изучающих дисциплину «Иностранный язык (английский).

Целью данных методических указаний является обучение практическому владению английским языком в профессиональной сфере.

Методические указания направлены на формирование следующих общекультурных компетенций:

– способность к коммуникации в устной и письменной форме на русском и иностранном языках для решения задач межличностного и межкультурного взаимодействия (ОК-3).

Предполагается, что данные методические указания помогут студентам в усвоении дисциплины на данном этапе обучения:

знать:

– правила наиболее употребительной грамматики и основные грамматические явления, характерные для устной и письменной речи повседневного общения;

– основные приемы аннотирования, реферирования и перевода литературы на общекультурные, общепрофессиональные и бытовые темы.

уметь:

– читать и понимать со словарем литературу на темы повседневного общения, а также общекультурные и общепрофессиональные темы;

– участвовать в обсуждении тем, связанных с культурой, наукой, техникой;

– понимать устную (монологическую и диалогическую) речь на бытовые, общекультурные и общепрофессиональные темы.

владеть:

– навыками устной речи – делать сообщения, доклады (с предварительной подготовкой) по пройденным темам;

– навыками письма для ведения бытовой переписки, переписки по общепрофессиональным и общекультурным темам;

– навыками общения по специальности на иностранном языке.

Материал методических указаний представлен ***темами***:

Тема 1. Металлы и их свойства (Metals and their properties).

Тема 2. Металлообрабатывающие операции (Metalworking).

Тема 3. Механическая обработка металлов и металлообрабатывающие станки (Machining of metals and machine-tools).

Каждая тема содержит текстовый материал, который сопровождается различного рода упражнениями, построенными таким образом, чтобы помочь студентам изучить лексику, научить находить основную информацию в тексте, переводить и аннотировать тексты профессиональной направленности.

В данной разработке использовалась следующая литература и Интернет-ресурсы:

1) Чистик, М. Я. Учебник английского языка для политехнических вузов / М. Я. Чистик. – Москва : Высшая школа, 1988. – 352 с.

2) Бгашев, В. Н. Английский язык для студентов машиностроительных специальностей : учебник / В. Н. Бгашев, Е. Ю. Долматовская. – Москва : Астрель, 2002. – 384 с.

3) Tests in the use of technical English. (Тесты по английскому языку для студентов технических вузов). – Минск : Амалфея, 2003. – 240 с.

4) Агабекян, И. П. Английский для инженеров : учебник / И. П. Агабекян, П. И. Коваленко. Ростов-на-Дону : Феникс, 2002. – 320 с.

5) http://en.wikipedia.org/wiki/Metals

6) http://en.wikipedia.org/wiki/Metalworking

7) http://en.wikipedia.org/wiki/Machine-tools

Part I. Metals and their properties

While studying this part you will learn about metals, their properties, alloys, corrosion and corrosion protection of metals.

Text 1
Engineering materials

1. ***Read the text.***

Engineers have to know the best and most economical materials to use. Engineers must also understand the properties of these materials and how they can be **worked**. There are two kinds of materials used in engineering – metals and non-metals. We can divide metals into **ferrous** and **non-ferrous**. The former contain **iron** and the latter do not contain iron. **Cast iron** and **steel**, which are both **alloys**, or **mixtures** of iron and **carbon**, are the two most important ferrous metals. Steel contains a smaller proportion of carbon than cast iron. Certain elements can improve the **properties** of steel and are therefore added to it. For example, **chromium** may be included **to resist corrosion** and **tungsten** to **increase hardness**. **Aluminium**, **copper**, and the alloys (**bronze** and **brass**) are common non-ferrous metals.

Plastics and **ceramics** are non-metals; however, plastics may be **machined** like metals. Plastics are classified into two types – **thermoplastics** and **thermosets**. Thermoplastics can be **shaped** and **reshaped** by **heat** and **pressure** but thermosets cannot be reshaped because they **undergo** chemical changes as they harden. Ceramics are often **employed** by engineers when materials which can **withstand** high temperatures are needed.

2. ***Translate the words in bold from English into Russian. Learn the words.***

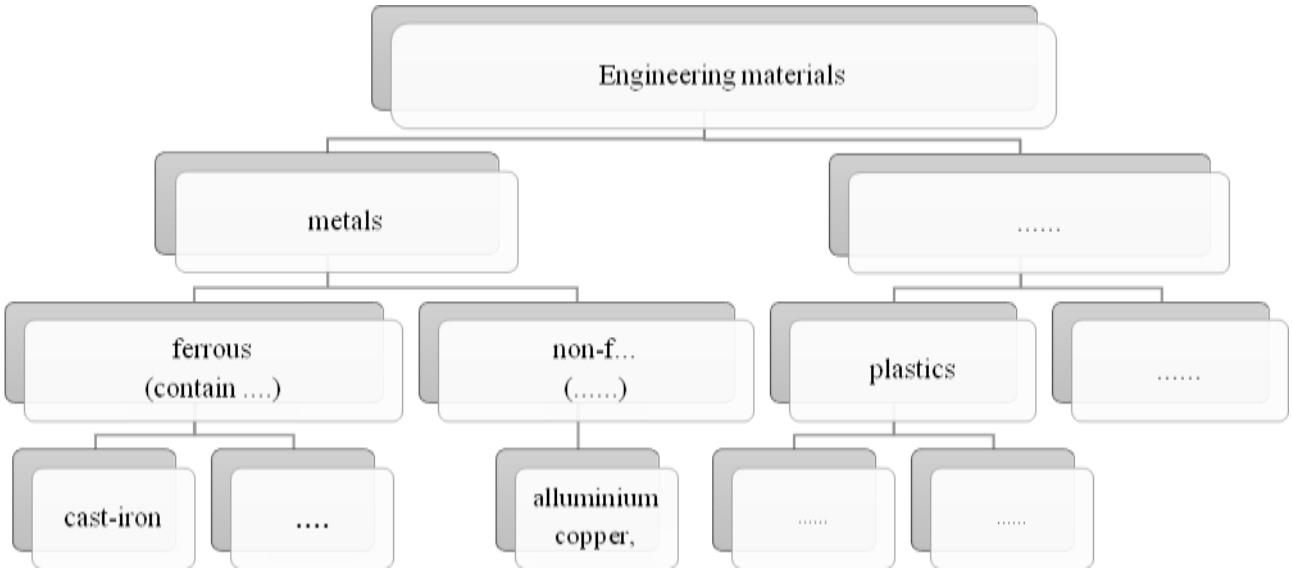
3. ***Find the English equivalents to the phrases in the text.***

Более экономичные материалы, свойства материалов, содержать железо, смесь железа и углерода, содержать меньшую пропорцию углерода, улучшать свойства материала, противостоять коррозии, увеличить прочность, формовать при помощи тепла и давления, подвергаться химическим изменениям, использоваться, выдерживать высокие температуры.

4. Answer the questions.

1) What are the two kinds of materials used in engineering?
2) Do all metals contain iron?
3) What is an alloy?
4) Why are certain elements added to metals?
5) Can plastics and ceramics be machined?
6) All plastics can be shaped and reshaped, can they? Why?
7) Why are ceramics used in engineering?

5. Complete the diagram and speak about engineering materials.



Text 2
Occurrence of metals

1. Read the text and answer the following questions.

1) When was iron first used?
2) What is metallurgy?
3) What do iron ores contain?
4) How is iron obtained from the ores?
5) What is the ore?
6) What is a mineral?

Useful words:

hematite – гематит, красный железняк
limonite – лимонит, бурый железняк

magnetite – магнетит, магнитный железняк
siderite – метеорит железный, сидерит
constituent – компонент, составляющая
absorption – абсорбция, поглощение
to extract – извлекать
ore – руда
gangue – породные примеси
to reduce – редуцировать; понижать; ослаблять; сокращать
carbonate – карбонат, карбонатная горная порода
sulphur – сера
phosphorous – фосфористый
manganese – марганец
lithium – литий
melted – расплавленный
to treat – обрабатывать, подвергать обработке

Iron was used in the earliest times of which we have any historical records. The art of making weapons from iron was known to the Egyptians and Hindoos.

The metals are widely distributed in nature in the form of silicates, oxides, and the sulphide, FeS. The chief ores of the metal are hematite, limonite, magnetite, and siderite. Iron occurs in plants and animals as a constituent of complex organic compounds. It is present in the hemoglobin of the blood and is involved in this condition in the absorption of oxygen in the lungs.

The naturally occurring materials containing compounds of the metals which may be economically extracted are called ores. The definite chemical compound of metal in the ore is termed a mineral. The name gangue is applied to the constituents of the ore other than the mineral containing the metal to be extracted.

Iron is obtained by reducing its ores with carbon. The ores contain, in addition to the oxides and carbonate of the metal, small amounts of combined sulphur, phosphorous, and manganese and are mixed with more or less sand and clay. The metals from lithium down to manganese are obtained by electrolysis of melted compounds that conduct an electric current.

The science which treats the methods used to obtain the metals in free condition from compounds that occur in nature is called metallurgy.

2. Translate into English.

1. Железо широко используется в промышленности.
2. Сталь – это железо, которое содержит от 0,05 до 1,7 процентов углерода.
3. Золото, серебро, олово, платина, ртуть и медь добываются в свободном состоянии.
4. Железо получают из руд.
5. Искусство изготовления оружия было известно многим древним народам.

Text 3
Metals and their properties

1. Translate the text with the help of a dictionary.

Metals are known to be the most important materials used in engineering industry. People began to use metals after wood and stone, but now they are more important than these old materials. We know more than sixty five metals to be used in industries. Of all metals being utilized in industry iron is supposed to be the most important one. Iron combined with some other metals is ferrous metal, all the other being non-ferrous metals.

Ferrous metals are steel and cast iron.

Non-ferrous metals are copper, zinc, aluminium, lead, tin.

Metals are widely used because of their useful properties. They are much harder, stronger than wood and that is why some engineering constructions were impossible when people did not know how to produce and use metals. Strength, hardness, plasticity are considered to be the properties which made metals so useful in industry.

Strength of metal is the property to withstand to external forces without changing their shape.

Hardness is the property of a material to resist deformation under applied load. It is the most important mechanical property of metals.

Plasticity is the ability of material to change its form without breaking under the influence of load and preserve this changed form after removal of the loads.

When two or more metals are mixed in the melted condition and allowed to solidify such solids are called alloys. Engineering metals are usually used in industry in the form of alloys as their properties are much better than the properties of pure metals.

2. Translate the sentences.

1. The uses of metals are based on their physical or chemical properties.
2. Metals vary in density, hardness, heat and electrical conductivity and weight.
3. Metals react with oxygen in the air to form oxides over changing timescales (iron rusts over years, while potassium burns in seconds).
4. The transition metals (such as iron, copper, zinc, and nickel) take much longer to oxidize.
5. Others, like palladium, platinum and gold, do not react with the atmosphere at all.
6. Metals in general have high electrical conductivity, thermal conductivity, luster and density, and the ability to be deformed under stress without cleaving.
7. Optically speaking, metals are opaque, shiny and lustrous.
8. Mechanical properties of metals include their ductility, which is largely due to their inherent capacity for plastic deformation.

Text 4
Properties of metals

1. Make the summary of the text

The metals resemble one another in their general chemical behaviour with other substances, but they differ markedly in activity.

The uses to which metals are put are based upon their physical or chemical properties. The metals vary greatly in density. The lightest is lithium, which has the density of 0.534 and is, therefore, about one-half as heavy as water. The heaviest is osmium (D. 22.48) which is

closely related to platinum (D. 21.45) in physical and chemical properties. The so-called light metals, of which sodium, potassium, magnesium and aluminium are examples, have a density less than 4; iron, lead, tin, silver, etc. are known as heavy metals.

The metals also vary in hardness, from potassium, which can be molded like wax, to chromium, which will cut glass. The metals and other substances differ in the extent to which they can resist a strain that tends to bring about a permanent change in their form. All substances offer more or less resistance to the flow of an electric current through them. With any given substance, the resistance is determined by its dimensions and the temperature.

The solids obtained when two or more metals are mixed in the molten condition and allowed to solidify are called alloys. Each constituent of an alloy is called a component. Alloys may be binary (two-component), ternary (three-component), etc. The ability of various metals to form alloys differs greatly.

density – плотность
to melt – плавить
strain – нагрузка, натяжение, напряжение
to mold – отливать в форму

2. Fill in the table with suitable properties: plastic, fluid, ductile, elastic, durable, workable, malleable, strong, weak, tough. ***Take a good dictionary to help you. Learn the words.***

Definition	Property	
The metal flows easily when it melts.	The metal is <u>fluid</u>.	It has <u>fluidity</u>.
The metal pulls out of shape without breaking.	The metal is ……	It has ……
The metal returns to its original shape.	The metal is …	It has ……
The metal can be stretched without breaking.	The metal is ……	It has ……
The metal can be hammered out of shape without breaking.	The metal is……	It has ……
The metal can be worked.	The metal is	It has ……

	……	
The metal is long-lasting.	The metal is ……	It has ……
The metal lacks strength.	The metal is ……	It has ……
The metal is not easily broken.	The metal is ……	It has ……
The metal is strong and durable.	The metal is ……	It has ……

Text 5
Alloys

1. Read the text and answer the following questions.

1. What is the most common metal?
2. What are the properties of cast iron?
3. What is the carbon content in high-carbon steels?
4. How is semisteel made?
5. What can you say about wrought iron?

Pure metals are comparatively seldom used; in engineering, application is made chiefly of alloys which consist of two or more metals, or of metals and metalloids.

Alloys are metallic solids, complex in composition, formed as a result of the freezing of the melt – the liquid solution of two or more metals, or metals and metalloids.

Each constituent of an alloy is called a component. Alloys may be binary (two-component), ternary (three-component), etc.

The ability of various metals to form alloys differs greatly and, therefore, the structure of various alloys after solidification may also be very diverse.

Cast iron is a general term applied to iron-carbon alloys containing more than 1.7 per cent of carbon. Cast iron without the addition of alloying elements is weak in tension and shear, strong in compression and has low resistance to impact. It is obtained from the cupola furnace where pig iron is remelted in contact with coke. Grey cast iron has the carbon present in the free or graphite state and is soft,

easily machined, and only moderately brittle. White cast iron has most of the carbon in the combined state and is therefore hard and brittle. Malleable cast iron is made by heating white iron castings for a period of several days in airtight pots filled with an oxide of iron.

Steel is a ferrous material with a carbon content from 0.1% to 1.0%. Semisteel is a name to a metal made by melting 20 to 40 percent of steel scrap with cast iron in the cupola. Steel castings are more expensive but stronger and tougher.

Wrought iron is quite ductile and can be easily rolled, drawn, forged and welded. It has high resistance to corrosion. The carbon content is generally less than 0.1% and the material must contain not less than 1% slag.

Cast steel normally contains about 0.5% of carbon, and is used to replace cast iron when castings of considerable strength are required. Forged steel is steel that has been hammered, drawn, pressed or rolled in the process of manufacturing of a particular part.

Text 6
Steel

1. Read the text and find the information on the following points:

1. What is steel?
2. What are the main properties of steel?
3. What kinds of steel are there?
4. What are they used for?
5. What are the grades alloy steels are grouped into?

There are two general kinds of steels: carbon steel and alloy steel.

Carbon steel is known to contain only iron and carbon; while alloy steel contains some other “alloying elements” such as nickel, chromium, manganese, molybdenum, tungsten, vanadium etc.

Carbon steel seems to be the most common steels used in industry. The properties of these depend only on the percentage of carbon. Carbon steels are subdivided into groups.

Low carbon steels are very soft and are used for rails, bolts and for machine parts that do not need strength.

High carbon steel or “tool steel” may be hardened by heating it to a certain temperature and then quickly cooling in water. The more carbon the steel contains and the quicker cooling is, the harder it becomes. Because of its high strength and hardness this grade of steel is used for manufacturing tools and working parts of machines.

Alloy steels are known to have the following grades:

Special alloy steels, such as nickel steel, chromium steel are utilized for gears, bearings, shafts and wires. Alloying elements make these steels tougher, stronger and harder than carbon steels. Some alloying elements cause steels to resist corrosion and such steels are called stainless steels.

High-speed steel (HSS) contains tungsten, chromium, vanadium and carbon. Tools made of high speed steel perform operations at much higher speeds than carbon steels.

2. Retell the text.

Text 7
Non-ferrous metals

1. Read the text.

Non-ferrous metals are more expensive than ferrous metals and are used only when some characteristic not possessed by iron or steel is essential or desirable in application. These characteristics are: high electrical and thermal conductivity, high corrosion resistance, non-magnetic qualities, light weight, etc.

The metals most frequently used to make non-ferrous metal castings are copper, tin, zinc, lead, nickel, gold, and aluminum. Some of the basic non-ferrous metals and their characteristics are described below.

Copper is a reddish-brown, tough metal. It has very high electric conductivity and high corrosion resistant qualities. Copper is used for making electrical contacts and wires, pipes, telephone cables, tanks, water heaters, etc.

Zinc is a hard, brittle, bluish-white metal that is employed in the pure form as sheet zinc.

Lead is a very heavy bluish-grey metal which is yet soft. This metal is highly resistant to corrosion, but its strength is so low that it

must be supported by a core of some other metal. Lead is used for lining pipes, acid tanks and coating electrical cables.

Aluminum is a soft, silvery white metal. It is light in weight, has high corrosion-resistant qualities and is used for automobile and airplane parts as well as for making different light-weight objects used in everyday life such as frames, cooking utensils, chairs, etc.

Tin is a silvery, corrosion-resistant metal. Tin is hardly used in pure form, but is employed as an alloying element.

Nickel is a hard, tough, silvery metal. It has high corrosion-resistant qualities and is used for plating other metals such as iron and brass.

2. Match the metals to their properties and application.

Metal	Properties	Application
1. copper 2. zinc 3. lead 4. alluminium 5. tin 6. nickel	a) heavy bluish-grey metal, soft, highly resistant to corrosion, but its strength is low; b) soft, silvery white metal, light in weight, high corrosion-resistant qualities; c) reddish-brown, tough metal, very high electric conductivity and high corrosion resistant qualities; d) silvery, corrosion-resistant; e) hard, tough, silvery metal, high corrosion-resistant qualities; f) hard, brittle, bluish-white.	a) is used for lining pipes, acid tanks and coating electrical cables. b) is used for plating other metals such as iron and brass. c) is employed in the pure form in the forms of sheets. d) hardly used in pure form, but is employed as an alloying element. e) is used for automobile and airplane parts as well as for making different light-weight objects used in everyday life such as frames, cooking utensils, chairs, etc. f) is used for making electrical contacts and wires, pipes, telephone cables, tanks, water heaters.

3. Use the information of the table to describe metals:

e.g. Zink is a hard, brittle, bluish-white metal which is used in pure form as sheet zinc.

Text 8
Non-ferrous metals

1. ***Read the text and fill in the table below the text:***

Aluminium and its alloys. Aluminium is one of the lightest metals used for machine construction. It is commonly used alloyed with copper, silicon or magnesium, the world's lightest structural metal.

Intensive chemical research has created a large number of nonmetallic synthetic materials grouped under the general term of plastics, e. g. bakelite, plexiglass, textile fibres, synthetic rubber and several protective coatings.

Next to oxygen, aluminium is the most abundant element in nature: about 7.45 per cent of the earth's crust consists of aluminium.

Aluminiumis extracted from rock with a high alumina content. The most important sources are bauxite, kaolin, nepheline and alunite.

Bauxite is the principal source of aluminium. The less silica in a bauxite the higher its quality as an aluminium ore. Kaolin clays are very abundant in nature but the extraction of aluminium from these ores presents difficulties due to the considerable amount of silica present.

The most important properties of aluminium are its low specific gravity (2.7), high electrical and thermal conductivities, high ductility, and corrosion resistance in various media.

Pure aluminium has only few applications; it is used for the manufacture of electrical wire, chemical apparatus, household utensils and for coating other metals.

Aluminium alloys are more widely used in industry. Wrought aluminium alloys have a high mechanical strength which in some cases approaches the strength of steel. Wrought aluminium alloys are further classified as (1) non-heat-treatable and (2) heat-treatable alloys. Wrought aluminium alloys also include complex alloys of aluminium, with copper, nickel, iron, silicon and other alloying elements. Complex wrought aluminium alloys of the duralumin (dural) type and certain others have found most extensive application in many industries.

Copper and its alloys. Copper is a valuable metal. Its wide application in many fields of engineering is due to its exceptionally

high electrical and thermal conductivity, low oxidisability, good ductility and to the fact that it is the basis of the important industrial alloys, brass and bronze.

The raw materials for the production of copper are sulphide or oxide copper ores.

Various grades of copper are used for engineering purposes. It must be noted that even a minute amount of impurities sharply alters the properties of pure copper. The mechanical strength of pure copper is not high and depends upon the degree of deformation (reduction in working). Pure copper is used chiefly for electrical engineering products such as cables and wire.

The copper alloys are more widely employed. The alloying of copper with other elements increases the strength of the metal in some cases and improves the anticorrosive and antifriction properties in others. Copper alloys comprise two main groups – brasses and bronzes. Alloys of copper and zinc are called brasses. The addition of appreciable amount of tin, nickel, manganese, aluminium and other elements to copper-zinc alloys imparts higher hardness, strength and other desirable qualities. Complex copper-zinc alloys comprising three, four or more components are special brasses.

Alloys of copper with a number of elements including tin,aluminium, silicon, manganese, iron and beryllium are called bronzes. Tin bronzes are divided into two groups: wrought bronzes, containing up to 6% Sn, and casting bronzes, containing over 6% Sn.

Certain grades of special bronzes deserve more detailed consideration. Aluminium bronzes contain from 4 to 11% Al; their high mechanical properties and corrosion resistance considerably surpass those of tin bronzes and brasses. The cast ability of aluminium bronzes is good and they are frequently used in foundry practice. Sheets, strips, bars and wire are made by the rolling process. Aluminium bronzes with admixtures of iron and manganese are suitable for castings and for working, especially for smith and closed-die forging.

Magnesium and its alloys. Magnesium has a specific gravity of approximately 1.7; its alloys are the lightest of all engineering metals employed.

The melting point of magnesium is 650°C; its boiling point is 107°C. Magnesium is very inflammable and burns with a dazzling flame, developing a great deal of heat.

The mechanical properties of magnesium, especially the tensile strength, are very low and therefore pure magnesium is not employed in engineering.

The alloys of magnesium possess much better mechanical properties which ensure their wide application.

The principal alloying elements in magnesium alloys are aluminium, zinc and manganese. Aluminium, added in amounts up to 11 per cent, increases the hardness, tensile strength and fluidity of the alloy. Up to 2 per cent zinc is added to improve the ductility and castability. The addition of 0.1–0.5 per cent manganese raises the corrosion resistance of magnesium alloys.

Small additions of cerium, zirconium and beryllium enable a fine-grained structure to be obtained, they also increase the ductility and oxidation resistance of the alloys at elevated temperatures.

Magnesium alloys are classified into two groups: (1) wrought alloys, (2) casting alloys.

Wrought magnesium alloys are chiefly used for hot smith and closed-die forged machine parts. They are less frequently used as sheets, tubing or bar stock.

Magnesium casting alloys are widely used as foundry material though their castability is inferior to that of aluminium-base alloys.

Non-ferrous metal	**Properties**	**Application**	**Alloying element**
Aluminium and its alloys			
Copper and its alloys			
Magnesium and its alloys			

Text 9
Corrosion of metals and alloys

1. Read the text and find the information on the following points.

1. What is corrosion?
2. What are three factors affecting corrosion?
3. Give the classification of corrosion.
4. What are the principal corrosion protection methods.

Almost all metals and alloys subject to the action of atmospheric air or other surrounding media (for example, sea water, soil, acid and alkali solutions, organic liquids, etc.) are gradually destroyed, beginning from the surface, and lose their initial appearance. This progressive destruction of a metallic surface exposed to an external aggressive (active) medium is called corrosion.

Experience shows that corrosive destruction depends mainly upon the following three factors: (1) the chemical nature of the metal or composition of the alloy and their structures; (2) the chemical nature of the surrounding medium and the percentage of aggressive matter in metals (oxygen, moisture, acids, alkalis, etc.) and (3) the temperature of the surrounding medium.

As to its character, metal corrosion may be classified as: (1) uniform corrosion, in which the whole surface of the metal or alloy is corroded with equal intensiveness; (2) localized corrosion, in which only certain areas of the surface are attacked; (3) selective corrosion, where only separate structural components of an alloy are affected and (4) intercrystalline corrosion, which involves destruction of the metal or alloy along its grain boundaries.

According to the mechanism of the corrosion process it is necessary to distinguish between chemical and electrochemical corrosion.

Chemical corrosion conforms to the laws of chemical kinetics. A typical example of chemical corrosion is the oxidation and erosion of the valves of internal combustion engines by the incandescent products of combustion. A film of corrosion products, usually oxides, is formed on the surface of metal in the course of chemical destruction. In some cases this film may protect the underlying metal

against further corrosion, i. e. make it more passive in respect to the surrounding medium.

Electrochemical corrosion occurs in the presence of liquids which are electrolytes containing free ions. The essence of electrochemical corrosion is that the atoms on the surface of the metal in contact with the electrolytic solution, pass into the solution as ions and leave an equivalent quantity of electrons in the metal.

The principal corrosion protection methods applied in practice are: (1) alloying metals to obtain chemically inactive alloys of special composition; (2) forming oxide films on the surface of metal parts; (3) applying protective metallic coatings on the parts; (4) protecting the surface of metal with a coat of paint or lacquer.

Useful words:
To subject – подвергать воздействию
acid – кислота
alkali (*pl*. alkalis) – щелочь
incandescent – раскаленный
film – пленка
lacquer – лак, глазурь
grain – зерно, кристалл, гранула

Revision

1. ***Make a table. Look through Part I once again and fill in the table with suitable words.***

Metals	Properties	Verbs
ferrous non-ferrous cast iron steel, etc.	hardness (hard), strength (strong), etc.	To work to resist (corrosion), etc.

2. ***Form derivatives from the words***

Russian	Adjective	Noun	Verb
Твердый	hard		harden

Мягкий		softness	
Прочный	strong		
Слабый			weaken
Жесткий	tough		

3. Translate the sentences.

1. Ferrous metals consist of iron combined with carbon, silicon and other elements. But carbon is the most important element in ferrous alloys.
2. Ferrous metals are used in industry in two forms: steel and cast iron, which differ in the quantity of carbon content.
3. Alloys consist of a simple metal combined with some other element.

Steel is a ferrous material having some carbon content. There are two kinds of steel: carbon steel and alloy steels.

4. Carbon steel should contain only iron and carbon without any other alloying element.
5. Alloy steels are those in which in addition to carbon an alloying element is present. These alloying elements have an effect on the properties of steel. They increase its strength and hardness, for example, high percentage of chromium makes steel rust-resistant, and we call it “stainless steel”.
6. Strength, ductility and machinability are the most important industrial and commercial properties of steel. Such properties as resistance to wear, electrical conductivity, magnetic properties are important in special uses of metals.
7. According to their chemical and mechanical properties steels may be used in different branches of industry, for example, in machine building, rocket engineering, automobile industry, etc.

3. Complete the sentences. You can use the sentences to speak about metals and their properties.

1) Engineers have to know …and understand…….
2) Metals are known to be……
3) There are two groups of metals…..
4) The main properties of metals that make them so useful in industry are……

5) Alloys are …….and they are made in order to…..
6) There are two main ferrous alloys used in industry…….
7) Non-ferrous metals (such as…….) have the following properties…..
8) Most metals and alloys are subjected to……
9) The principal corrosion protection methods applied in practice are ……

Part 2. Metalworking

While studying the part you will learn about metalworking processes and heat treatment of metals.

Metalworking is the process of working with metals to create individual parts, assemblies, or large scale structures. The term covers a wide range of work from large ships and bridges to precise engine parts and delicate jewellery. It therefore includes a correspondingly wide range of skills, processes, and tools.

Text 1
Metalworking processes

1. Read the text.

Metals are important in industry because they can be easily **deformed** into useful shapes. A lot of metalworking processes have been developed for certain **applications**. They can be divided into five broad groups: ***rolling, extrusion, drawing, forging, sheet-metal forming.***

During the first four processes metal is **subjected** to large amount of **strain (deformation).**But if deformation goes at a high temperature, the metal will **recrystallize** – that is, new strain-free grains will grow instead of deformed grains. For this reason metals are usually rolled, extruded, drawn, or forged above their recrystallization temperature. This is called **hot working**. Under these conditions there is no limit to the compressive plastic strain to which the metal can be subjected.

Other processes are performed below the recrystallization temperature. These are called **cold working**. Cold working **hardens**

metal and makes the part stronger. However, there is a limit to the strain before a cold part **cracks**.

Rolling is the most common metalworking process. More than 90 percent of the aluminum, steel and copper produced are rolled at least once in the course of production. The most common rolled product is **sheet**. Rolling can be done either hot or cold. If the rolling is finished cold, the **surface** will be **smoother** and the product stronger.

Extrusion is **pushing** the **billet** to **flow** through the **orifice of a die** (отверстие пресс-формы). Products may have either a simple or a complex **cross section**. Aluminium window frames are the examples of complex extrusion.

Tubes or other hollow parts can also be extruded. The initial piece is a thick-walled tube, and the extruded part is shaped between a die on the outside of tube and a **mandrel** held on the inside.

In impact extrusion (also called back-extrusion) (штамповка выдавливанием), the workpiece is placed in the bottom of a hole and a loosely fitting **ram** is pushed against it. The ram forces the metal to flow back around it, with the gap between the ram and the die determining the wall thickness. The example of this process is the manufacturing of aluminium beer cans.

Drawing consists of pulling metal through a die. One type is wire drawing. The diameter **reduction** that can be achieved in one die is limited, but several dies in series can be used to get the desired reduction.

Forging is the shaping of a piece of metal by pushing with open or close dies. It is usually done hot in order to reduce the required force and increase the metal's plasticity.

Open-die forging (штамповка открытым штампом) is usually done by **hammering** a part between two flat faces. It is used to make parts that are too big to be formed in a closed die or in cases where only a few parts are to be made. The earliest forging machines lifted a large hammer that was then dropped on the workpiece, but now air or steam hammers are used, since they allow greater control over the force and the rate of forming. The part is shaped by moving or turning it between blows.

Closed-die forging (штамповка закрытым штампом) is the shaping of hot metal within the walls of two dies that come together to **enclose** the workpiece on all sides.

Sheet metal forming is widely used when parts of certain shape and size are needed. It includes forging, bending and shearing. One characteristic of sheet metal forming is that the thickness of the sheet changes little in processing. The metal is **stretched** just beyond its **yield point** (предел текучести) (2 to 4 percent strain) in order to retain the new shape. **Bending** can be done by pressing between two dies. **Shearing** is a cutting operation similar to that used for cloth.

Each of these processes may be used alone, but often all three are used on one part. For example, to make the roof of an automobile from a flat sheet, the edges are gripped and the pieces pulled in tension over a lower die. Next an upper die is pressed over the top, **finishing** the forming operation (штамповку), and finally the edges are sheared off to give the final **dimensions**.

2. Translate the words in bold into Russian.

3. Find out the English equivalents to the following words:

могут легко деформироваться, нужные формы, подвергать деформации, пластическая деформация сжатия, самый обычный процесс обработки металла, отверстие фильеры, сложное сечение, толщина стенки, протягивание металла через фильеру, уменьшение диаметра, сохранить новую форму, увеличить пластичность металла, сила и скорость штампования, отделочная обработка, малые допуски.

4. Make nouns from the verbs. What do they mean?

Deform – deformation, apply – application, roll – …, extrude – …, draw – …, forge – …, push – …, reduce – …, hammer – …, shape – …, stretch – …, bend – …, shear – …, finish – …

5. Answer the questions.

1. What are the main metalworking processes?
2. What is rolling? Where is it used?
3. What is extrusion? What shapes can be obtained after extrusion?
4. What are the types of extrusion?

5. What is sheet-metal forming and where it can be used?
6. What are the types of forging?

Text 2
Heat treatment

Metals can be **heat treated** to alter the properties of strength, ductility, toughness, hardness or resistance to corrosion. Common heat treatment processes include annealing, normalization, quenching and tempering.

Heat treatment of metals

1. ***Read the text.***

Metals undergo heat treatment to improve its structure and to obtain higher or specified mechanical properties.

The types of heat treatment applied in practice are: **(1) annealing, (2) normalization, (3) quenching and (4) tempering.**

Heat treatment is the process of controlled heating and cooling of metals to change their structural arrangement and to ensure certain desirable properties.

Annealing consists of heating the metal to a temperature slightly above the critical temperature and then cooling slowly to produce an even grain structure, reduce the hardness, and increase the ductility.

Normalizing is a form of annealing in which the material is cooled in the air.

Quenching or rapid cooling from above the critical temperature by immersion in cold water or some other cooling medium, is a hardening treatment.

Tempering consists of reheating the quenched metal to restore ductility to some extent and reduce the brittleness.

2. ***Learn the words:***

quenching − быстрое охлаждение; закалка; закаливание
annealing − отжиг, нормализация, отпуск
normalization − нормализация
hardening − затвердевание, закаливание
tempering − закалка с последующим отпуском

3. Find the English equivalents in the text.

Подвергать тепловой обработке, улучшить структуру, отжиг, охлаждение, зернистая структура, улучшить ковкость, погружение в холодную воду, уменьшить хрупкость.

4. Answer the questions.

1. What is heat treatment?
2. What for is heat treatment used?
3. What are the types of heat treatment?
4. What are annealing, normalization, quenching and tempering?

Revision

1. Complete the sentences. Use the sentences to speak about metalworking processes and heat treatment of metals.

Metalworking is the process.....

Metalworking processes can be divided into.....

Metals can be heat treated to.....

The types of heat treatment applied in practice are.....

Part 3. Machining of metals and machine-tools

While studying the part you will learn about machining of metals and machining tools.

The **machining of metals** is the processes of removing chips from the metal parts. These processes include turning, drilling, boring, reaming, broaching, milling and grinding. They have been greatly developed since the development of the steam engine. Machining operations underlie all modern industrial production. In the design of a modern machine of any type are reflected the latest developments of practically all the other engineering industries.

Text 1
Machining of metals

1. ***Read the text.***

The strict distinction between the operations of ***drilling*** and ***boring*** is that the first initiates a hole, while the second enlarges one already existing. ***Reaming*** is the operation enlarging a machined hole to accurate size with a smooth finish. The ***sawing*** of materials is an important operation too.

Broaching is a machining method in which one or more cutters (broaches) with a series of teeth are pushed or pulled across a surface to machine that part to the desired shape. The broach has a number of successive teeth of increasing size which cut in a fixed path.

Grinding is the only method of cutting such materials as hardened steel. Grinding is performed with a rotating abrasive wheel. It produces very fine finishes, making very light cuts, or high precision forms

Milling is the complex shaping of metal (or possibly other materials) parts, by removing unneeded material to form the final shape. It is generally done on a milling machine. Two common types of millers are the horizontal miller and vertical miller.

Turning is a metal cutting process for producing a cylindrical surface with a single point tool.

2. ***Learn the words***

machining – обработка, механическая обработка, обработка резанием, обработка на станке
turning – точение, обточка, токарная обработка
drilling – сверление
boring – сверление, расточка
reaming – развертывание
broaching – протягивание, прошивание
milling – фрезерование
grinding – оттачивание, шлифовка
sawing – распиловка, раскрой, резка
fine finish – тонкая отделка, чистовая обработка
smooth finish – шлифование, доводка

3. Translate the words in bold into Russian.

4. Find in the text the English equivalents to the words:
металлорежущий станок, стружка, точный, режущий инструмент, резец, фреза, точность, аккуратность, траектория, канал, лежать в основе чего-либо.

Text 2
Machine-tools

1. Read the text

Machine-tools are machines designed for cutting metal parts by means of a cutting tool. The machine-tool comprises the principle manufacturing equipment in a machine shop. It is the original source of every manufactured article we use or touch. It cannot only reproduce itself but it is the only machine which can create other machines.

Without a machine-tool the engineer would be stripped of his power and opportunities. Every tool, machine and material stems directly from machine-tools or was evolved from machines which themselves were produced by machine-tools.

Machining operations, or metal-cutting processes, underlie all modern industrial production.

The general term «machine-tool» is applied to various classes of power-driven metal-cutting machines employed in the machine shop for the purpose of shaping many commercial products.

The function of machine-tools is to hold both the work and a cutting tool or tools and move them relative to each other to obtain the proper cutting action and at an economic speed. The part of the machine-tool which removes the metal during a metal-cutting process is called a cutting tool. Cutting tools used for various metal-cutting operations may be different and the type depends on the work which is performed and on the material. The main types of machine-tools used for industrial production are lathes, drilling machines, milling machines, etc.

The lathe is a machine-tool in which work is held so that it can be rotated about an axis. The cutting tool is traversed past the work from one end to the other. It is designed primarily for turning and

boring operations. However, in addition to turning and boring, many other operations may also be performed on a lathe. The lathe is considered to be the oldest but still the most important of all machine-tools. Any shop, containing machines or machine-tools, contains a lathe.

Lathes used in shop practice can be of different designs and sizes. These lathes fall into various types, either according to their characteristic constructional features, or according to the work for which they are designed.

Useful words:

cutting tool – режущий инструмент, резец
to stem from – происходить
power-driven – механизированный, с электроприводом
work – заготовка, обрабатываемая деталь
relative to – относительно
lathe – токарный станок
axis – ось
to traverse – пересекать

2. Match the beginnings of the sentences with their endings.

1. Machining operation underlie	a. the work they are designed for
2. Machining operations are applied for the purpose of	b. to obtain the proper cutting action
3. The work and the cutting tool are moved relative to each other	c. shaping many commercial products
4. A cutting tool is the part of the machine-tool which	d. all modern industrial production
5. The type of the cutting tool depends on	e. for cutting metal parts by means of a cutting tool
6. Machine-tools are designed	f. for turning and boring operations
7. The cutting tool is designed primarily	g. removes the metal during a metal-cutting process
8. Lathes fall into various types according to	h. the work which is performed and on the material

Text 3
Machine-tools

1. Read the text and answer the questions:

1. Where are machine-tools used?
2. What parts does the ordinary drilling machine consist of?
3. What operations is the lathe used for?
4. What are the main types of lathes?
5. What do lathes differ in?

The machine-tool is the principal manufacturing equipment in a machine shop. It is essential in the manufacture of every product from a giant turbine to minute jewels for aircraft instruments.

Fundamentally all machine-tools remove metal and can be divided into the following categories:

1) Turning machines (lathes)
2) Drilling machines.
3) Boring machines.
4) Milling machines.
5) Grinding machines.

One of the simplest tools is the ordinary drilling machine. It consists of a spindle which imparts rotary motion to the drilling tool, mechanism for feeding the tool into the work, a table on which the work rests, and a frame. The drilling machines or drill presses are grouped into the following four classes: sensitive, upright, radial and multi-spindle machines.

A milling machine is a machine-tool that removes metal as the work is fed against a rotating cutter.

The lathe is a machine-tool which can perform a wide variety of operations. It is primarily used for turning and boring operations. In addition, the lathe can be used for drilling, reaming, tapping and, by employing suitable adapters, operations of milling and grinding may be carried out without difficulty. The lathe is the oldest machine-tool, but it is still widely used.

There are many types of lathes that differ in their size, design, method of drive, arrangement of gears and purpose.

According to the character of work performed, the design and construction lathes are divided into the following types: bench lathes,

chucking lathes and automatic lathes. There are also screw machines, boring mills, crankshaft lathes, wheel lathes, etc.

2. Learn the words:

spindle – вал, ось, шпиндель
to impart – давать, наделять качеством
to feed – подавать, питать
frame – рама, остов, каркас, стойка
upright – вертикальный
radial – радиально-сверлильный (станок)
multispindle – многошпиндельный (токарный автомат)
sensitive – точный
tapping –нарезание резьбы метчиком
drive – привод
gear – устройство, механизм, привод, зубчатое колесо
bench lathe – настольный токарный станок
chucking lathe – патронный токарный станок
screw machine –винтонарезной станок
crankshaft lathe – станок для токарной обработки коленчатых валов
boring mill – сверлильный станок

3. Give definitions to the following terms.

Turning, drilling, boring, reaming, broaching, grinding, machine-tool, milling machine, lathe.

4. Make summary of the text.

Text 4
Machine-cutting tools

1. Read and translate the text:

The cutting tool is that part of a cutting machine which removes material from revolving work. Careful attention should be given to the cutting tools in any metal-cutting operation as the application of incorrect or faulty tools results in poor work and higher cost.

As a rule cutting tools are made of hardened and tempered steel or alloy metals. All cutting tools can perform certain work and may be

subdivided into turning tools, boring tools, milling cutters, planing tools, shaper tools etc. Each cutting tool is known to consist of a shank for holding the tool in the machine and a tip or cutting edge for removing chips from the work.

The various types of cutting tools differ in shape and in the angles to which the tool surface is to be ground. The shape of the tool depends on a large number of factors, such as the specific operation, the material to be cut and the material the tool is made of.

Cutting tools for longitudinal turning are subdivided into roughing tools and finishing tools.

Roughing tools are applied both for roughing and removing the excessive metal from the work. Such tools are usually carbide-tipped and have a long cutting edge.

Finishing tools are supposed to be used after the work has been turned with a roughing tool to give accurate size and clean surface to the work being machined. Material is cut off by means of tools known as cutting-off tools.

Before starting the cutting operation tools should be clamped in the tool-holder by means of two or more bolts.

Useful words:

faulty – неисправный, поврежденный
planning tool – строгальный резец
shaper tool – фасонный резец
shank – хвостовик, корпус
tip – наконечник
cutting edge – режущая кромка
to grind – затачивать
longitudinal turning (=linear turning) – продольное точение, продольная обточка
bolt – болт
roughing tool – черновой резец
finishing tool – чистовой инструмент, чистовой резец
to clamp – зажимать
tool-holder – резцедержатель

2. Put the words into the correct order to make sentences:

1. is, The cutting tool, that part of, material from, which removes, a cutting machine, revolving work.
2. hardened and tempered, Cutting tools, metals, steel, or alloy, are made of.
3. is known, Each cutting tool, a shank for, in the machine and holding the tool, a tip or cutting edge, to consist of, for removing chips from the work.
4. Roughing tools, the excessive metal, for roughing and removing, are applied, from the work.
5. to give accurate size, Finishing tools, to be used, and clean surface, being machined, are supposed, to the work.
6. should be clamped, Before starting, tools, by means of two or more bolts, in the tool-holder, the cutting operation.

Text 5
Metal-Cutting Machines. The Lathe

1. Read the text.

The most useful and versatile machine in the workshop is a turning machine (lathe). As the name shows, it is used for turning different objects and parts. However, besides turning many other operations can be performed on a lathe, such as drilling, reaming, tapping and by employing suitable adapters operations of milling and grinding may be carried out without difficulty.

The lathe consists of the following basic parts: the bed, the headstock, the tailstock, the saddle (or carriage) with the tool-post and the driving and gear mechanism.

The bed is a base for supporting and aligning the components of the machine. At the opposite ends of the bed there is a headstock and a tailstock.

The headstock carries a pair of bearings in which the spindle rotates. The spindle holds the workpiece and rotates with it. The headstock also incorporates the driving and gear mechanism. The parts of this mechanism are the feed shaft and the change gear box. The feed shaft is designed for driving the tool-post, and the change gear box drives the spindle of the lathe at various speeds. Tapered centres in the nose of the spindle and of the tailstock hold the work firmly

between them. The tool-post is driven along the saddle either forwards or backwards at a fixed and uniform speed. That is why the operator is capable of making accurate cuts and giving the work a good finish.

There are many types of lathes but all of them operate on the same basic principle: the workpiece is revolved by power and a cutting tool is brought against it, removing metal in the form of chips.

The other principle of operation is that used in milling, grinding and drilling machines. In these machines the tool is fixed and the work is moved to and fro against it in a horizontal plane.

Useful words:

versatile – универсальный
workshop – цех
bed – станина, фундамент, основание
headstock – передняя бабка
tailstock – задняя бабка
saddle – салазки, суппорт, каретка
carriage – салазки, суппорт, каретка
tool-post – верхняя часть суппорта, резцедержатель
driving mechanism – движущий механизм, приводное устройство
gear mechanism – зубчатая передача
to support – поддерживать
to align – выравнивать, совмещать
bearing – подшипник
feed shaft – ходовой вал, вал подачи
change gearbox – гитара зубчатых колес
finish – доводка, шлифование, чистовая отделка
move to and fro – двигаться туда и обратно

2. Which of the following sentences are true?

1. The main components of the lathe are: the bed, the headstock, the saddle and the driving and gear mechanism. 2. The headstock and the tailstock are located at one end of the bed. 3. The tool-post is mounted on the bed. 4. The tool-post carries the tool. 5. The spindle holds and rotates the work. 6. The function of the change gear box is driving the headstock spindle. 7. The tool-post is driven by the feed-shaft. 8. All lathes operate on the same principle: the tool is fixed and the work is moved to and fro against it in a horizontal plane.

Text 6
Lathe tools and their uses

1. Make summary of the text.

Lathe tools are generally made of High Speed Steel which is known to have a high degree of hardness even at high temperatures. To overcome the problem of the cost of this material the lathe tool may consist of a block of HSS welded to high tensile steel shank or the tool may be in the form of a small bit fitted into a holder.

The angles which are ground into a lathe tool vary considerably with factors such as the metal being cut, the rate of feed, the amount of material to be removed with each cut and the finish required as well.

Another important factor in successful machining is the selection of the correct spindle speed. Thus, a deep roughing cut will be taken with a slow spindle speed and, in turn, a light finishing cut with a faster spindle speed. In addition, the resulting spindle speed will depend on the diameter of the work.

The tool can be moved to take a cut along the length of the workpiece, this is known to be sliding. The tool being moved across the end of the workpiece, this is known as facing.

When setting up the tool it is important to position the cutting edge level with the centre height of the workpiece. The tool can be correctly aligned. The more common lathe tool shapes are subdivided into some groups. In order to remove waste in deep cuts roughing lathe tools are ordinarily used, round nose tools being preferred for general purposes. By means of finishing tools facing and finishing in light cuts can be performed. Facing lathe tools can perform cutting square shoulders and for cutting off components to length parting tools are to be used.

Revision

1. Translate the sentences

1. The engine lathe is the most commonly used machine-tool. It is used for great variety of metal operations, such as turning, drilling, screw cutting and many others.
2. The principal units of the lathe are the bed, the headstock, the tailstock.

3. The bed is the base of any machine-tool and it is made of grey iron casting on which the saddle and the tailstock slide along special guideways. The headstock is also located and bolted on the bed.
4. The headstock contains the spindle and the speed gearbox. The spindle is the part of the machine to which power is applied to rotate the work. The changing of the spindle speed is effected by levers.
5. The tailstock consists of a casting fitted to the bed. The function of the tailstock is to support one end of the work turned between centres and to mount the tools.
6. The carriage of the lathe, which carries the tool, is made up of two principal parts: the saddle and the apron. The saddle travels along the guideways of the bed. The apron represents the front wall of the carriage. On the front of the apron are mounted the handles and levers by which the actions of the tool are controlled

2. Complete the sentences. Use the sentences to speak about metal-cutting machines:

1) The machining of metals is…
2) The main machining processes are…
3) All machining operations are made by …
4) Machine-tool is…
5) The part of a machine-tool which removes metal is called…
6) The main types of machine-tools used for industrial production are…
7) The most versatile machine-tool is…
8) The basic parts of the lathe are…

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Metals, metalworking processes, metalworking machines (Металлы, металлообрабатывающие операции, металлообрабатывающие станки)

Методические указания по английскому языку
для практических занятий и самостоятельной работы
студентов направления подготовки 15.03.05
«Конструкторско-технологическое обеспечение
машиностроительных производств»
очной формы обучения

Рецензент

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Печатается в авторской редакции

Подписано в печать 26.09.2016. Формат 60×84/16.
Бумага офсетная. Отпечатано на ризографе. Уч. изд. л. 1,8.
Тираж 24 экз. Заказ
КузГТУ. 650000, Кемерово, ул. Весенняя, 28.
Издательский центр КузГТУ. 650000, Кемерово, ул. Д. Бедного, 4а.