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ОБУЧЕНИЕ ЧТЕНИЮ ЛИТЕРАТУРЫ ПО СПЕЦИАЛЬНОСТИ

Учебно-методическое пособие для студентов факультета нано и биомедицинских технологий и механико-математического факультета

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Предисловие

Предлагаемое учебно-методическое пособие предназначено для студентов факультета нано и биомедицинских технологий и механико-математического факультета, которые начинают знакомство с литературой по специальности на английском языке.

Цель пособия - обучение студентов точно понимать и переводить оригинальные научные тексты по специальности.

В качестве текстового материала были взяты аутентичные тексты из американских научных и научно-популярных изданий: “Materials Science and Technology Teachers Handbook”, “Mathematics, Poetry and Beauty”, “Mathematics in Everyday Life”, “An Introduction to the Philosophy of Mathematics”, “Creators of Mathematical and Computational Sciences”, а также интернет-ресурса wiseGEEK.

Пособие состоит из двух частей и содержит 20 научных текстов по специальности, сопровождаемые упражнениями на контроль понимания текстов и отработку лексического материала. Каждый текст предваряет терминологический словарь, который помогает устранить лексические трудности.

Структура пособия обеспечивает эффективную работу студентов как самостоятельную, так и под руководством преподавателя.

Content

Part I “Nanotechnology”

Unit 1

Vocabulary

capability – способность, возможность
field of science – область науки
scale – масштаб, шкала
to launch – запустить, начинать
room – место
to popularize – излагать, распространять

What is Nanotechnology?

Over the past few decades, the development of new and more advanced energy technologies with the *capability* of improving life all over the world have been sought in the fields of science and engineering. In order to make the next leap forward from the current generation of technology, scientists and engineers have been developing a new *field of science* called Nanotechnology.

Nanotechnology is defined as the science and technology of building electronic circuits and devices from single atoms and molecules, or the branch of engineering that, deals with things smaller than 100 nanometers. A nanometer (nm) is one billionth of a meter, roughly the width of three or four atoms. For *scale* comparisons, the average human hair is about 80,000 nanometers wide, and a single virus particle is about 100 nanometers in width. The prefix **nano**-comes from the Greek word **nenos**, meaning "dwarf." Scientists originally used the prefix just to indicate "very small," as in "nanoplankton," but it now means one-billionth, just as **milli**- means one-thousandth, and *micro*- means one-millionth.

The term Nanotechnology is also often used to describe the interdisciplinary fields of science devoted to the study and use of nanoscale phenomena.

The story of nanotechnology begins in the 1950s and 1960s, when most engineers were thinking big, not small. This was the era of big cars, big atomic bombs, big jets, and big plans for sending people into outer space. Huge skyscrapers, like the World Trade Center (completed in 1970) were built in major cities of the world. The world's largest oil tankers, cruise ships, bridges, interstate highways, and electric power plants are all products of this era. The invention of the transistor in 1947 and the first integrated circuit (IC) in 1959 *launched* an era of electronics miniaturization. It was these small devices that made large devices, such as spaceships, possible.

As electronics engineers focused on making things smaller, engineers and scientists from other fields also turned their focus to small things - atoms and molecules. At the same time, chemists worked to combine atoms into new kinds of molecules, and had great success converting the complex molecules of petroleum into all sorts of useful plastics.

Usually the credit for inspiring nano-technology goes to a lecture by Richard Phillips Feynman, a brilliant physicist who later won the Nobel Prize for "fundamental work in quantum electrodynamics". On December 29, 1959, Feynman delivered a lecture at the annual meeting of the American Physical Society; in that talk, called "There's Plenty of *Room* at the Bottom", Feynman proposed work in a field "in which little has been done, but in which an enormous amount can be done in principle." In his lecture Feynman described how the entire Encyclopedia Britannica could be written on the head of a pin, and how all the world's books could fit into a pamphlet.

Feynman himself didn't use the word "nanotechnology" in his lecture; in fact, the word didn't exist until 15 years later, when Norio Taniguchi of the Tokyo University of Science suggested it to describe technology that strives for precision at the level of about one nanometer. Only in the 1980s did this new field of study get a name -Nanotechnology. This new name was *popularized* by physicist K. Eric Drexler.

Exercises

1. Give the definition of the following words in English

nanotechnology
nanometer
nanoscale
to launch
head of a pin

2. Fill in the gaps with suitable words from the box.

nanometer	electric	invention	huge	width
devoted	in order to			

1. The …….. of the computer has revolutionized the business world.
2. This value shall be calculated using intervals of one …… .
3. The river here spreads to a …… of half a mile.
4. Plants need light …….. survive.
5. We decided to install a wooden floor and ……. lights.
6. The work also requires a …… investment of time.
7. He ……. himself to the study of nature.

3. Put the following words in the sentences into the right order.

1. and, Nanotechnology, have, scientists, been, of, developing, a, new, engineers, field, science, called.
2. a, one, is, billionth, a, nanometer, of, meter
3. worked, molecules, combine, to, chemists, atoms, kinds, new, of, into
4. a, Nobel, physicist, who, brilliant, the, Prize, won

5. described, the, Feynman, entire, of, Encyclopedia, how, Britannica, could, written, pin, on, the, be, head, a

4. Find the equivalents of the following words in the text.

1) совершить скачок; 2) открытый космос; 3) первая интегральная схема; 4) это сделало возможным; 5) ежегодное собрание; 6) новая область науки получила название; 7) используется для описания; 8) произошел от греческого слова

5. Answer the following questions

1. What does nanotechnology study?
2. When did the story of nanotechnology begin?
3. What was Feynman's lecture about?

6. Think of 5 questions of different types covering the text.

Unit 2

Vocabulary

pounding – измельчение, дробление
to require – требоваться
layer - слой
molecular beam epitaxy - молекулярно-пучковая эпитаксия
to expose – воздействовать, облучать

Formation of Materials

To have very small materials, it is necessary to have a way to form materials in the architectures and the morphology that you desire. Traditional methods of forming materials into specific shapes and devices include cutting, chipping, *pounding*, extruding. Nanotechnology is different. Whereas bulk procedures begin from a larger structure and form it into smaller structures, nanotechnology procedures can also include beginning at the atomic level and building up into larger, nanoscale structures. Where formation of smaller materials from larger is known as "top-down" technology, the formation of materials from atomic or molecular structures is known as "bottom-up."

Top-down methods can create nanoscale technology and they are used extensively today in the electronics industry. For example, faster computer chips *require* smaller parts to fit on the same size package at higher density; these parts are pieced together with more and more complex architectures and designs. Typically, top-down formation of nanoscale structures uses the same basic tools as those employed today to form smaller structures from larger. The technique known as

photolithography is one such process. Photolithography is the most common technique used to create patterns on semiconductors and is capable of forming sub-100 nm patterns, although around 30 nm this becomes extremely difficult and costly. With photolithography in the computer industry, a silicon wafer is coated with a light-sensitive film called a photoresist that will harden when light is shone on it. A photomask with the design for each layer of the circuit is created and the photoresist-covered circuit board is then exposed to light (of a specific wavelength) through the mask, so that predetermined areas of the photoresist harden. The wafer is then *exposed* to an acid bath, hot ions, or other sloughing material so that the unhardened areas are removed. In this way, the features of a processor are built up *layer* by layer.

Bottom-up methods take the basic building blocks of nature and build up nanoscale materials from them. Typical methods of forming materials from the bottom up include vapor deposition (both physical and chemical), *molecular beam epitaxy*, and what is known as self-assembly. It was this type of material formation that Richard Feynman spoke of: "What could we do with layered structures with just the right layers? What would the properties of materials be if we could really arrange the atoms the way we want them? They would be very interesting to investigate theoretically. I can't see exactly what would happen, but I can hardly doubt that when we have some control of the arrangement of things on a small scale we will get an enormously greater range of possible properties that substances can have, and of different things that we can do"[Feynman 2002:135].

We can divide the materials that are being developed into two basic categories: organic (i.e., carbon based) and inorganic (i.e., not carbon based).

Richard P. Feynman, The Pleasure of Finding Things Out: The Best Short Works of Richard P. Feynman (New York: Perseus Books Group, 2002), p. 135.

Exercises

1. **Give the definition of the following words in English**

top-down methods
bottom-up methods
morphology
at the atomic level
self-assembly

2. Fill in the gaps with suitable words from the box.

exposed	arrangement	nanoscale	create	formation
procedures	hardly			

1. The report revealed that workers had been …… to high levels of radiation.
2. We now know a lot more about the early stages of planetary …… .

3. I …….. know the people I'm working with.
4. We found that this chemical process …….. hydrogen chloride as a by-product.
5. A small flower …….. on the kitchen table can brighten up the room.
6. New …… shave minutes from the unloading process.
7. Carbon at the ……. is actually transparent and flexible.

3. Put the following words in the sentences into the right order.

1. atomic, the, known, formation, from, or, molecular, materials, structures, is, as, of, bottom-up.
2. is, the, common, on, technique, used, photolithography, to, create, most, patterns, semiconductors.
3. interesting, they, be, would, to, very, theoretically, investigate.
4. of, a, processor, the, are, layer, built, up, layer, features, by.
5. it, this, Richard, type, that, of, was, formation, Feynman, spoke, material, of.

4. Find the equivalents of the following words in the text.

1) Технология нисходящего производства; 2) технология восходящего производства; 3) широко используется; 4) основные методы; 5) фотолитография; 6) газофазное осаждение; 7) маленький масштаб; 8) теоретически исследовать

5. Answer the following questions

1. What are the traditional methods of forming materials?
2. What are nanotechnology procedures?
3. What are the peculiarities of “top-down” and “bottom-up” methods?

6. Think of 5 questions of different types covering the text.

Unit 3

Vocabulary

ball-point pen – шариковая ручка
materials science - материаловедение
solid matter – твердое вещество
inorganic – неорганический
organic - органический
approach – подход
property – свойство

materials scientist – материаловед, специалист по материаловедению
wire - провод
china teapot – фарфоровый заварочный чайник
to conduct electricity – проводить электричество
essential – необходимый, основной

What is materials science?

Materials make modern life possible—from the polymers in the chair you're sitting on, the metal *ball-point pen* you're using, and the concrete that made the building you live or work in to the materials that make up streets and highways and the car you drive. All these items are products of *materials science* and technology (MST). Briefly defined, materials science is the study of "stuff." Materials science is the study of *solid matter*, *inorganic* and *organic*.

Materials science and technology is a multidisciplinary *approach* to science that involves designing, choosing, and using three major classes of materials—metals, ceramics, and polymers (plastics). Most materials fit into a few big, general categories:

Metals

Whole periods of human civilization - such as the Bronze and Iron ages - are named for metals. These were the first materials to be "engineered," that is, people changed them to fit what they needed to do, rather than just letting their natural *properties* determine what they could be used for. These days, *materials scientists* are using metals in ways no one could have pictured even a few years ago - for example, shaping copper into tiny *wires* a thousand times skinnier than a strand of your hair!

Ceramics

Think about a china teapot - that's one type of ceramic. But ceramics can also be used to create bone and tooth replacements, super-strong cutting tools, or *to conduct electricity*. With the addition of oxygen or nitrogen, metals become ceramics, too.

Semiconductors

One of these materials - silicon - is making it possible for you to read these words right now! That's because silicon is the *essential* material in an electronic computer chip. "Semiconductor" means a material can conduct electricity with a bit of help in the form of added "impurities." Your CD, DVD player, and telephone - all depend on semiconductors.

Polymers

Polymers are just very big molecules made of smaller molecules linked together into long, repeating chains. You may not know it, but you're in touch with polymers every day more than any other kind of material. Rubber bands are made of polymers, so are paints and every kind of plastic. And by the way, most of the food you eat is made of natural polymers!

Wood also could be used. Another class of materials used in MST is composites, which are made of a combination of materials (such as in particle board or fiberglass). Materials science combines many areas of science. Because of the

interdisciplinary nature of materials science, it can be used both as an introductory course to interest students in science and engineering and also as an additional course to expand the horizons of students already taking science and mathematics courses.

Exercises

1. Give the definition of the following words in English

materials science
metals
ceramics
polymers
composites
particle board
semiconductors

2. Fill in the gaps with suitable words from the box.

approach	technology	interdisciplinary	solid	science
wire		essential		

1. This …… is considered essential for effective implementation.
2. By the mid 20th century, humans ……. had achieved a mastery of sufficient to leave the atmosphere of the Earth for the first time and explore space.
3. …… projects on these questions have recently been started at the subregional and regional levels.
4. The containers have to be …… enough to withstand the pressure.
5. Many leading scientists do not consider that …….. can give absolutely reliable knowledge.
6. You have to find the …….. that connects the manual override to the electromagnet.
7. You can get ……. travel information from the website.

3. Put the following words in the sentences into the right order.

1. combines, science, many, science, many, of, materials
2. study, is, of, materials, solid matter, the, science, organic, inorganic, and
3. be, create, can, bone, tooth, and, used, replacements, ceramics, to
4. food, most, is, you, of, polymers, the, eat, made, natural, of
5. chip, the, material, is, electronic, an, computer, silicon, in, essential

4. Find the equivalents of the following words in the text.

1) многодисциплинарный подход к чему-либо; 2) иметь дело с чем-либо; 3) продукт материаловедения; 4) учение о материале; 5)основные классы материалов; 6) супер прочные режущие инструменты; 7) интегральная схема; 8) естественные свойства

5. Answer the following questions

1. What does materials science study?
2. Name the general categories of materials
3. What is the essential material in an electronic computer chip?

6. Think of 5 questions of different types covering the text.

Unit 4

Vocabulary

composition – состав
X-ray diffraction – дифракция рентгеновских лучей
tile – теплозащитная плитка/пленка
flight crew - экипаж
fierce – сильный, резкий
fiber – волокно
rigid – жесткий, прочный
reliable materials – надежные материалы

A New Scientific Frontier

Atomic structure and chemical *composition* were once major focuses of materials science research. However, over the last few decades, this focus has changed dramatically as analytical chemistry, the electron microscope, *X-ray diffraction*, and a host of spectrometers have been developed that can analyze materials with accuracy.

Because scientists can now understand what materials are made of (chemical composition) and how they work (physical properties), the major focus of materials science has shifted to understanding how materials can be improved and what new materials can be developed to meet society's needs. These scientific advances caused a revolution in knowledge in materials. What was known about materials only 50 years ago could be printed in several volumes of books; today's advances fill shelves of books.

Examples of new materials abound and are reported regularly in newspapers and magazines. The space shuttle *tile*, which is used as a heat shield to protect the aluminum shell on the shuttle, is one example of this development of new and

improved materials. When NASA (the National Aeronautics and Space Administration) decided to build a space shuttle that would rocket into orbit and eventually plunge through the atmosphere and land on the ground like an airplane, no known insulating material existed that would protect the *flight crew* from the *fierce* re-entry heat, be light enough to coat the entire craft, and be reused a number of times.

So, ceramists (materials scientists who work with ceramics) designed special tiles made from high-temperature glass *fibers* and sintered them to form a *rigid,* but almost unbelievably light structure. These tiles are glued to the shuttle with silicone rubber and now do an admirable job of keeping heat away from the crew. The ceramists designed the tiles from "scratch" by adapting their knowledge of glass properties to meet the needs of the space shuttle. Further development continues as less bulky and more *reliable materials* are being developed to shield the Orient Express, a supersonic transport being developed for near-space travel over long distances around the Earth.

Exercises

1. Give the definition of the following words and expressions in English

composition
physical properties
space shuttle
glass fiber
to shield

2. Fill in the gaps with suitable words from the box.

X-ray	chemical	properties	knowledge	orbit
heat	structure			

1. The doctor decided to take an ……. of my back.
2. Chapter 1discusses the changing …… of agriculture in thiscountry.
3. The two plants have similar physical …….
4. A lot of ……. reactions are reversible.
5. He possessed a vast store of ……...
6. These paints can withstand …….. up to 200 degrees.
7. The shuttle can remain in …….. around the earth for up to 9 days.

3. Put the following words in the sentences into the right order.

1. now, what, can, they, and, understand, work, materials, of, made, scientists, how, are
2. are, to, these, with, tiles, the, rubber, glued, shuttle, silicone
3. from, special, made, glass, ceramists, tiles, fibers, high-temperature, designed

4. in, are, magazines, new, reported, of, and, newspapers, materials, regularly, examples
5. once, science, of, and, chemical, research, were, major, composition, structure, focuses, materials

4. Find the equivalents of the following words in the text.

1) за последние несколько десятилетий; 2) переместить фокус внимания на что-либо; 3) нужды общества; 4) теплозащитный экран; 5) приземлиться; 6) изолирующий материал; 7) сверхзвуковой транспорт; 8) невероятно легкая структура

5. Answer the following questions

1. Where is the major focus of materials science?
2. What kind of material is used as a heat shield for space shuttles?
3. What did ceramists designed for keeping heat away from the crew?

6. Think of 5 questions of different types covering the text.

Unit 5

Vocabulary

controversy – дискуссия, спор
to **keep pace –** идти в ногу, не отставать
durable – долговечный, надежный
engine - двигатель
stiffness - прочность
onboard computer – бортовой компьютер
ignition system – система зажигания
alloy – сплав

Materials Science in Our Everyday Lives

Another example of the development of new materials is in biomedicine. The recent *controversy* over silicone breast implants shows how much care must be taken in choosing, testing, and using materials that are used inside human bodies. More successful examples of materials developed for human bodies are such things as hip, knee, and finger joint replacements made from composite materials.

A modern automobile is a good example of how materials have changed to *keep pace* with industry and culture. The American car of the 1950s was a *durable* machine and pretty well suited to its environment. Gas was cheap, metal was thick and lavishly used. The resulting car was heavy, but Americans demanded high

performance for use on newly built freeways designed for speeds of at least 75 miles per hour. *Engines* were correspondingly large, with displacements approaching 500 cubic inches (that's about 8 liters!). Americans tended to abuse these cars, and they were built to take abuse.

No one ever claimed these cars were fuel efficient. Then came the oil shock of 1973, and cars had to change radically, and have kept changing to meet the demand for more fuel-efficient transportation. In the quest for efficiency, car weight was reduced, and some changes were made in streamlining. Sheet metal used to build car bodies became much thinner and had to be much stronger. Unit body construction provided a way to produce *stiffness* without all the weight of a separate frame. Plastics and aluminum were used extensively in many parts of the car, and aluminum use increased dramatically.

The electronics revolution has provided *onboard computers* to manage the fuel and *ignition systems* of the engine, which now operate much closer to optimum parameters because of the need for both fuel efficiency and reduced emissions. Removing lead from gasoline stimulated use of better *alloys* for valves and valve seats. Spark plugs no longer exposed to lead deposits last 30,000 miles. Many other changes have occurred to the automobile, and you and your students doubtless know a few more.

However you look at it, materials have become a scientific frontier that continues to develop new and improved ways for people to live and travel now and in the future.

Exercises

1. Give the definition of the following words and expressions in English

alloy
composite materials
radically
to manage sth
freeway

2. Fill in the gaps with suitable words from the box.

biomedicine	composite material	machine	speed
fuel	weight	efficient	

1. The car was not able to pull such a large ……..
2. What is the car's top …….. ?
3. With the rise of ……. came greater knowledge about the causes of infectious diseases.
4. Our new system will allow for more …….. use of resources.
5. A …… is made by combining two or more materials – often ones that have very different properties.

6. This light means you're running low on …… .
7. The …… is easy to use.

3. Put the following words in the sentences into the right order.

1. development, the, new, of, in, another, example, biomedicine, of, materials, is
2. from, valve, seats, valve, use, for, and, better, stimulated, lead, gasoline, removing, alloys, of
3. cars, to, abuse, Americans, these, tended
4. were, and, many, in, used, the, cars, of, parts, aluminum, plastics, extensively
5. was, machine, the, of, the, Americans, a, durable, 1950s, car

4. Find the equivalents of the following words in the text.

1) в поисках эффективности; 2) сократить (уменьшить) загрязнение; 3) недавняя дискуссия; 4) топливосберегающий; 5) широко использовался; 6) управлять; 7) система зажигания двигателя; 8) новая область науки

5. Answer the following questions

1. What is biomedicine?
2. What kind of materials are used for implants?
3. What changes occurred in automobile field?

6. Think of 5 questions of different types covering the text.

Unit 6

Vocabulary
amateur – любительский
to enroll in – зачислить, поступить
to major – специализироваться по какому-либо предмету
master's degree – степень магистра
piezoelectric materials – пьезоэлектрические материалы
silicate minerals – силикатные материалы
explosive – взрывчатое вещество
bachelor's degree – степень бакалавра
materials engineer - материаловед

Materials Scientists at Work
Mary Bliss

Astronomy was my first love. I joined an *amateur* astronomy club when I was 13 or 14. What I really liked about it was light and telescopes. At my high school, if you were good in science, that meant biology and you wanted to be a doctor or nurse.

Chemistry was taught like history. The labs were set up to reproduce some result, and everything seemed to be known. So, instead of doing a regular senior year of high school, I *enrolled in* an advanced studies program for high school students at Pace University. I took chemistry and liked it this time. By the time I finished high school, I had 29 college credits.

I was in my sophomore-level classes when I arrived at Alfred University with my 29 credits. I wanted to take physics because I was still interested in astronomy. I also took organic chemistry because I figured if I didn't like physics, maybe I would *major* in chemistry. I never worked so hard in my life. I didn't have the faintest ideas of what was going on in physics. Having a study partner was the only way I could handle those classes. One January session I also signed up for a class called Gemstones: Myth and Mystery with a professor in the College of Ceramics. I had a blast! I got to run the transmission electron microscope myself. We found an error in the literature, and I ended up presenting the paper at a regional society meeting and won an award for the best undergraduate research project at Alfred. So, professors in the Ceramics Department encouraged me to change my major. Besides, in exchange for changing my major, one ceramics professor was going to give me a matched pair of Herkimer diamonds.

I worked the summers of my junior and senior years at Corning Glass Works in Corning, New York. I learned what engineers do all day there. I also met some really good engineers. I liked Corning, but I knew I wouldn't be happy as a production engineer forever. So, I got a *master's degree* in ceramic science at Penn State University (working on *piezoelectric materials*). I wasn't very happy with this work so I did my doctorate in the Solid State Science Department doing spectroscopy on *silicate minerals*. What strikes me most is that I liked spectroscopy even when I was in high school.

Roy Bunnell

I was raised in Pocatello, Idaho, and developed a keen early interest in chemistry and physics, particularly as they apply to *explosives* and rockets. I still have 10 fingers and two functioning eyes, through either incredible luck or divine intervention. After I obtained a *bachelor's degree* in ceramic engineering from the University of Utah in 1965, I came to Battelle. By working on a wide variety of projects, ranging from nuclear reactors for space propulsion to materials compatibility in high-temperature sodium to amorphous carbon to high-temperature properties of zirconium alloys to nuclear waste glass to new composite materials, I have learned enough about metals and polymers to be considered a *materials engineer*.

Exercises

1. Give the definition of the following words and expressions in English

master's degree

bachelor’s degree
blast (*n*)
sophomore-level classes
major (*n*)

2. Fill in the gaps with suitable words from the box.

reproduced	microscope	engineer	obtain	error
nuclear reactor	compatibility			

1. Make sure the lens of the …… is clean.
2. The information may be difficult to ……...
3. This ……. has outstanding qualification in constructing bridges.
4. We need to minimize the chance of …….. .
5. Some diagrams are poorly …….. and tables printed vertically.
6. The ……. which propels the submarine was not damaged.
7. There are two primary methods of performing an application …… test.

3. Put the following words in the sentences into the right order.

1. club, astronomy, 13, I, 14, an, joined, when, amateur, or, was, I
2. were, to, up, set, the, result, some, labs, reproduce
3. Department, me, the, change, to, major, my, Ceramics, in, encouraged, professors
4. Engineer, have, I, about, polymers, enough, metals, be, to, learned, and, considered, a, materials
5. Penn, I, degree, got, State, at, master’s, ceramic, University, in, science, a

4. Find the equivalents of the following words in the text.

1) специальные курсы; 2) ошибка в литературе; 3)научно-исследовательский проект; 4) получить степень бакалавра; 5) движение в космосе; 6) просвечивающий электронный микроскоп; 7) поменять профиль; 8) работать над большим количеством проектов

5. Answer the following questions

1. What was Mary’s favorite subject?
2. What was Roy’s academic interest?
3. What kind of materials do Mary and Roy work with?

6. Think of 5 questions of different types covering the text.

Unit 7

Vocabulary

suitable - подходящий
medieval times – времена средневековья
to depict – изображать, описывать
usage – использование, применение
achievement –достижение
metallurgist – металлург
jet engine – реактивный двигатель
electronic circuit – электронная схема
application – применение
primarily – главным образом
ore – руда
shape – форма
inanimate – неодушевленный
to prompt – привести к чему-либо
stainless steel – нержавеющая сталь
internal structure – внутренняя структура

Metals

Metallurgy is the science of making metals and alloys in forms and with properties *suitable* for practical use. It has played a unique role in human history, having brought us out of the Stone Age into the Bronze Age and then into the Iron Age. The seemingly miraculous conversion of dull earths into shining metals was the very essence of the art and magic of alchemy. No science of metals existed in *medieval times* to understand and explain the secret methods used to make and form metals and alloys.

Some of the mystery over metallurgy still lingers today. Science fiction novels and moves *depict* space ships and other objects constructed of "wonder metals" with amazing properties. Such *usages* are believable because of the remarkable *achievements* of the modern *metallurgist* during this century in developing new metals and alloys for *jet engines, electronic circuits,* and other advanced engineering systems. These successes were not achieved based on the art of the past, but by the *application* of scientific principles. Metallurgy is now a disciplined applied science focused from a clear understanding of the structures and properties of metals and alloys.

Metallurgy can be separated into three basic components: chemical, mechanical, and physical. Chemical metallurgy deals *primarily* with the making of metals and alloys from their naturally occurring *ores*. Most metals are present in the Earth as compounds of some sort, such as oxides or sulphides. Metals must be extracted from these ores for practical use. The first metals were discovered accidentally more than 5,000 years ago. Metals such as copper, lead, and tin melted at low temperatures and were probably formed at camp fires. Great advances came in

metal production as furnaces were created to control the ore-melting and metal-forming process.

The importance of metals in history stems primarily from their mechanical behavior and use as construction materials. Metals combine the properties of high strength with the ability to change *shape* without breaking. This enables them to be shaped into a wide assortment of components, including car bodies, cans, and girders. Mechanical metallurgy deals with testing mechanical properties, the relationships between properties and engineering design, and the performance of metals in service.

The final critical component of the science of metals is physical metallurgy. This aspect deals with the internal world of metals and how internal structure can be designed and produced to give the best properties. Although metals look like *inanimate* objects, internally electrons dash about within them and atoms can move and exchange places while the metal is in solid form. As a result, changes in temperature can cause atoms to rearrange and *prompt* significant changes in properties. The ability to control these internal changes has led to dramatic improvements in the properties of metals. High-strength steels for building supports, *stainless steels* for corrosion-resistant applications (water pipes, pans, pots, etc.), and aluminum alloys for high-strength, light-weight airplane skins would not have been created without the ability to control and modify *internal structure*.

Exercises

1. Give the definition of the following words and expressions in English

metallurgy
alloy
alchemy
the structure of metals
electron

2. Fill in the gaps with suitable words from the box.

explain	mechanical	metallurgy	primarily	constructed of
significant	internal			

1. The …… engineering industry is very much export-oriented and a high degree of availability is expected.
2. The company at one time had a ……. tie to the defence industry.
3. They have a good collection of books on …… .
4. Your scan doesn't show the …….. structure.
5. The advertisement is aimed …… at children.
6. Managers should …….. the need for change.

7. Only the buildings that were …….. more substantial materials survived the earthquake.

3. Put the following words in the sentences into the right order.

1. of, some, mystery, over, the, still, metallurgy, lingers, today
2. temperature, in, can, atoms, to, changes, prompt, and, changes, rearrange, in, cause, properties, significant.
3. first, discovered, metals, the, than, were, 5000, more, accidentally, ago, years.
4. metals, present, most, Earth, in, as, of, are, some, compounds, sort, the
5. chemical, the, from, making, deals, metallurgy, occurring, of, with, and, metals, alloys, their, naturally, ores

4. Find the equivalents of the following words in the text.

1) наука о чем-либо; 2) удивительные свойства; 3) четкое понимание чего-либо; 4) могут быть добыты из; 5) этот аспект имеет дело с; 6) тестирование механических свойств; 7) внутренние изменения; 8) большое количество компонентов

5. Answer the following questions

1. What does metallurgy study?
2. What are basic components of metallurgy?
3. When were the first metals discovered?

6. Think of 5 questions of different types covering the text.

Unit 8

Vocabulary

raw materials- сырье
fiber-optic – волоконно-оптический
likewise – также, более того
tiny – крошечный, очень маленький
bonding - соединение
comparatively - сравнительно
outer electron – оптический электрон
conductor – проводник
liquid state – жидкое состояние
resistance – сопротивление, устойчивость

insulator - диэлектрик
brittleness – хрупкость
surface – поверхность
tough – прочный, крепкий
to penetrate – проникать

Ceramics

Ceramics are non-metallic and inorganic and are made from *raw materials* that are either mined from the earth or chemically synthesized. They are hard, generally resistant to heat and most chemicals, and lighter than most metals.

Traditional ceramic materials include glass windows, insulating bricks, pottery, and china. However, the *fiber-optic* phone lines that provide today's clear voice communication are also ceramic, products of high technology glassmaking. *Likewise*, the space shuttle is insulated against the searing heat generated as it returns from near space through the earth's atmosphere. Its aluminum hull is shielded by incredibly light bricks made from *tiny* glass fibers.

Ceramics are compounds that are generally formed by reacting a metal with other elements such as oxygen, nitrogen, carbon, or silicon.

The *bonding* is usually ionic and is very strong, making ceramics *comparatively* stable chemically. (Ionic means the joining of a positively charged atom to a negatively charged atom, usually metal atoms to non-metallic atoms.) This ionic bonding occupies the *outer electrons* of the metal, making the electrons incapable of moving in an electric field; thus, most ceramics are poor *conductors* of electricity. Ceramics also include glasses, which are composed of metals, oxygen, and silicon. By their nature, glasses do not crystallize as other ceramics do. As they cool from the *liquid state*, they become progressively stiffer until they are solid, which gives them different properties from other materials, such as not having a definite melting point.

Where *resistance* to extreme temperatures or molten metals is desired, ceramic materials emerge as extremely important. Without ceramics, it would probably be impossible to melt or cast metals; other materials will not resist the heat or chemical environment, and other materials allow heat to leak away, because they are not effective *insulators* like ceramics.

The powerful bonding forces in ceramics have some negative features, one of them being *brittleness*. Ceramics cannot be bent like metals or most other common materials, and they tend to break without warning. Tiny *surface* defects, too small to cause much of a problem with a metal, can greatly reduce the strength of a ceramic material. In a metal, flow at the defect location would reduce the effect of that defect; this flow is not possible in a ceramic. So cracks stay sharp and ceramics break instead of bend. (Metallic flow is the movement of one plane of atoms over another.)

Humankind first made ceramics in ancient times. Fire, probably at that time a relatively new discovery, was used to make clay vessels less likely to revert to a gooey mess when contacted by water. During this firing process, materials in the clays reacted, forming small amounts of glass that cemented the rest of the materials

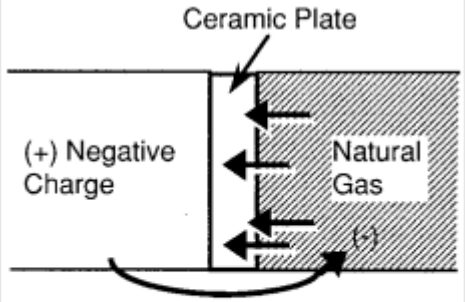
together. Glass was born in similar fireside experiments, and in Roman times, was more precious than gemstones and used similarly for decoration.

The future of ceramic materials is even more interesting. Scientists have created ceramics that, while not as *tough* as metals, are many times tougher than those made just a few years ago. These tough materials are being used increasingly as parts in automobile engines because of their lightness and resistance to wear.

Other ceramics have been made electrically conductive or able to allow oxygen ions *to penetrate* them. Both of these characteristics are needed for high temperature fuel cells that can convert fuels such as natural gas directly to electricity more efficiently than any other method (see Figure 1).

Ceramics are being formed by methods similar to those used for mass production of plastic parts, so that increasingly intricate parts can be made cheaply. All these developments combined ensure that ceramics will continue to play important roles in modern life.

Figure 1. Electrically Conductive High-Temperature Fuel Cell



Oxygen atoms (-) negative charge flow through ceramic to combine with (+) positively charged particles. An electric potential is created and electricity is "birthed."

Exercises

1. **Give the definition of the following words and expressions in English**

chemicals
outer electron
to melt
extreme temperature
fuel cell

2. Fill in the gaps with suitable words from the box.

ceramics	oxygen	environment	gemstones	electricity
methods	break			

1. Hydrogen combines with …….. to form water.

2. He is a world authority on …… .
3. The wire is charged with …… .
4. I had to …… a window to get into the house.
5. We need to find ways of producing energy without destroying the …….
6. Also, the study did not assess the capabilities of other …….. .
7. This is a brief description of manufacturing of ……. .

3. Put the following words in the sentences into the right order.

1. crystallize, glasses, ceramics, do, other, not, do, as
2. first, ancient, made, humankind, ceramics, times, in
3. most, conductors, ceramics, are, of, poor, electricity.
4. cracks, instead, stay, ceramics, sharp, and, of, break, bend.
5. cannot, bent, ceramics, other, like, be, metals, or, common, most, materials.

4. Find the equivalents of the following words in the text.

1) устойчивый к высокой температуре; 2) телефонная связь; 3) мелкие дефекты на поверхности; 4) проводящие электричество; 5) определенная точка начала плавления; 6) расплавленные металлы; 7) положительно заряженные частицы; 8) атомы кислорода

5. Answer the following questions

1) What are traditional ceramic materials?
2) Are ceramics tough materials?
3) What are ceramics made from?

6. Think of 5 questions of different types covering the text.

Unit 9

Vocabulary

chemical family – химическая группа
available – доступный
pressure – давление
chemical equation – химическое уравнение
chemical compound – химическое вещество
brackets – скобки
blow molding – выдувное формование
reinforcement – армирующий наполнитель
innumerable - бесчисленный
pliable – пластичный, гибкий

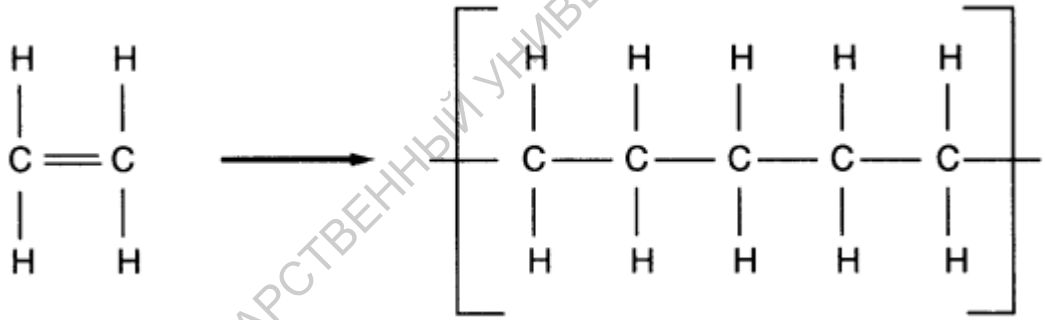
to cool – охлаждать

Polymers

As you look around, you will find plastic materials almost everywhere. Plastics are part of a *chemical family* called polymers, which also includes elastomers (rubber) and adhesives. Some polymers, such as cellulose are naturally occurring, but most are chemically synthesized using chemicals derived from petroleum, which are called petrochemicals. The main petrochemical used for making polymers is natural gas.

Petroleum is a widely used product in our world, consuming billions of gallons daily for powering everything from automobiles to motorbikes and producing other forms of power (i.e., electricity through power generation). Petrochemicals use only 5% of this *available* petroleum, and only about half of the petrochemicals go into making polymeric materials.

Polymers (poly-mers), meaning many units, are created by joining together monomers (single units, usually a *chemical compound* such as ethylene gas as demonstrated in the example), using various combinations of heat, *pressure*, and catalysts. For instance, polyethylene is created by polymerizing ethylene gas as shown in the following *chemical equation*. A combination of heat, pressure, and a catalyst cause the double bond between the two carbon atoms in the ethylene gas to break and attach to other ethylene molecules. A polyethylene molecule is thus formed.



The *brackets* in the above equation indicate that the polyethylene molecule continues out to very long lengths relative to the size of the carbon and hydrogen atoms.

Polymers have become such an integral part of our lives that most of the time they are not recognized. Of course, we all recognize plastic bags, pens, telephones, fast food containers, and other common things as plastic, but we often fail to recognize other important polymer applications such as contact lenses, clothing fabrics (Dacron, Orlon, Nylon, Spandex, and Rayon), carpet fibers, automobile tires, foam cushions in furniture and mattresses, shoe soles, paints, pipes, computer chips, and masks to produce electronic “chips,” automobile bumpers, and *innumerable* other objects. Plastics influence our lifestyle more than we could ever imagine. If we ever were to use just natural fibers (cotton and wool) instead of polymeric fibers for clothing, carpets, etc., all the available land in the United States would have to be used to raise sheep or cotton to maintain our present lifestyle.

Classification of Plastics

Thermoplastic

Basically, two types of plastics exist, thermoplastics and thermosets. Thermoplastics can be melted and reformed or reused. Typical thermal plastics include polyethylene, polypropylene, PVC, and nylon. Thermoplastics are converted to usable products by melt processing, (injection molding, extrustion, blow molding, and thermofoaming) which are explained below.

Injection molding forces melted polymer into a cold mold under pressure. When the polymer *cools*, it produces a part such as a pen barrel, a comb, a Tupperware container, a garbage can, or a refrigerator liner. Extrusion forces the melted polymer through a die to form continuous shapes such as pipe, tubing, sheet, or decorative molding. *Blow molding* uses air pressure to blow up the melted plastic like a balloon inside of a mold. When the plastic cools, it forms a bottle or other hollow shape. Thermoforming takes heated sheets of plastic and draws them into a mold with a vacuum to form such things as butter tubs, drinking glasses, small boats, and pick-up-truck bed liners.

Thermoset

Thermoset polymers “cure” or crosslink by a chemical process to become a stable material that cannot be melted. Typical thermosets include epoxy, polyester, phenolic, polyurethane, and silicone. Thermoset materials are often used with *reinforcements* such as glass, Kevlar, and carbon fibers to make strong, lightweight parts such as fiberglass boats, airplane wing panels, Corvette car bodies, skis, gasoline storage tanks, septic tanks, chemically resistant pipe, and many other things. They are also used as adhesives that can be formulated to bond almost anything.

Some thermosets are very hard and tough (bowling balls), while others are soft and *pliable* (rubber tires, balloons, baby squeeze toys). Some are used for paints and some for bonding thin sheets of wood to make plywood.

Exercises

1. **Give the definition of the following words and expressions in English**

elastomers
adhesives
chemical equation
computer chips
thermoplastic

2. Fill in the gaps with suitable words from the box.

occurring	widely	plastics	melt	force	length
combinations					

1. What I have to tell you is ……. blazed.
2. Discussion can be more effective than the use of brute …….
3. Job displacement is …… right across-the-board.
4. Certain …….. of sounds are not possible in English.
5. Some industries, for example ……..... , will evidently not be greatly affected.
6. Some fish can grow to a …….. of four feet.
7. ……. a lump of butter in your frying-pan.

3. Put the following words in the sentences into the right order.

1. influence, more, our, plastics, than, lifestyle, we, ever, could, imagine.
2. is, used, a, product, our, petroleum, in, widely, world.
3. some, and, are, hard, thermosets, very, tough.
4. the, petrochemical, main, used, natural, for, making, is, gas, polymers.
5. molding, injection, melted, cold, pressure, polymer, forces, a, mold, into, under.

4. Find the equivalents of the following words in the text.

1) существующий в природе; 2) широко используемый продукт; 3) трудно распознать; 4) два вида пластика; 5) атмосферное (воздушное) давление; 6) двойная связь; 7) химически синтезированный; 8) доступные материалы

5. Answer the following questions
1) Could you name a few things that are polymers?
2) How are polymers created?
3) How do polymers influence our lifestyle?

6. Think of 5 questions of different types covering the text.

Unit 10

Vocabulary

separately – по отдельности
automobile tire – автомобильная шина
friction force – сила трения
concrete – бетон
cohesion – межмолекулярная связь
hollow core – полый заполнитель
currently – в настоящее время

Composites

A composite material is a combination of two or more separate materials that has characteristics not shown by either of the materials *separately*. An *automobile tire*, for instance—an example of a composite material— is made of rubber reinforced by one or more types of fibers, such as nylon, rayon, steel, glass, or Kevlar. The rubber does a fine job of keeping the pressurized air inside, but would not survive the stresses imposed on it by the car as it is driven. The fibers are strong and tough, but it would be impossible for a structure made only from the fibers to hold air. Together, the materials form a composite structure that both holds air and resists stresses.

Looking more closely at the composition and structure of the tire tread, we can see that it too is a composite. The rubber provides a high *friction force*, very handy to have in the case of a car. A pure rubber tire wouldn't last very long, because the material is not very strong and becomes gummy when heated. Tiny balls of carbon known as carbon black reinforce the rubber and give it resistance to wear. Tire rubber compounds represent a trade-off between friction and durability, these factors being adjusted by the relative amounts of rubber and carbon black.

Composite materials have been around for a long time. Wood, a natural composite, is composed of cells made from cellulose fibers and bound together with a natural glue called lignin. If dried wood is examined under a microscope, the cellular arrangement becomes obvious. Although wood can be split parallel to these long cells, it is strong with the grain. The air spaces provided inside the cells of dried wood make it light in weight. This arrangement contributes to high strength at low weight and to toughness.

In the thirteenth century, the Mongols made composite bows from combinations of wood, animal tendons, silk, and adhesives. Even before that time, the Hebrew people added straw to their clay bricks to increase their durability.

Concrete is another example of a composite, and it has been made since Roman times. The rocks and sand are the reinforcement part of this composite, and the cement provides the *cohesion* that binds the structure/material together.

In addition to these "old" composites, the drive for stronger, stiffer, and lighter materials has produced many more modern composites of even higher performance such as tennis racquets, fishing poles, aircraft, space and automobile parts, and hulls of boats.

At the heart of any composite, a strong fibrous material bears the load. The fiber is constrained by the second material in the composite (the matrix) such that it takes the desired shape. Modern fishing rods are almost universally made from composites, whether the reinforcing fibers are glass, graphite, boron, or a mixture of these materials. The fibers, although strong, are not very stiff because they are very small in diameter, less than one-thousandth of an inch. By adding a matrix material, which is usually some type of epoxy in the case of the fishing rod, the fibers are tied together so that stress can be transferred from one fiber to another and so the fibers share the load. To further lighten the rod, it is made with a *hollow core* and is tapered so that the handle is thicker than the tip.

Most composites are used to make “things” that require high values of mechanical properties such as strength (resistance to breakage) or stiffness (resistance to bending) at a minimum weight. In these roles, composites can be made superior to structures made from any single material.

Modern composites use started with fiberglass in 1930, which is made from fine glass fibers bonded in most cases by polyester resin. The glass fibers are very strong in tension, and the resin helps to define the shape, bonds well to the fibers, and prevents the fibers from damaging each other by rubbing against their neighbors. Currently, many different types of fibers are available; the fibers are often quite expensive but are worth the price when the alternatives are considered. As more and more composite materials are used, the price will drop or become more compatible. Example: Some racquets, when they first came out, were $280 and now sell for $35.

A few years ago, composites were used only in parts of airplanes where their complete failure would have caused no serious problems. As confidence and reliability continues to increase, composites are being used in increasingly critical applications. *Currently*, several critical parts of passenger airliners are made from composites; some military airplanes are made largely from composites. Building the Voyager, the airplane that flew around the world without refueling in 1986, would have been impossible without modern composite materials.

Exercises

1.Give the definition of the following words and expressions in English

To damage
An alternative
fishing rod
friction force
durability

2. Fill in the gaps with suitable words from the box.

characteristics	structure	gummy	rubber	contribute	reinforce	durability

1. These genes are involved in determining the basic …….. of cells.
2. Nothing can rival cotton for ……. .
3. Congeners …….. special characteristics of taste, aroma, and colour to the beverages.
4. One of the most attractive ……. of his mind - its catholicity.
5. The …… will perish with age.
6. The depictions on paper money and coins …… national icons and symbols.
7. How did you get your hands so …… ?

3.Put the following words in the sentences into the right order.

1. composite, reinforced, by, made, rubber, material, a, of, more, one, or, types, of, is, fibers
2. rubber, high, the, a, friction, provides, force
3. the, are, fibers, glass, very, in, strong, tension
4. modern, use, with, fiberglass, in, composites, started, 1930
5. fibers, are, alternatives, quite, the, expensive, but, price, are, often, are, worth, when, the, the, considered.

4. Find the equivalents of the following words in the text.

1) Волокнистый материал; 2) разделять нагрузку; 3) механические свойства; 4) использование современных композитных материалов; 5) как доказательство; 6) небольшой в диаметре; 7) противостоять напряжению; 8) предотвратить волокна от повреждения

5. Answer the following questions

1) What is a composite material?
2) What kinds of composites are the oldest?
3) What are the peculiarities of glass fibers?

6. Think of 5 questions of different types covering the text.

Part II “Mathematics”

Unit 1

Vocabulary

to occupy – занимать (место)
human inquiry – человеческое познание
peculiar – специфичный, своеобразный
causal powers – каузальные силы
to pronounce – провозглашать
apparently – очевидно, по всей видимости
to proceed – действовать, происходить
a posteriori – апостериорный, основанный на опыте
obstinate – упрямый, своенравный
charged with – ответственный за (что-то)
the rest – другие, остальной

significance – значение, значимость, важность
on the face of it – по формальным признакам, на первый взгляд
revisable – изменяемый
crucial – ключевой, значимый
concerned with – связанный с, имеющий отношение к
acquisition – приобретение (знания)
the very – сам, именно тот
impose upon – навязываться

Mathematics and Its Philosophy

"A mathematician is a device for turning coffee into theorems"
Paul Erdös (1913–1996)

Mathematics *occupies* a unique and privileged position in human inquiry. It is the most rigorous and certain of all of the sciences, and it plays a key role in most, if not all, scientific work. It is for such reasons that the great German mathematician Carl Friedrich Gauss (1777–1855) *pronounced* mathematics to be the queen of the sciences. But the subject matter of mathematics is unlike that of any of the other branches of science. Mathematics seems to be the study of mathematical entities—such as numbers, sets, and functions—and the structural relationships between them. Mathematical entities, if there are such things, are very *peculiar*. They are abstract: they do not have spatio-temporal location and do not have *causal powers*. Moreover, the methodology of mathematics is *apparently* unlike the methodology of other sciences. Mathematics seems *to proceed* via a priori means using deductive proof, as opposed to the *a posteriori* methods of experimentation and induction found in the rest of science. And, *on the face of it* at least, mathematics is not *revisable* in the way that *the rest* of our science is. Once a mathematical theorem is proven, it stands forever. Mathematics may well be the queen of the sciences, but she would seem to be an eccentric and *obstinate* queen.

The philosophy of mathematics is the branch of philosophy *charged with* trying to understand this queen. We investigate the limits of mathematics, the subject matter of mathematics, the relationship between mathematics and *the rest* of science, the logic of mathematical proofs, and the *significance* of the language of mathematics to mathematical practice. They are significant for both philosophy and for mathematics. For example, understanding one of the paradigmatic cases of secure, a priori knowledge is *crucial* to the branch of philosophy *concerned with* knowledge and its *acquisition*: epistemology. The importance of philosophy of mathematics to mathematics is also clear. Apart from anything else, philosophy sheds light on what mathematics is about. No self-respecting branch of science should be in the position of not knowing what its primary object of study is. More importantly, it may well be that *the very* methodology of mathematics hangs on the answers to some of the philosophical questions that *impose* themselves *upon* us.

(Source: "An Introduction to the Philosophy of Mathematics")

Exercises

1. Give the definition of the following words in English.

abstract
queen
proof
language
limit

2. Fill in the gaps with suitable words from the box. Change the grammatical form if necessary.

the rest	significance	concerned with	the very	peculiar	crucial

1. The weather could be a……. factor in tomorrow's game.
2. I didn't realize the true…….. .of this comment at the time.
3. You're a bastard and thief and deserve to be locked up for ……. of your life.
4. Applicants for this post should be interested in modelling studies in atmospheric sciences…… changes in the Earth's climate.
5. We want you to be among ……..first in Britain to benefit from these developments and to enjoy them!
6. The choice of a system because of particular or …… features also needs careful consideration.

3. Put the following words in the sentences into the right order.

1. the structural entities is between study and mathematical them mathematics the of relationships
2. unlike mathematics of sciences the methodology is the methodology of other
3. what is mathematics on the light of philosophy is about branch that philosophy of mathematics the sheds

4. Find the equivalents of the following words in the text.

1) предмет изучения; 2) математические категории; 3) структурные отношения; 4) пространственно-временное положение; 5) королева наук; 6) дедуктивное доказательство; 7) проливать свет.

5. Answer the following questions.

1. Why is the mathematical methodology different from the rest of science?
2. What does the philosophy of mathematics study?

3. What is epistemology?

6. Think of 5 questions of different types covering the text.

Unit 2

Vocabulary

evidence – факт, доказательство
to perceive – воспринимать
properties - свойства
explanation – объяснение
to contribute to – делать вклад во что-то
definition - определение
to reveal – раскрывать, открывать
meaning - значение
to refer to – относиться к чему-то
embedded in smth. – содержащийся, заключенный в чем-то

The Matrix as an Introduction to Mathematics

In my classes on the nature of scientific thought, I have often used the movie The Matrix (1999) to illustrate how *evidence* shapes the reality we *perceive* (or think we perceive). As a mathematician and self-confessed science fiction fan, I usually field questions related to the movie whenever the subject of linear algebra arises, since this field is the study of matrices and their properties. So it is natural to ask, why does the movie title reference a mathematical object?

Of course, there are many possible *explanations* for this, each of which probably *contributed* a little *to* the naming decision. First off, it sounds cool and mysterious. That much is clear, and it may be that this reason is the most heavily weighted of them all. However, a quick look at the *definitions* of the word *reveals* deeper possibilities for the *meaning* of the movie's title. Consider the following definitions *related to* different fields of study taken from Wikipedia on January 4, 2010:

• Matrix (mathematics), a mathematical object generally *represented* as an array of numbers.
• Matrix (biology), with numerous meanings, often referring to a biological material where specialized structures are formed or embedded.
• Matrix (archeology), the soil or sediment surrounding a dig site.
• Matrix (geology), the fine grains between larger grains in igneous or sedimentary rocks.
• Matrix (chemistry), a continuous solid phase in which particles (atoms, molecules, ions, etc.) are embedded.

All of these point to an essential commonality: a matrix is an underlying structure in which other objects are embedded. This is to be expected, I suppose,

given that the word is derived from the Latin word referring to the womb—something in which all of us are embedded at the beginning of our existence. And so mathematicians, being the Latin scholars we are, have adapted the term: a mathematical matrix has quantities (usually numbers, but they could be almost anything) embedded in it. A biological matrix has cell components embedded in it. A geological matrix has grains of rock embedded in it. And so on. So a second reason for the cool name is that we are talking, in the movie, about a computer system generating a virtual reality in which human beings are embedded (literally, since they are lying down in pods). Thus, the computer program forms a literal matrix, one that bears an intentional likeness to a womb.

However, there are other ways to connect the idea of a matrix to the film's premise. These explanations operate on a higher level and are explicitly relevant to the mathematical definition of a matrix as well as to the events in the trilogy of *Matrix* movies. They are related to computer graphics, Markov chains, and network theory.

(Source: "Mathematics in Popular Culture")

Exercises

1. Give the definition of the following words in English

fan
Wikipedia
chemistry
Latin

2. Fill in the gaps with suitable words from the box. Change the grammatical form if necessary.

meaning	properties	possibilities	explanation	evidence	definition	quantity

1. The investigation will look for _____of financial mismanagement.
2. The police also found a large _____ of drugs in the apartment.
3. The different substances are listed in groups according to their chemical_____.
4. Children need to understand the true _____of Christmas.
5. People who do not fit the traditional _____of a refugee may not be allowed to stay in a country.
6. One possible ___ _____is that he may have forgotten that there was a meeting today.
7. His degree and job experience give him a wide range of _____ for a career.

3. Put the following words in the sentences into the right order.

1. a embedded other is structure which are matrix an in objects
2. to release led film the success of sequels the film the of two
3. for creating the was sound for Dane A. Davis the film responsible effects
4. ideas a movie Warner Bros $60 deep to create with invested philosophical million

4. Find the equivalents of the following words in the text.

a) научная мысль; b) круто и загадочно; c) различные области науки; d) основная схожесть; e) математическая матрица; f) математическое определение; g) и так далее; h) последовательность чисел; i) виртуальная реальность.

5. Answer the following questions

a) What branch of mathematics studies matrices and their properties?
b) What is the general definition of matrix given in the text?
c) What is the origin of the word “matrix”?

6. Think of 5 questions of different types covering the text.

Unit 3

Vocabulary

department - факультет, отдел
to be supposed to – предполагаться, быть должным
raw material – сырье, сырьевой материал, первичный материал
exception - исключение
to supersede – обходить, обгонять, вытеснять
even number – чётное число
odd number – нечётное число
to exist - существовать
to create – создавать
order – порядок, последовательность
external – внешний
to discover – открывать, делать открытие
to invent – изобретать
to investigate – исследовать, расследовать
fervent dispute – горячие споры
approach – подход
to argue – утверждать, доказывать, спорить
this is not the case – это не тот случай

Do mathematicians discover or invent?

Don't go around saying the world owes you a living; the world owes you nothing; it was here first.
Mark Twain, American writer and humorist, 1835–1910

A standard physics department has both theoreticians and experimentalists. Experiments *are supposed to* be the *raw material* for theories. In a mathematics *department* it is rare to find experimentalists (surprisingly enough, there are *exceptions*: in a leading Canadian university there was a Laboratory for Experimental Mathematics for some period of time). Mathematicians don't need laboratories. They do their work in an office, on a blackboard or on paper, and all they need is their minds. In this aspect they are *superseded* only by philosophers.

The president of the university visited the mathematics department. "You know," he told his hosts, "of all faculty members, I like mathematicians best. All they need is paper, a pen, and a wastebasket." Ruminating, he then added, "Philosophers are even better. They don't need the wastebasket."

Scientists study the world. What do mathematicians *investigate*? Is it something that exists in the world or the products of their feverish minds? In short, do mathematicians *discover* or *invent*? Does mathematics discover order that *exists* in the world or does it *create* the *order*? Do mathematicians construct something new, like a house, or discover something that already existed, the way Columbus discovered America? Is a concept like "*even number*" part of the *external* world, or is it only in the mind of the thinker?

This is supposed to be the subject of *fervent dispute* among mathematicians. The *approach* that says that mathematical objects are as real as chairs and tables is called "Platonism" (incidentally, the original Platonism is more extreme. Plato *argued* that the concept of the table is more real than the table itself). A bitter row is supposed to exist between Platonists and anti-Platonists. In practice *this is not the case*. The twentieth-century American mathematician Ralph Boas **claimed** that he had never met a mathematician who was not a Platonist. Almost all mathematicians believe in the reality of their objects. Numbers, geometric shapes, functions, evenness of numbers — these are all part of the actual world. Mathematics is discovery, not invention. Mathematics reveals order that is out there in the world. A concept is nothing more than mirror image in our brain of a pattern in reality. A mathematician is more of a photographer than a sculptor.

(Source: "Mathematics, Poetry and Beauty")

Exercises

1. Give the definition of the following words in English

university
laboratory
wastebasket
scientist
to believe

2. Fill in the gaps with suitable words from the box. Change the grammatical form if necessary.

exist	discover	exception	approach	order	invent	create

1. The dogs are given numbers, and stand in numerical …….while the judge looks at them.
2. Several new species of plants have recently been……. .
3. This approach has been used in South Africa to……..development corridors.
4. Various programmes also ……..... to protect mothers during pregnancy and after childbirth.
5. A cooperative and problem-solving……was the best way of defending victims.
6. Newton was the man who …… the idea of gravity.
7. The treaty was signed by all the EU member countries with one significant……: Britain.

3. Put the following words in the sentences into the right order.

1. laboratories, don't, mathematicians, need
2. department, president, of, the, the, mathematics, the, university, visited
3. of, in, reality, their, all, mathematicians, the, believe, almost, objects
4. order, the, world, that, is, reveals, there, mathematics, out, in

4. Find the equivalents of the following words in the text.

1)математический факультет; 2)ведущий университет Канады; 3) зеркальное отображение; 4) профессорско-преподавательский состав вуза; 5) лихорадочные умы; 6) американский математик 20 века; 7) геометрические формы.

5. Answer the following questions

1. Is it true that you can't find the experimentalists among mathematicians? Prove it.
2. Why did the university president say that philosophers were better than mathematitians?
3. What is the original Platonism?

6. Think of 5 questions of different types covering the text.

Unit 4

Vocabulary

seemingly – на вид, судя по виду, по-видимому
bengali literature – бенгальская литература
to instill- внушать, прививать
obstructing – затруднительный, препятствующий
feature – особенность, черта
intersections - пересечения
infinity - бесконечность
to implement – выполнять, осуществлять
embodiment – воплощение
aforementioned - вышеупомянутый
come to represent – представлять, воплощать
convergence – сходимость

What is Math Poetry?

Math and poetry are two *seemingly* contrasting areas of study. The two can be combined to form math poetry in many interesting ways, however. A poem's structure and images can be compared with or *instilled with* mathematical concepts. In addition, poetry can be used as a tool to teach math.

Some poets, like those representative of *bengali literature*, associate the structure of a poem with mathematical concepts as one form of math poetry. For example, just as a mathematical equation is often a *straightforward* formula one must follow, so a poem can offer a straightforward thought with few words and no *obstructing* language. In such structures, mathematical imagery is often still prominent, however.

Perhaps the main *feature* of math poetry is the use of mathematical imagery within the poem. Poets such as Rita Dove have popularized this practice. In one poem, this poet begins by claiming she has proven a theorem. By poem's end, she has also worked in the geometric idea of *intersections* and the concept of *infinity*. Common math symbols like multiplication and division signs or the pi symbol may or may not be featured in such poems.

Math poetry can also be used as a tool to teach mathematical concepts with humor and imagination, particularly for young children. Creative teachers have constructed poems to demonstrate everything from addition and subtraction to understanding money exchanges. One category example is equational poetry, which involves using words or images *to implement* a mathematical formula through poetic rhyme and verse. These approaches may use actual numbers or they may use descriptive ideas — such as bee plus skin equals sting — although the latter is more effective for a general idea. Some instructors may even opt for poems in place of the traditional literature story-form math problem.

Despite one's reliance on feelings and the other's reliance on logic and reason, advocates believe that mathematics and poetry can work hand-in-hand. After all, mathematical concepts are often presented in the form of words and situations, as in

the *aforementioned* word problems. Further, individuals often use poetry or other symbolic language to remember math ideas, such as creating acronyms to remember the specific order of a formula. Higher mathematics like calculus and geometry routinely merge letters and numbers as well.

One can even argue that mathematics itself — much like poetry — is a discipline of symbols. Just as a well-placed word or metaphor becomes the *embodiment* of a larger theme in poetry, so does one simple math symbol or formula *come to represent* concepts of time, movement, and reality itself. In both seemingly divergent arenas, one may find the patterns of life. Math poetry can illustrate this *convergence*.

(Source: "wiseGEEK http://www.wisegeek.com")

Exercises

1. Give the definition of the following words in English

poetry
humor
money
to remember
sting

2. Fill in the gaps with suitable words from the box. Change the grammatical form if necessary.

straightforward	equation	symbol	feature	to prove	embodiment

1) The mathematical…….should read: Peace multiplied by Love equals Infinity;
2) Since the early years of this century it has been recognized by scholars that this story had its origins in a tale about someone being attacked by the spirit or demon of the Jabbok, the…… of the great dangers involved in crossing the river at night after the rains;
3) The article was written in……., almost conversational language.
4) A main ……of this tool is the ease with which levels of information can be incorporated into the document and unfolded if desired.
5) Most of the evidence was destroyed in the fire. Thus it would be almost impossible…….him guilty.
6) The bridge was like a ……. which suddenly made me realise what is happening to that country.

3. Put the following words in the sentences into the right order.

1. to be humor can teach poetry with concepts imagination math used mathematical and
2. to mathematical poetry use often remember ideas people
3. concepts demonstrate creative different construct poems to mathematical teachers

4. Find the equivalents of the following words in the text.

1) обмен денег; 2)математическое уравнение; 3) математические образы; 4) работать рука об руку; 5) язык символов; 6) рифма и размер; 7)сложение и вычитание; 8) знаки умножения и деления.

5. Answer the following questions

1. Who is Rita Dove and how does she use mathematical imagery?
2. How is math poetry used in teaching mathematics?
3. How can math poetry be used for remembering the specific order of a formula?

6. Think of 5 questions of different types covering the text.

Unit 5

Vocabulary

requirements - требования
equation – уравнение
variable – переменная, величина
deal with – иметь дело, изучать, рассматривать
differential calculus – дифференциальное исчисление
to be eligible – иметь право
prior to enrolling – перед зачислением (на курс)
to affect – влиять
application – применение, приложение
accounting – бухгалтерский учёт
math majors – специалисты по математике

What are the Different Disciplines of Mathematics?

Mathematics includes many disciplines that have evolved throughout history. Simple examples include addition and subtraction, while extremely complex forms include chaos and games theories. Traditionally, however, the high school and early college years focus on the following disciplines.

Algebra is the gateway to most mathematics studies. Students may study algebra in 8th, 9th, or 10th grade, depending on their skills and school *requirements*. Normally, first year algebra concerns itself with the study of *equations* to find

unknown elements. Students learn how to solve equations for two to three *variables*, depending on the class.

Generally, the study of algebra is followed by the study of geometry, which is usually taken after a first year algebra course. A second year algebra course includes geometric principals. In colleges, the study of algebra is often combined with the study of geometry, and students do not take a separate course.

Most teachers start teaching basic algebraic and geometric concepts long before students actually take those classes. In many cases, students are now doing one and two-step equations solving for a variable by third or fourth grade. The familiarity with solving equations is thought to help prepare the student for working with multiple variables in first year algebra.

Students also often learn basic formulas for measuring objects, like triangles, squares, and circles, by fifth or sixth grade. This early preparation in mathematics rarely questions the "why" of a formula, but prepares the students to ask it. This question will be answered by the proofs and theorems that dictate and explain why formulas for obtaining measurements in shapes actually work.

Some students end their mathematics education with second year algebra. Many, however, go on to study trigonometry, a branch that *deals with* the principles of angles and shapes. Some feel that trigonometry is advanced geometry, while others argue it is a completely separate area of study. It has broad applications, but one most familiar to people is its use in astronomy to measure the distance of stars and planets from each other in a process called triangulation.

After trigonometry, students often study calculus, which is developed from advanced algebra and geometry. In many colleges, students can study either calculus or trigonometry as a final mathematics course. Calculus is actually two different branches: differential and integral. *Differential calculus* concerns itself with equations measuring things like distance and velocity. Integral calculus evaluates geometry with attention to real world applications, like how time or temperature might *affect* an equation.

Both forms of calculus are essential to understanding applications in major sciences like physics. In fact, in most colleges, one must at least *be eligible to* take calculus courses *prior to enrolling* in physics courses. Some advanced science courses require that one has already taken calculus, since calculus equations are fundamental to understanding the more complex aspects of a science.

Another branch of mathematics is the field of statistics and probability. Those studying economics or *accounting* must usually take a course in one or the other — or in both — to meet graduation requirements for college. Beyond these branches, there are many other sub-fields that become very specific in their applications. Math majors will pursue these courses in order to earn advanced degrees.

(Source: "wiseGEEK http://www.wisegeek.com")

Exercises

1. Give the definition of the following words in English

college
planet
astronomy
education
physics

2. Fill in the gaps with suitable words from the box. Change the grammatical form if necessary.

requirements	deal with	equation	probability
graduation	enrolling	affect	application

1. An emotional upset can…… your physical health.
2. She has fulfilled the general……of the course.
3. The problem can be written in the form of an algebraic……..
4. The scientist is looking for a practical……of his idea.
5. Women are ……. in and graduating from college in higher numbers than men and earning more of the advanced degrees.
6. After my…… from university, I immediately found a job.
7. We need sufficient time to ……the problem.
8. There is a strong …… that the problem will recur if we do not solve it now.

3. Put the following words in the sentences into the right order.

2) to solve, students, learn, equations, how
3) study, by, the, followed, of, geometry, algebra, study, is, the, of
4) basic, learn ,measuring, formulas, students, for, objects
5) branch, deals, of, angles, trigonometry, with, principles, is, a, of, mathematics, that, the

4. Find the equivalents of the following words in the text.

1) сложение и вычитание; 2) теории игр; 3) неизвестные элементы; 4) высшая геометрия; 5) требования к окончанию учебного заведения; 6) углы и формы; 7) доказательства и теоремы; 8) расстояние и скорость; 9) отдельная область науки.

5. Answer the following questions

1. Why do teachers start teaching students basic algebraic concepts long before the main course?
2. What is the difference between differential calculus and integral calculus?

3. Why is the knowledge of calculus required for advanced science courses?

6. Think of 5 questions of different types covering the text.

Unit 6

Vocabulary

outcome – исход, результат
circumstances – обстоятельства
to establish – основывать, устанавливать
seminal – основополагающий, новаторский
counter intuitive – неочевидный, парадоксальный
to predict - предсказывать
to confess – признаваться, исповедоваться
to outweigh – превосходить, перевешивать

Game theory

Game theory is a branch of mathematics that aims to lay out in some way the *outcomes* of strategic situations. It has applications in politics, inter-personal relationships, biology, philosophy, artificial intelligence, economics, and other disciplines. Originally, it attempted to look only at a fairly limited set of *circumstances*, those known as zero sum games, but in recent years its scope has increased greatly. John von Neumann is looked at as the father of modern game theory, largely for the work he laid out in his *seminal* 1944 book, *Theory of Games and Economic Behavior*, but many other theorists, such as John Nash and John Maynard Smith, have advanced the discipline.

Since game theory became *established* as a discipline in the 1940s, and since it became even more embedded in mathematics and economics through John Nash's work in the 1950s, a number of practitioners of this subject have won Nobel Prizes in Economics.

Game theory basically works by taking a complex situation in which people or other systems interact in a strategic context. It then reduces that complex situation to its most basic "game," allowing it to be analyzed and for outcomes to be *predicted*. As a result, it allows for prediction of actions that otherwise could be extremely difficult, and sometimes *counter intuitive*, to understand. One simple game most people are very familiar with is Rock, Paper, Scissors, which is used by some game theorists, although because of its lack of information it does not have a great deal of relevance on real world situations.

One of the most important examples of a widely-known game is referred to as the Prisoner's Dilemma. In this scenario, we imagine two criminals captured by the police after committing a crime, such as robbing a bank of $10 million US Dollars (USD) together. They are each placed in separate rooms, and the police ask for them *to confess*. If one prisoner confesses, while the other doesn't, the confessor is let off

free to keep the $10 million USD for themselves, while the other will go to jail for four years. If neither confess, they will both be let off for lack of evidence, and will each keep $5 million USD. If both confess, their sentences are reduced for cooperating, but they still both spend a year in jail.

The Prisoner's Dilemma is important in game theory for a number of reasons, and is expanded on to arrive at much more complex situations. The most intelligent decision to make in the situation given in the Prisoner's Dilemma is to confess, no matter what. It minimizes personal risk, and *outweighs* the personal gain of both being let off free. As with many games in game theory, this simple game can be expanded to many different situations in the real world with similar circumstances: an easy example is two businesses competing in the market, where it is in both parties' best interest to set high prices, but even better to set a low price while the competitor sets a high price.

Other famous game theory games include the Cake Cutting game, the Stag Hunt, the Dollar Auction, the Coordinators Game, the Dictator Game, and the Ultimatum Game. Games are generally separated into two categories, depending on whether they are zero-sum, meaning the gains gained by one player or group of players are equaled by the losses by others, or non-zero-sum.

(Source: "Mathematics in Everyday Life")

Exercises

1. Give the definition of the following words in English

artificial intelligence
Nobel Prize
criminal
market
price

2. Fill in the gaps with suitable words from the box. Change the grammatical form if necessary.

to expand	outcome	to establish	to predict	to confess

1. The hotel wants……to expand its business by adding a swimming pool.
2. Both sides were happy with the eventual……..outcome of the talks.
3. The city of Boerne was……established by German settlers in the 1840s.
4. Father, I'd like……to confess a sin I thought I could live with.
5. The test can accurately…….predict what a bigger explosion would do.

3. Put the following words in the sentences into the right order.

1. situations can different many in this world to be simple game expanded the real

2. taking complex theory context works in game by a situation a strategic
3. actions theory could understand game to predict that allows to the be difficult

4. Find the equivalents of the following words in the text.

1) игра с нулевой суммой; 2) камень, ножницы, бумаг; 3) совершение преступления; 4) отсутствие доказательств; 5) ряд причин; 6) устанавливать высокие цены; 7) межличностные отношения; 8) ограниченное множество.

5. Answer the following questions.

1. How does game theory work?
2. What is the scenario of the Prisoner's Dilemma?
3. What is the best decision in the Prisoner's Dilemma

6. Think of 5 questions of different types covering the text.

Unit 7

Vocabulary

upheaval - переворот
to acquire – приобретать, получать
fluency – беглость, свободное владение
frequently – часто
on one occasion - однажды
notable men – знатные люди
Cherbourg – г. Шербур
to supplant – вытеснять, занимать чье-то место
in so far as – поскольку; ввиду того, что
to turn loose (on) – отпустить, позволить наброситься (на что-то)
composition - сочинение
on the contrary – напротив, наоборот
front rank – высший класс
rival – соперник, конкурент

Augustin-Louis Cauchy *(part 1)*

Augustin-Louis Cauchy (1789–1857) was born in Paris on August 21, 1789, during a period of *upheaval* in French history. Cauchy was the eldest of six children. His childhood fell during the bloodiest period of the Revolution. He and his family had to live in the village of Arcueil. Cauchy's first teacher was his own father, Louis-Francois , who taught him and his five brothers and sisters by writing his own textbooks. In this way, Cauchy

acquired fluency in both French and Latin. At Arcueil, two men who *frequently* visited Cauchy's father were Marquis Laplace and Count Claude-Louis Berthollet (1748–1822). Before long, Laplace discovered that Cauchy had a phenomenal mathematical talent.

Lagrange, then professor at the Polytechnic, visited Cauchy's father to discuss business. *On one occasion*, when Laplace and several other *notable men* were present, Lagrange pointed to young Cauchy and said, "You see that little young man? Well! He will *supplant* all of us *in so far as* we are mathematicians." Believing that the little boy might burn himself out, Lagrange advised his father, "Don't let him touch a mathematical book till he is 17." On another occasion he said, "If you don't hasten to give Augustin a solid literary education his tastes will carry him away; he will be a great mathematician but he won't know how to write his own language." Louis-Francois took this advice to heart and gave his son a sound literary education before *turning him loose on* advanced mathematics.

At the age of 13, Cauchy entered the Central School of the Pantheon. From the beginning, Cauchy was the star of the school, winning all of the most prestigious prizes in Greek and Latin *compositions*. In 1804, Cauchy left the school, and for the next 10 months studied mathematics intensely with a good tutor. In 1805, at the age of 16, he entered the Polytechnique. In 1807, Cauchy joined the civil engineering school, completing his training in 1810. In March of 1810, Cauchy joined the military at Cherbourg and stayed there for 3 years.

Outside of his heavy duties his time was well spent. He said "Work doesn't tire me; *on the contrary* it strengthens me and I am in perfect health." He found time for research. By December of 1810, he had begun "to go over again all the branches of mathematics, from Arithmetic to astronomy." On top of all this, he still found time to instruct others, and he assisted the mayor of Cherbourg by conducting school examinations. *Yet*, he still found time for his hobbies.

At the age of 27, Cauchy had raised himself to the *front rank* of living mathematicians. His only serious *rival* was Gauss, who was 12 years older. Gauss produced the fundamental theorem of algebra in 1797, while Cauchy's memoir on the definite integral with complex-number limits was not produced until 1814. This has probably hurt the Polytechnique's printing budget; Cauchy was known for the massive length of his works, which usually ranged from 80 to 300 pages. Shortly after 1816, Cauchy became a member of the Academy of Sciences. He was also made Professor of the Polytechnique. His mathematical activity was incredible; sometimes two full length papers would be presented before the Academy in the same week. He became better known than Gauss to the mathematicians of Europe.

(Source: "Creators of Mathematical and Computational Sciences")

Exercises

1. Give the definition of the following words in English

childhood
heart
tutor

professor
education

2. Fill in the gaps with suitable words from the box. Change the grammatical form if necessary.

fluency	composition	rival	member	to acquire	frequently

1. Despite putting out her best effort, she was unable to beat her longtime tennis ……
2. In recent years she has appeared in public less……..
3. Candidates must produce a private letter and a…… each of which should be between 150 and 200 words long.
4. Students must demonstrate……. in a foreign language to earn a degree.
5. Children of Kuwaiti women married to foreigners…… Kuwaiti nationality only under special conditions.
6. Mike was a……. of the local volunteer fire brigade.

3. Put the following words in the sentences into the right order.

1. children writing father by his textbooks Cauchy's taught his own
2. writing at best Greek school was Latin best Cauchy at compositions in the and
3. time and strong for felt hobbies healthy Cauchy and found his
4. his budget of works hurt printing the massive was by Polytechnique's length

4. Find the equivalents of the following words in the text.

1) выдающийся математический талант; 2) высшая математика; 3) член академии наук; 4) пределы комплексных чисел; 5) глубокое знание словесности; 6) гражданское строительство; 7) определенный интеграл.

5. Answer the following questions.

4. When was Cauchy's mathematical talent first discovered?
5. What was Cauchy's hobby during the early 1800s?
6. How can you prove Cauchy's incredible scientific activity?

6. Think of 5 questions of different types covering the text.

Unit 8

Vocabulary

Cauchy's root test – признак сходимости Коши
ratio test – сравнительный признак (сходимости рядов)

product –произведение
inequality - неравенство
landmark paper - выдающаяся работа
fixed value – постоянная величина, заданное значение
variable - переменная
latter – последний
continuity - непрерывность
pointwise convergence – поточечная сходимость
uniform convergence – равномерная сходимость
to assert - утверждать, заявлять
prolific – плодотворный, продуктивный
unexpectedly – неожиданно
incoherently – бессвязно, непоследовательно
undeniably – несомненно, бесспорно
in any event – как бы то ни было, в любом случае

Augustin-Louis Cauchy *(part 2)*

In elementary mathematical courses Cauchy's name is remembered in *Cauchy's root test*, Cauchy's *ratio test*, Cauchy's *product*, Cauchy's *inequality*, Cauchy's integral theorem, and the Cauchy–Riemann equations (which were obtained earlier by d'Alembert in 1752). In 1815, Cauchy published a *landmark paper* in which he gave the first systematic and modern treatment of determinants. It was in this paper that $\det(AB) = \det(A)\det(B)$ for two square matrices A, B of the same size was proved for the first time in its full generality. Special cases of the theorem had been stated and proved earlier, but it was Cauchy who made the final jump.

In 1821, he defined the basic concept of the *limit* as follows: When the values successively *attributed to* a particular *variable* approach indefinitely a fixed value, so as to end by differing from it by as little as one wishes, this *latter* is called the limit of all the others. The concept of *continuity* is also due to Cauchy. He defined the *derivative* of $y = f(x)$, with respect to x, as the limit when $\Delta x \to 0$ of the difference quotient $\Delta y/\Delta x = (f(x + \Delta x) - f(x))/\Delta x$. While dealing with infinite series of functions on an interval, he made mistakes by not distinguishing between *pointwise and uniform convergences*. His most famous false theorem *asserts* that the sum-function $s(x) = f_0(x) + f_1(x) + \ldots$ of a convergent series of continuous functions $f_n(x)$ is also continuous. Cauchy's contribution to the theory of determinants is his most *prolific*. He introduced the word 'characteristic' to matrix theory by calling the equation $|A - \lambda I| = 0$ the 'characteristic equation.'

Cauchy died rather *unexpectedly* in his 68th year on May 25, 1857. A few hours before his death he was talking animatedly with the Archbishop of Paris about the charitable works he had in view; charity was one of Cauchy's lifelong interests. His last words were addressed to the Archbishop: "Men pass away but their deeds abide." Long after his death, Cauchy was severely criticized for *overproduction* and hasty composition. Some writers praise his teaching, but others say he rambled *incoherently*, and according to one report of his day, he once devoted an entire lecture

to extracting the square root of 17 to ten decimal places by a method well known to his students. One year Cauchy started his calculus course with 30 students and all but one dropped out. *In any event*, Cauchy is *undeniably* one of the greatest minds in the history of mathematics.

(Source: "Creators of Mathematical and Computational Sciences")

Exercises

1. Give the definition of the following words in English

charity
to praise
to criticize
mistake
lecture

2. Fill in the gaps with suitable words from the box. Change the grammatical form if necessary.

infinite	inequalities	coherent	overproduction	prolific	to expect

1) The highest price was in 2001 and the lowest in 2002 and 2003, which can be explained by the…….. of wheat after the good season of 2001;
2) He has proposed a new system designed to remove…….. in health care.
3) Holocaust denier David Irving is a …… writer who has written many books on themes related to World War II and the Third Reich.
4) They need strong partners, strategic vision and a……., more comprehensive approach.
5) Sometimes very small investments can release enormous,……potential that exists in all of us.
6) They……. a noticeable improvement in sales of new computers.

3. Put the following words in the sentences into the right order.

1. for function of his theory famous complex is Cauchy most development
2. large to writings into century it volumes almost a collect Cauchy's took 27
3. theory made a significant Cauchy to determinants of contribution the

4. Find the equivalents of the following words in the text.

1) бесконечный ряд функций; 2) квадратная матрица; 3) характеристическое уравнение; 4) квадратный корень; 5) с точностью до десяти знаков после запятой; 6) оживленно разговаривать.

5. Answer the following questions.

1. What theorem was completely proved by Cauchy in 1815?
2. Were Cauchy's theorems always true?
3. Why was Cauchy criticized after his death?

6. Think of 5 questions of different types covering the text.

Unit 9

Vocabulary

to increase – увеличивать, повышать
series- ряд, последовательность
amount - количество
value – значение
to guess – догадываться
crucial – решающий, критический (момент)
if, say – если, скажем…
to consume – употреблять
House of Commons – Палата общин (одна из палат парламента)
Budget speech – доклад о бюджете
valuable - ценный
to eliminate – исключать, ликвидировать
to obtain - получать
pre-determined – заранее определенный
to expire – заканчиваться, истекать (о сроке)
utility – полезность, практичность
reluctant – делающий с неохотой, сопротивляющийся

Who Wants to Be a Millionaire?

A contestant, David, faces a series of up to twelve quiz questions, the correct answer being one of four possibilities displayed. A correct answer *increases* the *amount* won, an incorrect answer ends the game. David has several "lifelines"—ways of getting assistance—each of which can be used at most once. We assess their *value* below. Having seen the question, the answers, even after using some lifelines, David can opt to take the amount won before he saw that question. If he is uncertain of the answer, how should he decide what to do?

The twelve possible winning amounts range from £500 to £1,000,000, with two "safe havens" at £1000 and £50,000. If David gives an incorrect answer after reaching one of these amounts, his game ends, but he wins the amount in the highest safe haven reached. Earlier, we introduced the notion of *utility* as an aid when deciding whether *to guess*, or to end the game and take a sure amount.

His prior wealth is *crucial* in constructing his own utility function. If he is of modest means and, having reached £20,000, he is only about 60 % confident of his answer to the £50,000 question, he should probably take that £20,000, rather than risk losing £19,000 of it; but if he is better off, and that loss would not be a disaster, the potential gains if his favoured answer is valid could be decisive.

How valuable are his lifelines? With Ask the Audience, each of the 200 or so members of the studio audience votes for their favoured option. *If, say*, one of the four options gains even 50% of the votes, and no other choice has more than 20%, that is strong evidence that the most popular choice is indeed correct; but a 55 – 45 split between two choices would be far less reliable. But be warned: once, over 80% of the audience wrongly claimed that alcohol could be *consumed* in the *House of Commons* during the State Opening of Parliament (it is only permitted during the Budget speech).

In Fifty-fifty, two incorrect alternatives are removed, leaving one wrong answer and the correct answer. This can be decisively helpful—David may know that the remaining wrong answer in incorrect—but it is completely unhelpful if he had already mentally discarded the two choices removed. This option would be very *valuable* at the first question after a safe haven, if David cannot *eliminate* any of the four choices: here it can never be wrong to offer some answer, and the opportunity to guess between two choices, rather than four, is very attractive.

With Phone-a-Friend, David may select one of several *pre-determined*, isolated, "friends", and have some 30 seconds *to obtain* help over the phone. He must be brisk, or his time will *expire*. This lifeline raises an interesting point: if the friend's help is the main factor in getting the correct answer, how much money, in fairness, should David give his friend as a reward? Discuss!

At later stages of the game, one opportunity to Switch to a completely new question may be offered. The questions tend to get more difficult as the game progresses, and he will have some reasonable idea of his objective chance of answering questions at that level—maybe 80% at earlier stages, 40% now. Whatever that current figure is, he should be *reluctant* to Switch if he thinks his chance with the actual question exceeds it, as Switching would be expected to make matters worse.

(Source:" Mathematics in Everyday Life")

Exercises

1. Give the definition of the following words in English

game
disaster
Parliament
alcohol
friends

2. Fill in the gaps with suitable words from the box. Change the grammatical form if necessary.

to expire	amount	valuable	to obtain	to increase	to eliminate

1. We strongly believe that elected members can make a very…….. contribution.
2. The certificate of airworthiness for the aircraft presented to the Panel shows that it…… on 31 December 2003.
3. The physician…….. the dosage from one to four pills.
4. One "bit" is the smallest…….. of data which can exist, and corresponds to the answer to a yes-or-no question.
5. The role of the working group is……. information on social and financial consequences of the financial crisis
6. Serious efforts are being undertaken…….. any form of such abuse.

3. Put the following words in the sentences into the right order.

1. game an television is British millionaire international origin show of
2. David by was show of created the format the Briggs
3. game questions increasingly asked knowledge are general contestants difficult
4. television of game shows popular in history one became the show the most

4. Find the equivalents of the following words in the text.

1) совершенно бесполезный; 2) «несгораемая сумма»; 3) очень привлекательн(ый,ая); 4) функция полезности; 5) убедительное доказательство; 6) гораздо менее надежные; 7) предпочтительный ответ; 8) справедливости ради.

5. Answer the following questions.

1. What happens if you give the wrong answer after reaching one of the safe havens?
2. Is *Ask the Audience* lifeline always reliable? Why?
3. What is the best moment in the game to use *Fifty-fifty* lifeline? Why?

6. Think of 5 questions of different types covering the text.

Unit 10

Vocabulary

wide range – широкий выбор, целый ряд
opportunities - возможности
military – военное дело

diverse – разнообразный
to rely on – полагаться на (что-то)
degree – степень
accuracy – точность
precision – прецизионность
to accomplish – выполнять, достигать
as such – соответственно, в этой связи
variety – ряд, множество, разнообразие
primarily – изначально, первоначально
to tend to– иметь тенденцию, стремиться, обычно
to involve – включать, содержать
academic community – научное сообщество
in and of itself – сам по себе, как таковой
application – применение
such as – такой как
substantial amount – значительное количество

What are the different types of mathematics career opportunities?

There is a *wide range* of mathematics career *opportunities* in fields as *diverse* as education, engineering, *military*, and social sciences. Many modern fields *rely on* a *degree* of *accuracy* and *precision* that can only be *accomplished* through mathematical work while many others rely on the compilation and analysis of statistics. *As such*, there are many mathematics career opportunities for those who are skilled in a *variety* of facets of mathematics. Even some careers that are not *primarily* based in mathematics, such as computer science, biomedical research, and environmental science occasionally offer positions for mathematically inclined individuals. Mathematics career opportunities beyond "pure" academic mathematics are often interesting because they provide specific real-world problems for people with mathematics skills to work to solve.

Many individuals who primarily studied mathematics during their higher education favor mathematics career opportunities based in academia. Such careers *tend to involve* conducting and publishing research regarding problems and methods that are of interest to the mathematical *academic community*. Those who pursue mathematics career opportunities in academia are also generally expected to teach several classes each year. This career path is good for those who are primarily interested in mathematics *in and of itself* rather than its *application* to other fields and problems. This path may also offer the opportunity to work in a variety of fields such as physics, economics, and computer science over the course of one's academic career.

Other people pursue mathematics career opportunities that have particular goals beyond simply advancing the field itself. Many people, for instance, choose to study economics as well as mathematics in order to go into a finance-related career. Others are more interested in applying mathematics to achieving a greater understanding of the workings of the world. Scientific fields such as chemistry and

physics are great for this, as there are many unsolved mathematical issues in both fields. Such mathematics career opportunities are most appropriate for people who are skilled at mathematics but who are interested in broader conceptual problems.

Still other mathematics career opportunities primarily involve solving specific practical problems, such as plotting flight trajectories or making engineering-related measurements. Fields *such as* aeronautics, engineering, telecommunications, and optics all tend to involve a *substantial amount* of mathematical work. Mathematicians can find profit and interesting and varied project-based work in such careers. They may also get the opportunity to learn non-mathematical skills relevant to the particular fields in which they choose to work.

(Source: "wiseGEEK http://www.wisegeek.com")

Exercises

1. Give the definition of the following words in English

research
career
opportunity
profit
economics

2. Fill in the gaps with suitable words from the box. Change the grammatical form if necessary.

degree	application	variety	to accomplish	military	involve	opportunity

1. Researchers took care to include a ……. of women in their study.
2. They wanted to join the…….to defend their country.
3. Visitors will have a unique …….to see how the programme is made.
4. For many jobs you need to have a university…….. .
5. The scientist is looking for a practical……. of his idea.
6. There are several different ways …… the same task.
7. The teacher……. her students in the project.

3. Put the following words in the sentences into the right order.

1. a mathematics are applied for the what job prospects career in ?
2. opportunities with program many business has career provided me management
3. schools are criminal there math different offering a for requirements in different degree justice
4. products of your provide range for services and we a wide convenience

4. Find the equivalents of the following words in the text.

1) математические навыки; 2) исследования в области биомедицины; 3) научные направления; 4) карьерный путь; 5) работа, связанная с финансами; 6) практические задачи; 7) высшее образование; 8) деятельность, основывающаяся на проектах; 9) нерешённые математические проблемы.

5. Answer the following questions

1. What fields of study offer positions for those skilled in mathematics?
2. What kind of professional activity is typical for those who pursue mathematics career opportunities in academia?
3. What are the career opportunities for those interested in applied mathematics?

6. Think of 5 questions of different types covering the text.