МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РОССИЙСКОЙ ФЕДЕРАЦИИ
ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ ОБРАЗОВАТЕЛЬНОЕ УЧРЕЖДЕНИЕ ВЫСШЕГО ОБРАЗОВАНИЯ
**«Московский политехнический университет»**
**(МОСКОВСКИЙ ПОЛИТЕХ)**

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# READER

Учебное пособие
для студентов машиностроительных специальностей

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Основная цель издания − обучение студентов чтению специальной литературы, владение которой необходимо будущему инженеру. При отборе материала главным критерия служила информативная ценность текстов и их соответствие интересам студентов начальных курсов технических вузов.

Предназначено для студентов машиностроительных специальностей.

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# Оглавление

# Методические рекомендации

Данное пособие направлено на развитие навыков и умений в таком важном виде речевой деятельности, как чтение.

Чтение занимает особое место в системе обучения иностранному языку, так как, будучи одной из форм речевого общения, не только способствует овладению языком, но и является средством ознакомления студентов с основами научных знаний в различных областях машиностроения.

Чтение на иностранном языке как вид речевой деятельности является необходимым для большинства людей. Возможность общаться на иностранном языке имеют немногие, а читать книги, журналы, статьи – практически все.

Чтение является рецептивным видом речевой деятельности, как и аудирование, однако по характеру значительно отличается от него, и, прежде всего, тем, что оно легче. Чтение − это наиболее удобная форма обучения иностранному языку, поскольку при чтении каждое слово всегда находится в окружении других, и к его восприятию можно вернуться неограниченное количество раз. Поэтому авторы данного пособия уделяют большое внимание различным видам чтения, а именно: просмотровому, ознакомительному, поисковому и изучающему.

Рассмотрим, как проводятся занятия со студентами для обучения отдельным видам чтения на примере текста «Metals. The history of metals». До чтения текста учащимся предлагаются вопросы, которые предусматривают краткое введение в содержание текста: «What is the most important metal today?», «When did man start to use metals?», «What is alloy?» Любой студент легко сможет ответить на такие вопросы и заранее поймет, о чем будет идти речь в тексте. Следует отметить, что развитие прогнозирования играет существенную роль в скорости приема информации, целостности восприятия и эффективности ее переработки. Кроме того, такие задания создают естественный мотив для первого обращения к тексту, что обеспечивает практику просмотрового чтения, на которое, как правило, отводится от двух до пяти минут.

Затем студентам дается задание обнаружить фрагменты текста определенного содержания. Для этого используют поисковое

чтение. Например, преподаватель просит учащихся найти ту часть текста, где рассказывается об этапах получения металла из руды. Так как текст разбит на абзацы, и они имеют заголовки, для студентов не составляет никакого труда найти отрывок «From ore to metal». Обнаруженные фрагменты предназначены для изучающего чтения, которое предусматривает полное и точное понимание текста.

Средством проверки выступает устный или письменный перевод. Основным требованием к переводу является его адекватность оригиналу. Поскольку, как показывает опыт, студенты задают много вопросов, касающихся качества перевода, в разделе «Translation work» пособия приведены примеры письменного перевода отрывков из текстов раздела «Texts for reading science». Данные задания используются для проверки знания учащихся лексического материала уроков, а также их умения сделать обратный перевод с русского языка на английский.

Одной из основных задач работы над текстами является выработка умения «вычитывать» из текста определенную информацию, что постепенно готовит студентов к написанию сообщений, рефератов, докладов. Если учащиеся слабо владеют английским языком, можно ограничиться сообщением на родном языке, постепенно подготавливаясь к участию в выступлениях на английском языке.

Таким образом, данное пособие является хорошей базой для дальнейшего изучения английского языка студентами машиностроительных специальностей.

# TEXTS FOR READING SCIENCE

## TEXT 1. Elements

***Read the text and answer the following questions:***

1. What is an element?
2. How many elements are known now?
3. What are synthetic elements?
4. Where are synthetic elements used?
5. What categories do elements fall into?
6. What properties do elements have in each category?
7. What properties do metals have?
8. What are nonmetals?
9. What are metalloids?

An element is a matter made of only one kind of atom. At this time, 115 elements are known and 90 of them occur naturally on Earth. These elements make up gases in the air, minerals in rocks, and liquids such as water. Examples of 90 naturally occurring elements include the oxygen and nitrogen in the air you breathe and the metals gold, silver, and iron. The other 25 elements are known as synthetic elements. These elements have been made by scientists with machines. Some synthetic elements have important uses in medical testing and are found in smoke detectors and batteries.

### Classification of elements

Elements fall into three general categories – metals, metalloids, and nonmetals. The elements in each category have similar properties. Metals generally have a shiny or metallic luster and are good conductors of heat and electricity. All metals, except mercury, are solids at room temperature. Metals are malleable, which means they can be

bent into various shapes. Metals are also ductile, which means they can be drawn into wires without breaking.

Nonmetals are elements that are usually dull in appearance. Most are poor conductors of heat and electricity. Many nonmetals are gases at room temperature, and bromine is a liquid. The solid nonmetals are generally brittle, meaning they cannot change shape easily without breaking. The nonmetals are essential to the chemicals of life. More than 97 percent of human body is made up of various nonmetals- oxygen-65%, carbon-18.5%, hydrogen-9.5%, nitrogen-3.2%. The nonmetals are found on the right side of the periodic table.

Metalloids are elements that have characteristics of metals and nonmetals. On the periodic table, metalloids are found between the metals and nonmetals. All metalloids are solid at room temperature. Some metalloids are shiny and many are conductors, but they are not as good at conducting heat and electricity as metals are. Some metalloids, such as silicon, are used to make the electronic circuits in computers, televisions, and other electronic devices.

# TEXT 2. Metals. The history of metals

***Read the text and answer the following questions:***

1. What is the most important metal today?
2. What was discovered by the accident?
3. When were the first good-quality steels made?
4. When did man start to use metals?
5. What is alloy?
6. What is metallurgy?
7. What metals don't exist in nature?

**Metal**

Metals are vital to modern life. All forms of transport are made of metals. Many buildings materials, tools and utensils used in the

home are made of metals. The precious metals such as gold and silver are used in jewelry.

## History of metals

Stone Age people used stone, wood and bones to make their primitive tools. They had no knowledge of metals. About 10,000 years ago in the Middle East, people began to use small amounts of copper that they found. However, it wasn't until about 7,000 years ago that people began to mine and smelt copper ores. As a result, copper became the first metal to be widely used. Bronze was probably discovered by accident when some copper and tin ores were heated together in a fire. Bronze is harder than copper, and it soon became widely used for weapons and also for ornaments and sculptures. The most important metal today is iron, which is used to make steel. High temperatures are needed to smelt iron ore. This was first done about 5,000 years ago, but it was not until 1709 that large quantities of iron were produced by smelting it with coke. The Iron Age followed, and iron was used to make the machines that were invented in the Industrial Revolution. In 1856 the first good-quality steel was made in large quantities. Steel was used to build railways, bridges and ships. The last important metal to be made was aluminum. Today, aluminum is second in importance to steel.

## How metals occur

Very few metals occur in their pure state. Most occur in minerals where they are combined with other elements. The mineral in which a metal occurs is called the ore. The commonest metals in the Earth's crust are aluminum and iron.

## From ore to metal

The main stages in processing an ore to make metal are: mining, concentration smelting, refining.

After the ore is mined, the unwanted dirt, clay and sand are removed, leaving a concentrate. This is then smelted – roasted in a furnace at very high temperatures. The metal obtained is in an impure form, and needs to be refined to remove the impurities.

## Alloys

An alloy is a substance made by mixing two or more metals together, usually while they are in a molten state.

Most of the metal tools and products used today are made from alloys rather than from pure metals. By mixing different metals in different amounts, alloys can be created with a wide range of properties. Bronze, the first important alloy to be made, is a mixture of copper and tin. The resulting alloy is harder than either copper or tin. Other alloys include steel, brass and cupro-nickel. Most alloys are tougher than pure metals and they are often cheaper to produce.

## Metallurgy

Metallurgy is the science of separating metals from their ores and preparing them for use. The extracted metals can be pure or alloyed (mixed with other metals). Metals and alloys have many uses. Pure metals are almost non-existent in nature. They are usually found in rocks that include other materials.

Mining operations are designed to collect ores. The first aim after mining is to separate the metal from the rest of the ore. This is called dressing and it begins with crushing the ore. The crushed mixture can then be washed and the purer minerals separated.

Once the minerals have been separated from the raw ore, the metals have to be extracted from the ore. This is usually done by intense heat in a blast furnace. The process is called smelting.

# TEXT 3. Atom

***Read the text and answer the following questions:***

1. What did Dalton think about?
2. What is the atom?
3. What did scientists bombard in their experiment?
4. What did Rutherford conclude?
5. How did he name the positively charged particles?

## An Early Idea

Democritus, who lived from about 460 B.C. to 370 B.C., was a Greek philosopher who thought the universe was made of empty space and tiny bits of stuff. He believed that the bits of stuff were so small they could no longer be divided into smaller pieces. He called these tiny pieces atoms. The term atom comes from a Greek word that means "cannot be divided". Today an atom is defined as a small particle that makes up most types of matter. Democritus thought that different types of atoms existed for every type of matter and that the atom's identity explained the characteristics of each type of matter. Democritus's ideas about atoms were a first step toward understanding matter. However, his ideas were not accepted for over 2,000 years. It wasn't until the early 1800s that scientists built upon the concept of atoms to form the current atomic theory of matter

## Lavoisier's Contribution

Lavoisier is a French chemist who lived about 2,000 years after Democritus, also was curious about matter, especially when it changed form. Before Lavoisier, people thought matter could appear and disappear because of the changes they saw as matter burned or rusted. You might have thought that matter can disappear if you've ever watched wood burn in a fireplace or at a bonfire. Lavoisier showed that wood and the oxygen combined during burning have the same mass as the ash, water, carbon dioxide, and other gases that are produced. An iron bar, oxygen, and water have the same mass as the rust

that forms when they interact. From Lavoisier's work came the law of conservation of matter, which states that matter is not created or destroyed-it only changes form.

## Models of the Atom

Models are often used for things that are too small or too large to be observed or that are too difficult to be understood easily. One way to make a model is to make a smaller version of something large. If you wanted to design a new sailboat, would you build a full-sized boat and hope it would float? It would be more efficient, less expensive, and safer to build and test a smaller version first. Then, if it didn't float, you could change your design and build another model. You could keep trying until the model works. In the case of atoms, scientists use large models to explain something that is too small to be looked at. These models of the atom were used to explain data or facts that were gathered experimentally. As a result, these models are also theories.

## Dalton's Atomic Model

In the early 1800s, an English schoolteacher and chemist named John Dalton studied the experiments of Lavoisier and others. Dalton thought he could design an atomic model that explained the results of those experiments. Dalton's atomic model was a set of ideas – not a physical object. Dalton believed that matter was made of atoms that were too small to be seen by the human eye. He also thought that each type of matter was made of only one kind of atom. For example, gold atoms make up a gold nugget and give a gold ring its shiny appearance. Likewise, iron atoms make up an iron bar and give it unique properties, and so on. Because predictions using Dalton's model were supported by data, the model became known as the Atomic Theory of Matter.

# TEXT 4. Compounds and mixtures

***Read the text and answer the following questions:***

1. What is matter?
2. What is a compound?
3. What do all compounds have?
4. What is water made up?
5. What does the number written below mean?
6. What are mixtures?
7. Can the properties of the substances in a mixture be changed?

Scientists classify matter in several ways that depend on what it is made of and how it behaves. For example, matter that has the same composition and properties throughout is called a substance. Elements, such as a bar of gold or a sheet of aluminum, are substances. When different elements combine, other substances are formed.

A compound is a substance whose smallest unit is made up of atoms of more than one elements bonded together. Compounds often have properties that are different from the elements that make them up. Water is distinctly different from the elements that make it. It is also different from another compound made from the same element. Have you ever used hydrogen peroxide to disinfect a cut? This compound is a different combination of hydrogen and oxygen and has different properties. Water is nonirritating liquid that is used for bathing, drinking, cooking and much more. In contrast, hydrogen peroxide carries warnings on its labels such as «Keep Hydrogen Peroxide Out of the Eyes». Although it is useful for cleaning contact lenses, it is not safe for your eyes.

All compounds have formulas that tell you which elements make up a compound as well as how many atoms of each element are present. The number written below and to the right of each element's symbol tells you how many atoms of that element exit in one unit of that compound. For example, hydrogen peroxide has two atoms of hydrogen and two atoms of oxygen. Water is made up of two atoms of hydrogen and one atom of oxygen. No matter what quantity of the compound you have, the formula of the compound always remains the same.

### Mixtures

When two or more substances (elements or compounds) come together but don't combine to make a new substance, a mixture results. Unlike compounds, the properties of the substances in a mixture can be changed without changing of the identity of the mixture. For example, if you put some sand into water, you have a mixture of sand and water. If you add more sand and more water, it is still a mixture of sand and water. Its identity has not changed.

# TEXT 5. Physical properties

A physical property is a characteristic you can observe without changing or trying to change the composition of the subject. How something looks, smells, sounds, or tastes are all examples of physical properties. You can describe all types of matter and differentiate between them by observing their properties. Some physical properties describe the appearance of matter. You can detect many of these properties with your senses. For example, you can see the color and the shape of the apple. You can also touch it to feel its texture. You can smell the odor or taste the flavor of some matter.

### State

To describe a sample of matter, you need to identify its state. Is the apple a solid, a liquid, or a gas? This property, known as the state of matter, is another physical property that you can observe. The apple, your book, and a pen are examples of matter in the solid state. Milk, water, and oil are examples of matter in the liquid state. The air in a tire and neon in a sign are examples of matter in the gas state. Perhaps, you are most familiar with the three states of water. You can drink or swim in liquid water. You use the solid state of water, which is ice, when you put the solid cubes in a drink or skate on a frozen lake. Although you can't see it, water in the gas state is all around you in the air.

Some physical properties depend on the size of the object. Another physical property that depends on the size is mass. Weight is a measurement of force. Weight depends on the mass of the object and on gravity. If you were to travel to other planets, your weight would change but your size and mass would not.

Another physical property, density, does not depend on the size of an object. Density measures the amount of mass in a given volume. To calculate the density of an object, divide its mass by its volume. Another property, solubility, also does not depend on the size. Solubility is the number of grams of one substance that will dissolve in 100g of another substance at a given temperature.

Melting and boiling points also do not depend upon an object's size. The temperature at which a solid changes into a liquid is called its melting point. The temperature at which a liquid changes into a gas is called its boiling point.

# TEXT 6. Chemical properties

***Read the text and answer the following questions:***

1. What is a chemical property?
2. What happens during chemical change?
3. What is rust?
4. When does the composition of the substance change?
5. What is produced during the chemical change?

Some properties of matter cannot be identified just looking at a sample. For example, nothing happens if you look at the matches. But if someone strikes the matches on a hard, rough surface, they will burn. The ability to burn is a chemical property. A chemical property is a characteristic that cannot be observed without altering the subject. As you can see, the matches are permanently changed after they are burned. Therefore this property can be observed only by changing the composition of the match. Another way to define a chemical property

is the ability of a substance to undergo a change that alters its identity. During chemical change, substances are changed into different substances. In other words, the composition of the substance changes. You are familiar with another chemical change if you have ever left your bicycle out in the rain. After a while, a small chip in the paint leads to an area of a reddish substance. This substance is rust. When iron in steel is exposed to oxygen and water in air, iron and oxygen atoms combine to form the principle component in rust.

Chemical change versus physical change. There is a difference between physical and chemical changes. The most important point is that in a physical change, the composition of a substance does not change and in a chemical change, the composition of a substance does change. When a substance undergoes a physical change, only its form changes. In a chemical change, both form and composition change. When the wood and copper undergo physical changes, the original wood and copper still remain after the change. When a substance undergoes a chemical change, the original substance is no longer present after the change. Instead, different substances are produced during the chemical change. When the wood and copper undergo chemical changes, wood and copper have changed into new substances with new physical and chemical properties.

# TEXT 7. Speed

***Read the text and answer the following questions:***

1. When does the speed decrease?
2. What do you have to know about motion?
3. What is called the average speed?
4. What is called the constant speed?
5. How can the average speed be calculated?
6. When are the average and constant speeds the same?
7. What is the velocity?
8. When is the direction of motion changed?

Think of skateboarding down the side of a half-pipe for the first time. As you reach the bottom, you are going fast, and you feel excitement and maybe fear. Your speed decreases as you move higher up the wall. When you reach the top, you are at near standstill. To understand how to describe motion, think about the movement of the bicycle. To describe how fast the bicycle is travelling, you have to know two things about its motion. One is the distance it has travelled, or how far it has gone. The other is how much time it took to travel that distance.

## Average speed

A biker rider can speed up and slow down several times in a certain time period. One way to describe the bike rider's motion over this time period is to give the average speed. To calculate average speed, divide the distance travelled by the time it takes to travel that distance. Because average speed is calculated by dividing distance by time, its units always will be a distance unit divided by a time unit. For example, the average speed of a car can have units of kilometers per hour rather than meters per seconds.

## Instantaneous speed

Average speed is useful if you don't care about the details of the motion. For example, suppose you went on a long trip and travelled 640 km in 8 h. Your average speed was 80 km/h, even though you might have stopped for red lights, got stuck in a traffic jam, or enjoyed a long stretch of high speed on a highway. When your motion is speeding up and slowing down, it might be useful to know how fast you are going at a certain time. For example, suppose the speed limit over a 100-km section of freeway is 100 km/h. Even though a car might travel this distance with an average speed of 90 km/h, it can be moving faster than the speed limit at different times. To keep from exceeding the speed limit, the driver would need to know the instantaneous speed – the speed of an object at any instant of time. When you ride in a car, the instantaneous speed is shown by the speedometer. The odometer measures the distance travelled.

### Constant speed

Sometimes an object is moving such that its instantaneous speed doesn't change. You may have noticed that the speedometer needle will hardly move when the driver is using cruise control. When instantaneous speed doesn't change, an object is moving with constant speed. When both sides of this equation are multiplied by the time, you have the following new equation.

Total distance travelled = average speed x time

d=s x t

### Velocity

Suppose you are walking with a constant speed, heading north. You turn when you reach intersection and start walking with the same speed, but now you are heading east. Your motion has changed, even though your speed has remained constant. The velocity of an object is the speed of an object and its direction of motion. Velocity changes when the speed changes, the direction of motion changes, or both change. When you turned the corner, your direction of motion changed, even though you speed remained the constant. Therefore, your velocity changed.

# TEXT 8. Energy changes

***Read the following text and answer the questions:***

1 What does the word energy mean?
2 What is energy?
3 What forms of energy do you know?
4 When does energy transformation occur?
5 What is called kinetic energy?
6 What determines the amount of kinetic energy in a moving object?

7 What is potential energy?

The word energy comes from the ancient Greek word «energos», which means «active». Energy is the ability to cause changes. For example, energy can change the temperature of water or the direction and speed of a baseball. Energy can change the arrangement of atoms in molecules and cause chemical reactions to occur. Energy comes in different forms. Food provides energy in the form of chemical energy. Your body converts chemical energy in the food you eat into the energy it needs to move, think, and grow. Nuclear power plants use nuclear energy contained in the center or nucleus of the atom to produce electricity.

## Energy transformations

Energy is stored in the chemical compounds in your muscles. When you push down on a bicycle pedal, chemical energy is used to make your legs move. An energy transformation occurs if energy changes from one form to another. During energy transformations, the total amount of energy stays the same.

## Kinetic energy

A moving ball has energy due to its motion. The energy the object has due to its motion is called kinetic energy. A leaf falling towards the earth also has kinetic energy. Although moving objects have kinetic energy, not all moving objects have the same amount of kinetic energy. What determines the amount of kinetic energy in a moving object? The amount of kinetic energy an object depends on the mass and speed of the object. If two objects were moving with the same speed, the object with more mass had more kinetic energy. Kinetic energy also depends on speed. The faster an object moves, the more kinetic energy it has. Kinetic energy increases as the speed increases.

Kinetic energy can be transformed from one object to another when they collide. A transfer of kinetic energy takes place when dominoes fall. You need to give only the first domino a bit of kinetic energy by tapping it to make it fall against the next domino. As the first

domino falls into the next one, kinetic energy is transferred to the second domino. This transfer of kinetic energy continues from domino to domino until the last one falls and hits the table. Then, the last domino's kinetic energy is transferred to the table.

# TEXT 9. Potential energy

***Read the text and answer the following questions:***

1. What is potential energy?
2. Can kinetic energy be transformed into potential energy?
3. What does the kinetic energy of the moving water spin?
4. What is the potential energy of the water transformed into?
5. What did James Joule demonstrate in 1840?
6. When can kinetic energy be converted into heat?

Potential energy is energy that is stored because of an object's position. When you raise an object above its original position, it has the potential to fall. If it falls, it has the kinetic energy. To raise an object, you have to transfer energy to the object. The higher an object is lifted above the Earth, the greater its potential energy. Kinetic energy also can be transformed into potential energy. Suppose you throw a ball straight up into the air. Because it is moving, the ball has kinetic energy.

You might have stood close to a large waterfall and heard the roar of the water. The potential energy that the water has at the top of the falls is transformed into kinetic energy as the water falls downwards. The kinetic energy of the moving water spins generators, which produce electricity. The potential energy of the water behind the dam is transformed into electrical energy.

In 1840, James Joule demonstrated the law of conservation of energy.

According to the law of conservation of energy, energy cannot be created or destroyed. It only can be transformed from one form into

another, so a total amount of energy in the universe never changes. The only change is in the form that energy appears in. Kinetic energy can be converted into heat when two objects rub against each other. As a book slides across a table, it will slow down and eventually stop. The book's kinetic energy isn't lost. It is converted into heat energy as the book rubs against the surface of the table.

# TEXT 10. Conductors and Insulators

1 What materials are called conductors?
2 What materials are good conductors of heat?
3 What materials are poor conductors of heat?
4 How are you keeping yourself warm?
5 What materials are good insulators?
6 What is called conduction?
7 What is called convection?

Conduction is a transfer of kinetic energy from particle to particle, in a solid, the particles involved don't travel from one place to another. They simply move back and forth in place, bumping into each other and transferring energy from fast-moving particles to slow-moving ones. Materials through which it is easy to transfer energy are thermal conductors. Most metals are good conductors of heat. Metals such as gold, silver, and copper are the best thermal conductors. Copper is widely available and less expensive than gold or silver. Some cooking pans are made of steel but have copper bottoms. A copper bottom conducts heat more evenly. It helps spread heat across the bottom surface of the pan to prevent hot spots from forming. This allows food to cook evenly.

**Insulators**

Some materials are poor conductors of heat. These materials can be used as thermal insulators. When you are cold, you can put on a

sweater or a jacket or add a blanket. You are keeping yourself warm by adding insulation. The clothes and a blanket are poor conductors of heat. In fact, they make it more difficult for heat to escape from your body, keeping you warm because they are made of materials that contain many air spaces. Air is a good insulator, so materials that contain air are also good insulators. Other examples of insulators include wood, rubber, and ceramic materials.

### Convection

Heat also can be transferred by particles that do not stay in one place but rather move from one place to another. Convection transfers heat when particles move between objects or areas that differ in temperature. This type of transfer is most common in gases and liquids. As temperature increases, particles move around more quickly, and the distance between particles increases. This causes density to decrease as temperature increases. Cooler dense materials then forces the warmer, less dense material to move upward.

A lot of birds float effortlessly high in the air. Sometimes a bird can stay in the air without flapping its wings, because it is held up by a thermal. A thermal is a column of warm air that is forced up as cold air around it sinks. It is convection current in the air. Convection also occurs in liquids. In a pot of boiling water, the warmer, less dense water is forced up as cooler, denser water sinks. Convection currents on a larger scale are formed in oceans by cold water flowing from the poles and by warm water flowing from tropical region.

# TEXT 11. Temperature

***Read the text and answer the following questions:***

1. What words are used to describe temperature?
2. How are atoms moving?
3. How can atoms in a gas move?

4. What distance can atoms in solids move?
5. What is temperature?
6. What is used to measure temperature?

Hot and cold are words used in everyday language to describe temperature. However, they are not scientific words because they mean different things to different people. A summer day that seems hot to one person might seem just right to another. Have you ever complained that a classroom was too cold when other students insisted it was too hot. What is temperature? Remember that any material or object is made up of atoms. The atoms in objects are moving constantly, even if the object appears to be still. Every object you can think of – your hand, the pencil, the book- contains atoms that are in constant motion. In solids, liquids, and gases the atoms do not move in a single direction, instead they move in all directions. In a gas, atoms are far apart and can move in all directions. In liquids, atoms are closer together and can't move as far as in a gas. In solids, atoms are bound more tightly together and can move only short distances. Instead of moving freely, atoms in a solid vibrate back and forth. The motion of atoms in all directions in solids, liquids, and gases are called random motion. Because the atoms are moving, they have kinetic energy. The faster the atoms are moving, the more kinetic energy they have.

Temperature is a measure of the average kinetic energy of the atoms in an object. When an object's temperature is higher, its atoms have more kinetic energy. At the higher temperature, the molecules are moving faster and have more kinetic energy.

## Measuring temperature

Temperature is related to kinetic energy. You might think that to measure temperature, you must measure the kinetic energy of the atoms. But atoms are too small that even a tiny piece of material consists of trillions and trillions of atoms. Because they are so small and objects contain so many of them, it is impossible to measure the kinetic energy of an individual atom. However, a practical way to measure temperature is to use a thermometer. One temperature scale you might familiar with is the Fahrenheit scale. On the Fahrenheit scale, the freezing point of water is 32 ° F, and the boiling point is 212 ° F. The

space between the boiling point and the freezing point is divided into 180 ° equal degrees. The Fahrenheit scale today is used mainly in the United States. Another temperature scale that is used more widely throughout the world is the Celsius scale. On the Celsius scale, the freezing point of water is 0 ° C and the boiling point is 100 ° C. Because there are only 100 ° Celsius degrees between the boiling and freezing points of water, a temperature change of one Celsius degree is bigger than a change of one Fahrenheit degree.

# TEXT 12. Newton's Laws of Motion

***Read the text and answer the following questions:***

1. What was the Newton's greatest discovery?
2. What affects the object and changes its movement?
3. What force slows down the object?
4. How is the force defined?
5. Which factors affects the force?
6. What are balanced and unbalanced forces?
7. What does the second law mean?

**Force**

What causes objects to move? In the lunchroom you pull a chair away from a table before you sit down and push it back under the table when you leave. You exert a force on the chair and cause it to move. A force is a push or a pull. In SI force is measured in newtons. One newton is about the amount of force it takes to lift a quarter-pound hamburger.

## Force and Acceleration

Exerting a force on an object causes its motion to change. So, a force causes an object to accelerate. For example, when you throw a ball, your hand exerts a force on the ball, causing it to speed up. The ball has acceleration because the speed of the ball has increased.

A force also can change the direction of an object's motion. After the ball leaves your hand, if no one catches it, its path curves downward and it hits the ground. Gravity pulls the ball downward and causes it to change direction.

The force of gravity has caused the ball to accelerate. Anytime a force acts on something, its speed changes or its direction of motion changes, or both.

## Balanced and Unbalanced Forces

More than one force can act on an object without causing its motion to change. If both you and your friend push on a door with the same force in opposite directions, the door doesn't move. Two or more forces are balanced forces if their effects cancel each other and they do not cause a change in an object's motion. If the effects of the forces don't cancel each other, the forces are unbalanced forces.

## Newton's First Law

When you give a book on a table a push, it slides and comes to a stop. After you throw or hit a baseball and it hits the ground, it soon rolls to a stop. In fact, it seems that anytime you set something in motion, it stops moving after a short period of time. You might conclude that to keep an object moving, a net force must be exerted on the object at all times. Newton and a few others before him realized that an object could be moving even if no net force was acting on it. According to Newton's first law of motion, an object will not change its motion unless a force acts on it. Therefore, an object that is not moving, like a book sitting on a table, remains at rest until something pushes or pulls it. What if an object is already moving, like a football you've just thrown to someone? Newton's first law says the motion of the football

won't change unless a force is exerted on it. This means that after the ball is in motion, a force has to be applied to make it speed up, slow down, or change direction. In other words, a moving object, like the ball moves in a straight line with constant speed unless a force acts on it.

### Newton's Second Law

According to Newton's first law, a change in motion occurs only if a net force is exerted on an object. Newton's second law tells how a net force acting on an object changes the motion of the object. According to Newton's second law, a net force changes the velocity of the object, and causes it to accelerate. Newton's second law states two things. One is that if an object is acted upon by a net force, the change in velocity will be in the direction of the net force. The other is that the acceleration can be calculated from the following formula: force equals product of mass and acceleration.

# TEXT 13. Machines

## Part 1

***Read the text and answer the following questions:***

1. What is a machine?
2. What is a simple machine?
3. What is a compound machine?
4. What is mechanical advantage?
5. How is work done in a simple machine?
6. What is an ideal machine?
7. What can a simple machine change?

The machine is a device that makes work easier. A simple machine is a machine that uses only one movement. A screwdriver is an

example of a simple machine. It only requires one motion – turning it. Simple machines include the inclined plane, wedge, screw, lever, wheel and axle, and pulley. A compound machine is a combination of simple machines. Machines can make work easier in two ways. They can change the size of the force you apply. They also can change the direction of the force.

Some machines are useful because they increase the force you apply. The number of times the applied force is increases by a machine is called the mechanical advantage (MA) of the machine. When you push on the handle of the can opener, the force you applied is called the input force. The can opener changes your input force to the force that is exerted by the metal cutting blade on the can. The force exerted by a machine is called the output force. The mechanical advantage is the ratio of the output force to the input force.

In a simple machine the input force and the output force do work. An ideal machine is a machine in which there is no friction. Then the work done by the input force is equal to the work done by the output force. In other words, for an ideal machine the work you do on the machine – work in – would be equal to the work done by the machine – work out.

work in = work out

A simple machine can change a small input into a large output force. So, if the work in is equal to the work out, a smaller input force must be applied over a large distance than larger input force. In all real machines, friction always occurs as one part moves past another. Friction causes some of the input work to be changed into heat, which can't be used to do work. So for a real machine, work out always will be less than work in.

# Part 2

***Read the text and answer the following questions:***

1. What is the pulley?
2. What is the lever?

3. What is the wheel and axle made of?
4. What is the mechanical advantage of an inclined plane?
5. What does the wedge change?
6. What is the screw?
7. What does friction between the threads and the material hold

A pulley is an object with a groove, a rope or chain running through the groove. A pulley changes the direction of the input force. A rope thrown over a railing can be used as a pulley. A simple pulley changes only the direction of a force, so its mechanical advantage is 1. It is possible to have a large mechanical advantage if more than one pulley is used. A double – pulley system has a mechanical advantage of 2. Each supporting rope holds half of the weight, so you need to supply only half the input force to lift it.

## The lever

Probably the first simple machine invented by human was the lever. The lever is a rod that pivots about a fixed point. The pivot point is called the fulcrum. Levers can increase force or increase the distance over which a force is applied. There are three types, or classes, of levers. The three classes depend on the position of the input force, output force, and the fulcrum. In a first- class lever is located between the input force and the output force. Usually a first- class lever is used to increase force. If the output force is between the input force and the fulcrum, the lever is a second –class lever. The output force is always greater than the input force for this type of lever. A hockey stick is a third-class lever. In a third –class lever, the input force is located between the output force and the fulcrum. The mechanical advantage of a third –class lever is less than one. A third – class lever increases the distance over which the input force is applied.

## The wheel and axle

An example of a wheel and axle is doorknob. A wheel and axle is made of two round objects that are attached and rotate together about the same axis. Usually the larger object is called the wheel the

smaller object is the axle. The mechanical advantage of a wheel and axle can be calculated by dividing the radius of the wheel by the radius of the axle.

## The inclined plane

An inclined plane is a sloped surface, sometimes called a ramp. Imagine, you have to lift a sofa onto the truck. If you used an inclined plane, you would have to move a sofa farther than if you lifted it straight up. The amount of work needed to move the sofa would be the same. Because the sofa moves the longer distance up the ramp, doing the same amount of work takes less force. The longer the ramp is, the less force it takes to move the object. Ramps might have enabled the ancient Egyptians to build their pyramids. To move limestone blocks having a mass of more than 1000 kg each, scientists think that the Egyptians built enormous ramps.

## The wedge

When you take a bite of an apple, you are using wedges. A wedge is a moving inclined plane with one or two sloping sides. Your front teeth are wedges. A wedge changes the direction of the input force.

## The screw

The screw is an inclined plane wrapped around a post. The inclined plane forms the screw threads. Just like a wedge, a screw also changes the direction of the force you apply. When you turn a screw, the input force is changed by the threads to an output force that pulls the screw into material. Friction between the threads and the material holds the screw tightly in place.

# TEXT 14. Microscope

***Read the text and answer the following questions:***

1.What is a microscope?
2 .What is a microscope used for?
3. What are the uses of a microscope?
4. Who was the first man to describe the structure of cork tissue?

**Microscope**

The microscope is an instrument that makes small objects appear larger. It consists of a series of glass lenses and a mirror mounted in a rigid frame. It is probably one of the most important of all inventions. Many discoveries and advances would not have been made without it. The first proper microscope – the compound microscope – was invented by Hans and Zacharias Janssen, two Dutch spectacle makers, around 1590. A compound microscope has more than one lens inside. Simple microscopes – ones with only one lens – are really no more than magnifying glasses. To obtain greater magnification, two lenses must be used: one called the objective and the other the eyepiece. The objective produces a magnified image of the object or specimen, and the eyepiece magnifies the image even further. A mirror in the microscope is used to pass light through the object so it can be more easily seen. In order for light to pass through the object, the object must be very thin and semi-transparent.

Robert Hooke (1635-1703) English physicist, much improved the microscope. Hooke was the first person to describe the cellular structure of cork tissue. The first person to observe red blood cells and micro-organisms through a microscope was Antony van und Leeuwenhoek (1632-1723).

Galileo was responsible for improving the compound microscope. However, it was not until about 1840 that good compound microscopes became available. In 1904, the ultra microscope was developed by the optical instrument makers, Zeiss of Germany. In this mi-

croscope, the specimen is illuminated from the side, rather than below. This made it possible to study even smaller particles. Today, electron microscopes, invented in 1931 in Germany, make it possible to view incredibly small objects such as viruses that cause disease and individual molecules that make up substances. Electron microscopes work on a beam of electrons rather than a light beam.

# TEXT 15. The hydraulic grinder and turning mills

Read the text and answer the following questions:
1 What operations is the universal grinder designed for?
2 Where is the universal grinder used?
3 How is the cross-feed operated?
4 Where is the wheel head clamped?
5 What are the vertical turning mills designed for?
6 How are the machines of this type controlled by?
7 What mechanism is the gearbox provided with?
8 What operations does the machine perform?

The hydraulic grinder. This universal grinder is designed for grinding cylindrical holes and faces of work pieces. It is widely used for lot production in various types of machine building plants. Machines of this type are of massive construction, but they can be operated as easily as the machines of smaller type. They are hydraulically operated and controlled by a single lever at the front end of the machine.

The wheel spindle is driven by a V –belt from a motor located on the wheel slide. The cross – feed is operated by a hydraulic unit. The wheel head is clamped on the top surface of the table.

The vertical turning mills. The vertical turning mills are universal high speed machines. They are designed for roughing and finishing operations. The machines are provided with two heads: vertical turret head and horizontal side head. Vertical turret head travels along the

horizontal ways of the cross-rail. Horizontal side head moves along the vertical ways of the column. The machine performs the following operations: cylindrical turning, facing, cutting, drilling, etc. Motion to the table is transmitted from the electric motor by means of V – belts and gearbox.

# TEXT 16. Welding

***Read the text and answer the following questions.***

1 What is welding?
2 What types of welding do you know?
3 What process is called hammer welding?
4 What types of welding does resistance welding process consist of?
5 What gases are used in gas welding?
6 What is gas welding usually used to join?
7 What is laser welding used for?
8 What welds can laser welding form?
9 What is plasma arc welding used for?

Welding is a process of joining together metallic parts by heating the place of contact to the fusion state. Welding processes are classified according to the source of energy, the metal and the state of the metal at the place of welding. There are different types of welding: hammer welding, electric arc welding, gas welding, laser and plasma arc welding, resistance welding, etc.

Hammer welding is a process in which two heated metal parts are joined and fused together by force from a power hammer. Resistance welding process forms a whole group consisting of many types of welding such as spot welding, butt welding and others. In arc welding the work pieces are not melted by a flame. They are melted by an electric arc. In order to create an arc, a powerful electric current must be provided. The current must be at least 60 A, otherwise the arc will not create enough heat. In gas welding, it is necessary to use a

mixture of two gases. To create a hot flame, a combustible gas must be mixed with oxygen. Gas welding is usually used to join steel to steel.

Laser arc welding is quickly becoming a practical welding process. Nowadays, the laser can form welds up to 1/32 inch deep. The laser's high power intensity permits welds between dissimilar metals. Plasma arc welding is efficient for welding stainless steels, titanium, nickel from 0.001 to 0.30 inch thick. This process is used for repairing delicate parts, for joining thin structures, and for welding electronic components. With the exception of aluminum any metal or combination of metals can be welded with plasma arc welding.

Welding – safety rules. Welding may be dangerous. Any of these accidents might happen to you: you could be blinded by sparks; you could get an electric shock; your face, body, legs or feet could be burnt; there could be a fire in the workshop.

Protective clothing:

1 A mask or a 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. They must be made of some of insulated material such as rubber.

4 Gloves, apron and cap must be worn. Overalls must have long sleeves and no pockets or cuffs.

5 The floor in the workshop must be made of concrete. There must be a metal container on the floor for the sparks.

# TEXT 17. The basic engineering processes

***Read the text and answer the questions.***

1 What operations does metal processing include?

2 What operation is called machining?

3 What is the most economical process for producing bars?

4 Why is heat treatment used?
5 What heat treatment operations do you know?

The processing of metals is the most important part of producing a wide range of products. Metal processing includes: casting, forming, machining and heat treatment. Each of these manufacturing processes represents a separate branch of the metal processing industry. Casting means shaping by transforming metals from liquid to solid state in a specially designed molds. Forming is shaping metals in solid state due to the property of metals called ductility. Forming includes rolling, shaping and pressing.

Machining is removing excess metal from parts in order to obtain a desired shape. To achieve a desired result various types of tools are used. Rolling is the most economical process for producing a large quantity of simple shapes such as bars, sheets etc. Forming, stamping and pressing deform a piece of metals applying either impact or static pressure.

Heat treatment is used to improve the properties of metals by controlled temperature changes. There are four groups of heat treatment: hardening, annealing, tempering and normalizing, which differ from one another in heating temperature, holding time and cooling rate.

# TEXTS FOR WRITTEN TRANSLATION

## ENERGY ABSORBING REACTIONS

Some chemical reactions need a constant supply of energy to keep them going. These reactions absorb energy. A chemical reaction that absorbs heat energy is called an endothermic reaction. Endothermic chemical reactions often take place in the preparation of food. Thermal energy is absorbed by the food as it cooks. For example, an endothermic reaction takes place in baking some kinds of cookies. The baking soda absorbs energy and produces a gas that puffs up the cookies.

Chemical reactions occur when sunlight strikes the leaves of green plants. These chemical reactions convert the energy in sunlight into chemical energy contained in a type of sugar. Oxygen is also produced by these chemical reactions. This process is called photosynthesis. When the plant is deprived of sunlight, the reactions stop. The photosynthesis is probably the most important endothermic process on Earth. Plants provide you, and almost all other living things, with food and oxygen through photosynthesis.

Energy releasing reactions. Endothermic chemical reactions are usually important because of the compounds the reactions produce. Other reactions are important because they release energy. Exothermic reactions are chemical reactions that release heat energy. When a substance burns, atoms in a substance combine with oxygen atoms in the air. An exothermic reaction occurs, and energy in the form of heat and light is released. The exothermic reaction that occurs when a material burns by combining with oxygen is called combustion. Burning of oil, coal and gas produces much of energy needed to heat homes and schools.

## ENERGY INSIDE A MOUNTAIN

One of the biggest power stations in the world is built in the heart of a Welsh mountain. It uses neither oil nor coal to produce electricity, but the water of a large mountain lake. The underground power

station is used to produce electricity by pumping water again and again between two lakes. The water is let out through the bottom of the top lake, and then it passes down to drive the turbines inside the mountain. The water turns the turbine to produce electricity. Afterwards the water is collected in the bottom lake at the foot of the mountain. The turbines then change the direction and work as pumps, returning the water to the top lake, ready to be used again.

In a few thousand years people may discover the machines and wonder what had happened there. The large mountain caves remind us of a cathedral, especially when they are quiet. However, they are usually full of noise cars and trucks passing through the dark tunnels, the noise of pumps, shouting.

## CHEMICAL BONDS

Energy is stored in the bonds between the atoms in a compound. The stored energy in the chemical bonds is a form of potential energy called chemical energy. The chemical energy stored in oil, gas, and coal is an important source of energy that is used every day. The chemical energy stored in food provides a source of energy for your body. The muscles in your body transform some of this chemical energy into kinetic energy and heat when they move.

Energy in reactions. In every chemical reaction, transformations in energy occur. To break bonds, energy must be added. The reverse is also true. When bonds form, energy is released. Often energy must be added before the reaction can begin. For example, energy is needed to start the reaction between hydrogen and oxygen to form water. When a lighted match is placed in a mixture of hydrogen gas and oxygen gas, the mixture will explode and water is formed. The energy to begin the reaction comes from the heat supplied by the flame. As the reaction occurs, bonds form between hydrogen and oxygen atoms, and water molecules form. The energy released as the bonds form results in the explosion. After the hydrogen and oxygen atoms are bound together to form a water molecule, it is difficult to split them apart. Energy – usually supplied by electricity, heat, or light – is required to break the chemical bonds.

## IDENTIFYING CHARACTERISTICS

Each element is different and has unique properties. These differences can be described in part by looking at the relationship between the atomic particles in each element. The periodic table contains numbers that describe these relationships.

Let's look at the element chlorine. CL is the symbol for chlorine and it has two numbers. The top number is the element's atomic number. It tells you the number of protons in the nucleus of each atom of that element. Every atom of chlorine has 17 protons in its nucleus.

Isotopes. Although the number of protons changes from element to element, every atom of the same element has the same number of protons. However, the number of neutrons can vary even for one element. For example, some chlorine atoms have 18 neutrons in their nucleus while others have 20. These two types of chlorine atoms are chlorine -35 and chlorine -37. They are called isotopes, which are atoms of the same element that have different numbers of neutrons

## CONSERVATION OF MASS

During a chemical change, the form or the composition of the material changes. The particles within the matter rearrange to form new substances, but they are not destroyed and new particles are not created. The number and type of particles remains the same. As a result, the total mass of the matter is the same before and after a physical or chemical change. This is known as the law of conservation of matter.

The law can sometimes be difficult to believe, especially when the materials remaining after a chemical change might look different from those before it. In many chemical changes in which mass seems to be gained or lost, the difference is often due to a gas being given off or taken in. The difference, for example, before and after the candle is burned is in the gases released into the air. If the gases could be contained in a chamber around the candle, you would see that the mass does not change. The scientists who first performed the careful experiments necessary to prove that mass is conserved was Antoine Lavoisier in the 18th century. It was Lavoisier who recognized that the mass of gases that are given off or taken from the air during chemical changes account for any differences in mass.

## MEASURING

The meter system of measuring was developed in 1795. A modern form of the metric system, called the International System, or SI, was adopted in 1960. SI provides standard measurements that all scientists around the world can understand. The metric system is convenient because unit sizes vary by multiples of 10. When changing from smaller units to larger units, divide by a multiple of 10. When changing from larger units to smaller, multiply by a multiple of 10. To convert millimeters to centimeters, divide the millimeters by 10. To convert 30 mm to centimeters, divide 30 by 10 (30 mm equal 3 cm).

Prefixes are used to name units. Here are some common metric prefixes and their meanings.

Metric Prefixes.

kilo – k – 1.000 thousand

hector – h – 100 hundred

deka – da – 10 ten

deci – d – 0.1 – tenth

centi – c – 0.01 – hundredth

milli – m – 0.001 thousandth

Liquid volume. The unit that is used to measure liquids is the liter. A liter has the volume of 1,000 cm. A milliliter is one thousandth of 1L and 1L has the volume of 1,000 ml. One milliliter of liquid completely fills a cube measuring 1 cm on each side. Therefore, 1 ml equals 1 cm.

## RECYCLING

Recycling is a way to separate wastes into their component parts and then reuse those components in new products. In order to be recycled, wastes need to be both physically – and sometimes chemically changed. The average junked automobile contains about 62% iron and steel, 28% other materials such as aluminum, copper, and lead, and 10% rubber, plastics, and various materials.

After being crushed and flattered, car bodies are chopped into small pieces. Metals are separated from other materials using physical processes. Some metals are separated using powerful magnets. Others are separated by hand. Rubber tires can be shredded and added to asphalt pavement and playground surfaces. New recycling processes

make it possible to supercool tires to a temperature at which the rubber is shattered like glass. A magnet can then draw out steel from the tires and parts of the car.

Some plastic can be melted and formed into new products. Others are ground up or shredded and used as insulating materials. Glass can be pulverized and used in asphalt pavement, new glass, and even artwork.

## POLLUTION

People designed and produced up- to-day machines and technologies to make their life more comfortable. But all these activities result in air and water pollution. One of the most important problems is the oceans. A lot of ships, carrying coal, oil and timber, put their wastes into water. As a result, a lot of fish and animals die because of polluted water, others are getting contaminated and people may get sick by eating them.

The second problem is air pollution. Cars and plants pollute the atmosphere with their wastes. They destroy the ozone layer which protects us from dangerous light of the Sun. They also destroy forests which are dying from acid rains.

Now people begin to realize the danger of their activities. People are concerned about the air and the water used by everyone, about the future of the planet, about the children who must live in a healthy world. People understand that their activities affect the nature and they should do everything to protect the planet from disaster.

## THE PROBLEM OF ENVIRONMENT

One of the greatest problems of all modern cities is the environment pollution. Every year people consume more goods. Production of goods and services requires energy and natural resources. Natural resources are getting more expensive, and air and water are becoming seriously polluted. The problem of environmental pollution is well-known to most people. We hear about it on TV and radio, read in newspapers and magazines.

The worst environment pollution is caused by manufacturers who put chemical wastes into rivers and seas. Another problem is air

pollution. The air is polluted by traffic and smog from industrial enterprises. The word «smog» comes from «smoke + fog». Smog is a sort of fog with other substances mix in it, which can be harmful.

Materials like paper and glass can be recycled, but, unfortunately, many materials such as plastics cannot be recycled and absorbed by the earth again. Some plastics cannot even be destroyed. As the result, people face the problem of preservation of our planet.

## DEVELOPMENT OF ENGINEERING

Until the Industrial Revolution there were two kinds of engineering: military engineering and civil engineering. During the early 19th century in England mechanical engineering developed as a separate field to provide machines and engines. The first school in the USA to offer an engineering education was founded in West Point in 1817 – the United States Military Academy. An engineering education was based on science and mathematics.

The primary types of engineering are chemical, civil, electrical, industrial and mechanical. Chemical engineering deals with design, construction, and operation of plants and machinery for making acids, dyes, plastics, and synthetic rubber. The chemical engineer must be familiar with both chemistry and mechanical engineering.

Civil engineering includes planning, designing, construction, and maintenance of structures, such as bridges, building, tunnels. Electrical engineering includes all aspects of electricity from power engineering to the development of devices for generation and transmission of electrical power. Electronics is a branch of electrical engineering that deals with devices using electricity for control of processes.

Industrial engineering or management engineering deals with efficient production. The industrial engineer designs methods, not machines.

Mechanical engineering deals with design, construction and operation of power plants, engines and machines. It deals mainly with the things that move. One way of dividing mechanical engineering is into heat utilization and machine design. Another way is dividing by function. It includes design, operation, management, development and construction. Development engineering deals with converting an idea into a practical product.

## TRANSLATION WORK

### Текст 1. Элементы

Элемент − это вещество, состоящее только из одного атома. В настоящее время существует 115 элементов и 25 из них являются синтетическими, так как они были созданы учеными. Некоторые синтетические элементы широко используются в медицине, а также для изготовления батареек.

Элементы делятся на три категории – металлы, металлоиды и неметаллы. Металлы – хорошие проводники тепла и электричества. Металлы можно легко растянуть в проволоку или придать им различную форму. Неметаллы имеют тусклую поверхность и плохо проводят тепло и электричество. Они играют важную роль в жизни людей. Более 97% человеческого тела состоит из кислорода, углерода, азота и водорода.

Металлоиды – это вещества, которые имеют свойства металлов и неметаллов. Некоторые металлоиды могут проводить тепло и электричество, но они являются плохими проводниками по сравнению с металлами. Металлоиды находят применение при изготовлении компьютеров, телевизоров и других приборов.

### Текст 2. Металлы

Во время каменного века люди использовали камни, кости и древесину для изготовления простых инструментов и только спустя 10000 лет они стали применять медь в небольших количествах. Бронза – это сплав меди и олово, которая намного прочнее, чем медь и стала широко использоваться для изготовления оружия. Но самым важным металлом является железо, которое было получено около 5000 лет тому назад.

Металлы широко применяются в транспорте, строительстве и промышленности. Сплав – это вещество, состоящее из двух или нескольких металлов. Большая часть инструментов изготавливается из сплавов. Смешивая различные металлы, можно получить сплавы с различными свойствами. Многие сплавы более твердые

и намного дешевле, чем чистые металлы. Самый распространенный сплав – сталь, которая состоит из железа и углерода. Количество углерода в стали влияет на ее свойства. Сталь с низким содержанием углерода используется при изготовлении труб и проволоки. Среднеуглеродистая сталь содержит от 0,2 до 0,4 % углерода и используется как конструкционная сталь. Добавление кремния придает стали прочность, а хром делает сталь коррозионностойкий. Чистые металлы, практически, не существуют в природе.

## Текст 3. Атом

Термин «атом» происходит от греческого слова, которое означает «нельзя разделить». Первым ученым, который попытался дать определение атому, был греческий философ Демокрит. Он считал, что для каждого вещества существует определенный вид атома, который и определяет свойства данного вещества. Спустя 2000 лет французский химик Лавуазье разработал теорию, согласно которой вещество нельзя создать или разрушить – оно только переходит из одной формы в другую. В начале 1800 г. школьный учитель из Великобритании, по имени Джон Дальтон, предположил, что вещество состоит из атомов, которые так малы, что их невозможно увидеть человеческим глазом. Он также считал, что каждое вещество состоит только из одного вида атома. Эта теория Дальтона стала известна как Атомная Теория Вещества.

## Текст 4. Соединения и смеси

Все вещества делятся на группы в зависимости от их состава и поведения. Соединения часто имеют свойства, которые отличаются от элементов, из которых состоит данное вещество. Например, вода отличается от элементов, из которых она состоит (кислород + водород) и обладает совершенно другими свойствами. Вода используется для купания, приготовления пищи, питья и в промышленных целях. Все соединения имеют формулы, кото-

рые указывают вам на элементы в составе данного соединения и количество атомов. Не важно, какое количество вещества вы имеете, формула соединения остается такой же. В отличие от соединения свойства веществ в смеси можно изменить без изменения природы смеси.

## Текст 5. Физические свойства

Примерами физических свойств какого-либо вещества является его цвет, запах, вкус, форма и внешний вид. Когда вы смотрите на яблоко, вы обращаете внимание на его цвет и форму, а также ощущаете его запах. Если вы откусите кусочек яблока, вы почувствуете его вкус: сладкий, горький или кислый. Но все вещества могут существовать в различных состояниях: жидком, твердом и газообразном. Яблоко – это пример вещества в твердом состоянии, а молоко, вода, масло являются жидкими веществами. Физическим свойством, которое зависит от размера предмета, является масса. Вес зависит от массы предмета и силы тяжести. Плотность не зависит от размера предмета и измеряет количество массы на данный объем. Растворимость также не зависит от размера. Растворимость − это количество граммов одного вещества, которое нужно растворить в 100 г другого вещества при данной температуре. Точка плавления и точка кипения также не зависят от размера предмета. Температура, при которой твердое вещество превращается в жидкое, называется точкой плавления. Температура, при которой жидкость превращается в газ, называется точкой кипения.

## Текст 6. Химические свойства

Во время химической реакции одни вещества превращаются в другие вещества, т.е. состав вещества изменяется. Существует разница между физическими и химическими изменениями. Необходимо отметить, что во время физических изменений состав вещества не меняется, а во время химических изменений – меняет-

ся. Когда вещество подвергается физическому изменению, меняется только форма, а когда происходят химические изменения, изменяется не только форма, но и состав вещества. Например, когда медь подвергается химическим изменениям, то она не сохраняется в соединении, а после физических изменений ее все еще легко обнаружить. Во время химических изменений образуются новые вещества с совершенно другими физическими и химическими свойствами.

## Текст 7. Скорость

Чтобы понять, как быстро движется велосипедист, вам необходимо знать две вещи о его движении: пройденное расстояние и время, которое ему требуется, чтобы проехать это расстояние. Скорость велосипедиста может увеличиваться или уменьшаться в течение некоторого времени. Чтобы узнать среднюю скорость велосипедиста за этот промежуток времени, нужно разделить расстояние на время, которое потребуется велосипедисту, чтобы проехать его. Обычно средняя скорость автомобиля или велосипеда измеряется в километрах. Чтобы не превышать ограничения скорости, водителю необходимо знать мгновенную скорость автомобиля в каждый момент времени. Во время езды в автомобиле спидометр показывает мгновенную скорость, а одометр измеряет пройденное расстояние. Иногда автомобиль движется так, что его мгновенная скорость не изменяется. Это означает, что он движется с постоянной скоростью.

## Текст 8. Изменение энергии

Слово «энергия» в переводе с греческого означает «активный». Энергия – это способность вызывать изменения. Например, энергия может изменить температуру воды или вызвать химическую реакцию. Преобразования энергии происходит, если она переходит из одной формы в другую. Во время преобразования энергии общее количество энергии остается таким же.

Энергия, который обладает предмет вследствие своего движения, называется кинетической энергией. Хотя движущие предметы обладают кинетической энергией, но не все предметы обладают одинаковым количеством энергии. Количество кинетической энергии предмета зависит от его массы и скорости. Если бы два предмета двигались с одинаковой скоростью, то предмет с большой массой обладал бы большей кинетической энергией. Кинетическая энергия также зависит от скорости. Чем быстрее движется предмет, тем большим количеством кинетической энергии он обладает. Кинетическая энергия увеличивается, когда скорость увеличивается.

## Текст 9. Потенциальная энергия

Потенциальная энергия – это энергия, которая накапливается из-за положения предмета. Чтобы поднять предмет, вы должны передать энергию этому предмету. Чем выше вы поднимаете предмет над землей, тем выше его потенциальная энергия. Кинетическая энергия также может преобразовываться в потенциальную энергию. Кинетическая энергия движущейся воды приводит в действие генераторы, которые вырабатывают электричество. Потенциальная энергия воды может также преобразовываться в электрическую энергию.

В 1840 году Джеймс Джоуль продемонстрировал закон сохранения энергии. Согласно этому закону энергия не может быть создана или разрушена; ее только можно преобразовать из одной формы в другую.

## Текст 10. Проводники и изоляционные материалы

Проводимость – это передача кинетической энергии от одной частице к другой. Частицы двигаются вперед и назад, ударяясь друг о друга и передавая энергию от быстро двигающихся частиц к частицам с маленькой скоростью.

Материалы, через которые они легко передают энергию, называются проводниками. Большинство металлов – хорошие проводники тепла. Некоторые материалы являются плохими проводниками тепла и используются как изоляторы. Воздух, резина, керамические материалы – хорошие изоляторы.

Тепло также может передаваться частицами, которые не остаются на одном месте, а передвигаются с места на место. Конвекция передает тепло, когда частицы двигаются между предметами или участками, которые имеют различную температуру. Этот тип конвекции чаще встречается в газах и жидкостях. Когда температура повышается, частицы двигаются быстрее и расстояние между ними увеличивается. Это является причиной уменьшения плотности и увеличения температуры. Более холодные и плотные материалы заставляют более теплые и мерее плотные материалы подниматься вверх.

## Текст 11. Температура

Холод и тепло – это два слова, которые используются для того, чтобы описать температуру. Однако, они не являются научными терминами. Температура – это измерение средней кинетической энергии атомов в предмете. Когда температура тела повышается, его атомы имеют больше кинетической энергии. При более высокой температуре молекулы двигаются быстрее и обладают большей кинетической энергией.

Температура связана с кинетической энергией. Если вы хотите измерить температуру, вам придется измерить кинетическую энергию атомов. Но атомы очень маленькие и даже небольшой предмет содержит триллионы и триллионы атомов, так что измерить кинетическую энергию одного атома просто невозможно. Для измерения температуры используют термометр. Точка замерзания воды по шкале Фаренгейта равняется 32 градусам, а точка кипения – 212. Шкала Фаренгейта используется в США, а шкала Цельсия, практически, во всем мире.

## Текст 12. Законы движения

Первый закон Ньютона. Если на тело не действуют силы, то данное тело находится в состоянии покоя или равномерного прямолинейного движения.

Согласно второму закону Ньютона – сила является мерой взаимодействия. При взаимодействии, чем больше сила, тем больше ускорение тела, на которое эта сила действует. Сила, действующая на тело, равна произведению массы тела на сообщаемое этой силой ускорение. В метрической системе сила измеряется в ньютонах. Один ньютон – это сила, которая необходима, чтобы поднять гамбургер весом в четверть фунта.

## Текст 13. Машины и механизмы

Машина – это устройство, которое облегчает работу. Простая машина выполняет только одно действие. Сложные машины – это комбинация из нескольких простых машин. Машины могут облегчать работу двумя способами: изменяя прикладываемую силу или изменяя направление этой силы. Идеальная машина – это такая машина, в которой отсутствует трение.

Шкив – это устройство, которое состоит из паза, веревки или цепи, проходящей через этот паз. Веревку, перекинутую через рельс, можно использовать как шкив.

Рычаг − это, вероятно, самое первое приспособление, изобретенное человеком. Рычаг – это стержень, который вращается относительно неподвижной точки. Рычаги могут увеличивать силу или расстояние, на которое эта сила приложена.

Колесо и ось изготавливают из двух круглых предметов, которые соединены друг с другом и вращаются вместе вокруг одной оси. Обычно, более крупная часть называется колесо, а меньшая часть – ось.

Наклонная плоскость представляет наклонную поверхность, называемая иногда рампа или загрузочная платформа. Чем длиннее рампа, тем меньше требуется усилия, чтобы передвинуть

предмет. Вероятно, рампы помогли древним египтянам построить их пирамиды.

## Текст 14. Микроскоп

Микроскоп – это инструмент, который увеличивает очень маленькие предметы, т.е. делает их большими. Многие открытия были сделаны с помощью микроскопа. Первый микроскоп был изобретен братьями Янсен в 1590 году. Этот микроскоп имел две линзы, расположенные внутри микроскопа.

Датский ученый Антони ван Ливенгук был первым, кто изобрел линзы с 300 кратным увеличением. В 1904 ультрамикроскоп был изобретен в Германии. В этом микроскопе образцы освещались сбоку, а не снизу, что давало возможность изучать даже очень маленькие частицы, такие как вирусы, вызывающие различные болезни. Современные электронные микроскопы используют пучок электронов, а не лучей света.

## Текст 15. Шлифовальный и фрезерный станки

Гидравлический шлифовальный станок предназначен для шлифования цилиндрических отверстий и торца заготовки. Такие станки имеют массивную конструкцию, но управлять ими можно с помощью одного рычага, как и небольшими станками. Шпиндель шлифовального круга приводится в действие от клинообразного ремня, расположенного на шлифовальном суппорте. Шлифовальный круг закреплен на поверхности стола.

Токарный станок предназначен для чистовой и черновой обточки поверхностей заготовок. Этот станок оборудован двумя головками: вертикальный револьверной головкой и горизонтальным боковым суппортом. Вертикальная револьверная головка двигается вдоль горизонтальных направляющих траверса (поперечины). Горизонтальный боковой суппорт движется вдоль вертикальных направляющих колонны. Станок выполняет следую-

щие операции: обточку цилиндрических поверхностей, торцовое точение, сверление, разрезание и другие операции.

## Текст 16. Сварка

Сварка – это процесс соединения двух металлических частей при нагревании места их контакта до состояния плавления. Виды сварки различаются в зависимости от источника энергии, металла и состояния металла на месте сварки.

Кузнечная сварка – это процесс, при котором две расплавленные металлические детали соединяются вместе при помощи механического молота. При дуговой сварке заготовки не плавятся с помощью пламени, а посредством электрической дуги. Чтобы получить электрическую дугу, необходим мощный электрический ток, не менее 60 А, иначе дуга не сможет вырабатывать достаточно.

## Текст 17. Основные технологические процессы

Обработка металлов включает: литье, штамповку, механическую обработку и термообработку. Литье означает получение отливок путем залива расплавленного металла в специальные формы. Штамповка – это способ обработки металлов давлением, благодаря такому свойству металлов, как пластичность. Механическая обработка – это удаление лишнего металла с поверхности заготовки, чтобы получить желаемую форму. Чтобы получить необходимый результат, используют различные инструменты. Штамповка, листовая штамповка и штамповка на прессе приводят к деформации металла, используя давление.

Термообработка используется для улучшения свойств металлов. Существуют следующие виды термообработки: закалка, отжиг, отпуск и нормализация, которые отличаются друг от друга температурой нагрева, скоростью охлаждения и время выдержки.

# ЗАКЛЮЧЕНИЕ

Издание предназначено для студентов машиностроительных специальностей и направлено на овладение навыками чтения и перевода специальной литературы, ее понимания, умения извлекать информацию, а также адекватного перевода на русский язык.

Пособие поможет студентам овладеть общетехнической лексикой, без которой невозможно выработать умение свободно ориентироваться в зарубежной научной литературе с целью поиска и обработки необходимой информации.

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# ADDITIONAL MATERIALS

## Metals, Alloys and Their Use

Man uses metals still so much today because of their valuable properties. The main advantage of metals is their strength and toughness.

Plastics are lighter and more corrosion-resistant, but they are not usually as strong as metals. Another problem with plastics is what to do with them after use. Metals can be recycled but plastics can only be burned.

Not all metals are strong. Copper and aluminum are metals, but if they are mixed together, the result is an alloy called aluminum bronze in which is much stronger than either pure copper or pure aluminum

Alloying is an important method of obtaining required properties such as strength, toughness, resistance to wear, magnetic properties, high electrical resistance or corrosion resistance.

The properties of a metal can be further improved by use of heat treatment. Heat treatment is a number of different procedures in which the properties of metals and alloys are changed. It usually consists of heating the metal or alloy to a selected temperature below its melting point and then cooling it at a certain rate to obtain those properties which are required. For example, hardening is used to make metals harder. Tempering makes them softer and less brittle. Annealing is carried out to make a metal soft so that it can be machined more easily. In this way, metallic materials can be produced to meet every kind of engineering specification and requirement.

## Metallurgy

Metallurgy is a part of Materials Science and of Materials Engineering that studies the physical and chemical behavior of metallic elements and their mixtures, which are called alloys.

Most metallic elements are best used in the alloyed form, for example, steel, brass, aluminum alloys. However, some almost (99,5 % or so) pure elements like semiconductors owe their properties. Metals work as structural materials under loading conditions where sudden failures must be avoided. The metals are stronger than most plastics and have more toughness than most ceramics. Unlike the mechanism that causes a metal or alloy to behave in the way it does, i.e. the changes that occur on the atomic level will affect the metal (or alloy) properties.

Extractive metallurgy is separating metals, usually in the form of a metal oxide, from their ore, and refining them into a pure metal. In order to convert metal oxide to a metal, the metal oxide must be reduced either chemically or electrolytically.

## Abrasive Materials and Tools

The abrasive branch of industry had been developing at an especially high rate during the post-war period. A number of plants were constructed engaging in the manufacture of abrasive materials and tools, these plants incorporating mechanized and automated in-line production.

The outstanding characteristics of these plants is the employment of powerful electrical and flame furnaces.

The machinery with the aid of abrasives has become a part of modern technology as a progressive method of machining ferrous and nonferrous metals and alloys, and also of plastics, glass, construction stone, wood, leather, precious stone and other materials.

Abrasive machining is the most effective method ensuring high accuracy and surface finish in machining parts of engines, bearings the inner surfaces of tubes and other kinds of products.

The perfect quality of the tools (high hardness and homogeneity of chemical composition) is ensured by the use of high-quality raw materials and the practice of a progressive technology.

## Milling Machine

A milling machine is a power-driven machine used for the complex shaping of metals parts. It consists of is rotating cutter which rotates in the vertical axis (like a drill) and can move in three dimensions relative to the work piece (in contrast to the drill which can only

move in one dimension while cutting). Cutters are usually manufactured from high speed steel in a number of shapes and sizes. They can also be obtained in carbide or diamond for special milling operations.

The motion is usually accomplished by a moveable table on which the work piece is mounted.

Materials best suited for milling are soft metals and plastics. Aluminum and brass are two commonly milled metals. The ability to mill a metal is limited only by the hardness of the cutter.

Milling machines may be operated manually or under numerical control. Such mills are called Numerical Control mills, which are widely used in small machine shops.

## Universal Cylindrical Grinding Machine

This universal grinder is designed for external grinding of both cylindrical and tapered surfaces. Depending on its size the work piece is either mounted between dead centers or is held in a chuck. It is widely used in piece and lot production plants.

The rigid and massive design of the machine ensures dependable operation. The work piece can be ground with high accuracy and excellent surface finish.

The hydraulic system accomplishes the following operations: reciprocating table travel, rapid approach and withdrawal of the wheel head.

The upper part of the table, the wheel head and the headstock can swiveled and clamped in the required position for taper grinding operations.

The one-piece cast-iron base is of box shape. It is rigid and stable, thus preventing the development of vibration during operation. The base ways have a large bearing surface, protected against dust.

## Spot Welding

In spot welding the components to be joined are pressed together by two copper electrodes and heated to the welding temperature. According to Joule's law, the welding current, the total resistance and the welding time determine the heat supply. Heat is removed primarily by thermal conduction or by thermal radiation. The heat loss depends on

the sheet thickness, the electrode shape and especially on the thermal conductivity of the materials being joined.

In the case of materials with high electrical and thermal conductivity, such as aluminum and its alloys, they exhibit lower resistance than steel, and higher welding currents are necessary to produce a spot weld bond with aluminum.

Aluminum alloys have high resistance due to the presence of an oxide film of different composition and thickness on each surface which is not electrically conductive. The oxide film breaks up during the welding process as a result of the surface deformation caused by the electrode force.

The weldability of aluminum materials is determined by chemical composition the metallurgical characteristics and the surface finish of the parts being welded.

## The Oxyacetylene Welding

Oxyacetylene welding, known as gas welding, is a process which relies on combustion of oxygen and acetylene. When mixed together in correct proportions within a torch or blowpipe, a hot flame is produced with a temperature of about 3,200°C. The chemical action of the oxyacetylene flame can be regulated by changing the ratio of oxygen to acetylene.

The following three flame settings are used: neutral, oxidizing and carburizing.

Welding is generally carried out using the neutral flame setting which has equal quantities of oxygen and acetylene. The oxidizing flame is obtained by increasing just the oxygen flow rate while the carburizing flame is achieved by increasing acetylene flow in relation to oxygen flow. Because steel melts at a temperature above 1500°C, the mixture of oxygen and acetylene is used as it is the only gas combination with enough heat to weld steel. Other gases such as propane, hydrogen can be used for joining lower melting point non-ferrous metals.

# GLOSSARY

**a numberof -** (целый) ряд, некоторое количество
**a rod** – стержень, прут(ок)
**a rope** – верёвка , канат
**ability-** возможность, способность
**absorb** – поглощать, впитывать
**acceleration** – акселерация , ускорение
**accountfor** – объяснять
**act** – действовать, поступать
**action** – действие
**adopt-** принимать
**advantage-** преимущество , выгода
**affect** – влиять
**alloy** – сплав
**alloy** – легировать
**alter –** изменять
**amount –** количество, величина, весь объём
**appear** – появляться
**appearance** – видимость
**appliance** – электрический прибор, устройство
**application** – применение
**apply –** наносить, накладывать
**arrange** – располагать в определенном порядке
**arrangement** – расположение
**atomicmass** – атомная масса
**atomicnumber –** атомный /порядковый/ номер (в таблице Менделеева)
**attach-** соединять
**attract** – притягивать
**available** – доступный
**average-** средний, обычный, среднее число
**axis** – ось
**balanced-** сбалансированный
**belocated** – располагаться
**berelated** – быть связанным

**be responsible** – нести ответственность
**behave-** вести себя
**bind** – связывать
**bind – крепитель, скоба**
**blast** – взрыв, дутье, звук, взрывная волна
**blast furnace-** доменная печь
**boil** – кипятить
**boiling point** – точка кипения
**bond-** связывать
**bonds –** связь
**bottom** – нижний, последний, основание
**brass-** латунь, медь
**brittle-** хрупкий , ломкий
**burn** – кипятить
**calculate** – вычислять, циркулировать
**cancel –** отменять
**carbon-** углерод
**cause** – вызывать
**cause-** причина
**change** – изменять
**charge** – заряжать
**chemical-** химический
**chemical bond** – химическая связь
**chemist** – химик
**circulate** – распространять
**close** – близкий
**collect** – собирать
**collide-** сталкиваться
**collision** – столкновение
**color** – оттенок, пигмент, цвет
**colorless-** бесцветный
**combine with –** объединять с
**common-** общий, совместный
**compare-** сравнивать
**composition-** структура
**compound** – соединение
**condition-** условие
**conduct electricity** – проводить электричество

**conduction** – проводимость , передвижение электронов
**conductor** – проводник
**connect** – связывать
**conservation-** сохранение
**constant speed-** постоянная скорость
**constantly-** постоянно
**contain-** содержать
**convert** – преобразовывать
**cool –** охлаждать
**create** – создавать
**crush –** дробить
**cut –** вырезать
**cutting** – режущий
**damage** – повреждать
**decrease** – уменьшать
**define** – определять
**definition** – определение, описание
**degree** – степень, градус
**dense** – густой, плотный
**density –** плотность , густота
**dependon** – зависеть от
**dependent** – зависимый
**depth** – глубина
**describe** – описывать
**destroy** – разрушать
**determine** – определять
**develop** – развиваться
**development** – развитие
**device** – устройство , прибор
**disadvantage** – недостаток
**disappear** – исчезать
**discovery** – открытые
**dissolve** – растворять
**divide** – делить
**division-** разделение
**double-pulley system** – двойная система шкива
**draw** – тащить, тянуть
**ductile** – вязкий, ковкий, тягучий (о металле)

**dueto** – в связи, в следствие , по причине
**during –** во время, в течение
**electric – field** электрическое поле
**electroncloud** – пространственный заряд; электронное облако; облако электронов
**electroniccircuit** – электронная схема
**emptyspace** – пустое место
**equal** – равный
**equation** – выравнивание
**exert a force** – оказывать воздействие
**exert** – оказывать
**exist** – существовать
**explode** – взрываться
**explosion-** взрыв
**extract** – извлекать
**fabrics-** структура, материя
**fall** – падать, опускаться
**familiar** – близкий
**feature** – характеристика , черта
**fixed point** – неподвижная точка, фиксированная точка
**flame –** пламя, огонь
**flow** – течение, поток, расход ( жидкости или газа)
**flow** – течь, протекать
**force** – сила, действие
**force** – давить
**form** – формировать
**form-** вид, очертание
**freely** – свободно
**freeze-** замораживать
**freezing point** – точка замерзания
**friction** – трение
**gain** – получать
**gasoline –** бензин
**generate –** генерировать
**glass –** стекло
**gravity** – тяжесть, сила тяжести
**grind** – молоть
**handle** – рукоятка

**heat** – тепло
**heavy** – тяжёлый
**height**- высота
**hold** – держать
**hydrogen** – водород
**identity** – идентичность
**image** – описание , отображение
**impure** – неоднородный
**impurity** – загрязнённость
**inorderto** – для того, чтобы
**inclinedplane** – наклонная плоскость
**include** – включать, содержать в себе
**increase –** увеличивать
**independent** – независимый
**inertia** – инерция, бездействие
**inputforce –** усилие на рычаге управления, входное усилие
**inside –** внутри, внутренний
**instantaneous speed**- мгновенная частота вращения, мгновенная скорость
**instead of –** вместо того, чтобы
**insulator** – изолятор, непроводник
**invent –** изобретать
**invisible –** невидимый
**involve –** включать
**lead** – свинец
**lenses** – линза, объектив , лупа
**level**- уровень
**lever** – рычаг , средство воздействия
**lift** – поднимать
**light beam**- световой луч
**light** – освещенность , свет, легкий
**like** – подобный
**limestone**- известняк
**liquid** – жидкость
**loss** – потеря, убыток, ущерб
**machine –** аппарат, станок
**magnifying glass**- лупа
**maintain** – поддерживать

**malleable –** ковкий
**mass unit –** единица массы
**matter –** материя
**measure** – измерять
**measurement** – измерение
**melting point** – точкаплавления
**mercury** – ртуть
**metalplate** – металлическая пластина
**metricunit** – метрическая единица
**mine** – добывать, разрабатывать; рудник
**mix** – смешивать
**mixture** – смесь
**motion** – движение
**move** – двигаться
**multiplication** – увеличение
**multiply** – умножать
**narrow** – узкий
**needle** – игла
**netforce –** равнодействующая сила
**nitrogen** – азот
**non-existent** – несуществующий
**nonmetal** – металлоид
**nuclear power plant** – атомная силовая установка
**nucleus** – ядро
**observation** – наблюдение
**observe** – наблюдать
**obtain** – получать
**occupy** – занимать
**occur** – происходить
**ordinary –** обычный
**ores** – руда
**original** – исходный
**output force** – сила выхода
**outside** – внешний
**overcome** – преодолеть
**oxygen** – кислород
**particle** – частица
**pedal –** нажимать

**perform –** выполнять
**permanent –** постоянный
**physical –** физический
**physicist** – физик
**plank** – доска, планка
**poor conductor** – плохой проводник
**positively charged** – положительно заряжённый
**potential energy** – потенциальная энергия
**powder –** порошок
**presence –** внешний вид
**process** – процесс, ход, способ
**produce** – производить
**property** – свойство
**provide** – предоставлять, обеспечивать
**pulley** – шкив
**pure** – чистый
**purify** – очищать
**purpose** – цель, намерение
**push** – толкать
**quantity** – количество
**raise** – поднимать, расти
**ramp** – аппарель , уклон
**random motion** – беспорядочное движение
**ratio** – соотношение
**rawores** – необогащённая /сырая/ руда
**ray** – луч
**reach** – достигать
**react** – воздействовать
**reaction –** реакция
**reason** – причина
**reefing** – рифление
**refine** – очищать
**relationship** – связь
**release –** освобождать
**remain** – оставаться
**remove** – удалять
**replace** – заменять
**represent** – представлять, изображать

**research** – исследование
**resemble** – иметь сходство
**resist** – сопротивляться
**resistance** – сопротивление
**result** – приводить к
**reverse** – отменять
**revolution** – кругооборот, вращение
**revolutions per hour** – оборотов в час
**revolve** – вращаться
**rotate** – вращать
**rotation –** вращение
**rough surface** – шероховатаяповерхность
**rough** – неровный
**rub** – тереть
**rubber band-** резиновая лента
**rust** – ржавчина
**rusty-** ржавый
**scale-** шкала
**screw thread** – резьба, винтовая нарезка
**screw** – винт, шуруп
**screw driv**er – отвертка
**seal** – прикладывать
**semi-transparent** – полупрозрачный
**separate** – разделять
**separate** – отдельный
**shape** – форма
**similar** – подобный
**simple** – простой
**single** – одиночный
**size** – размер
**slide** – скользить
**slow down-** замедлить
**smelt-** плавить
**smelting** – плавление
**smooth** – гладкий , ровный
**solid** – твёрдый
**solubility-** растворимость
**solution** – решение

**source-** источник
**space** – пространство , протяженность
**speed up** – ускорять
**split apart** – расколоться
**spot** – пятно
**spread-** распространять
**still air** – неподвижный воздух
**store** – хранить
**strength** – прочность
**stretch** – растягивать
**strong** – крепкий
**sublimation** – возвышение, очищение
**substance** – вещество
**supply** – обеспечить
**support** – поддерживать
**surface** – поверхность
**take place** – иметь место, происходить
**thermal** – тепловой
**thick** – густой
**thickness** – густота
**threaded** – нарезной
**throw** – бросать
**thunder** – шум
**thunder storm** – гроза
**tight** – плотный
**tightly** – плотно
**tin** – олово
**tiny** – крошечный
**to conserve** – сохранять
**tools** – инструменты
**total** -полный
**touch** – касаться
**tough** – жесткий
**transfer-** передавать
**transform-** превращать
**transformation** – преобразование
**transparent** – прозрачный
**travel** – движение

**turn –** поворачивать
**unbalanced** – несбалансированный
**unchanged** – неменяющийся
**uncharged** – незаряженный
**under certain conditions** – при определенных условиях
**undergo** – испытывать
**unfamiliar** – незнакомый
**unlike** – непохожий
**vapor -**пар
**vaporization** – парообразование
**variety-** разнообразие
**various** – различный
**vary** – варьироваться
**velocity** – скорость
**volume-** объём
**warm** – разогревать
**wave** – волна
**wedge** – клин
**weigh** – весить
**weight** – вес
**wheel and axle-** колесо и ось
**wide** – широкий
**width** – ширина
**wire** – провод

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