Part I. Mathematics through the Ages

Text 1. Counting in the Early Ages

Counting is the oldest of all processes. It goes back to the very dawn of human history. At all times and practically in all places, people had to think of supplies of food, clothing and shelter. There was often not enough food or other things. So, even the most primitive people were always forced to think of how many they were, how much food and clothing they possessed, and how long all those things would last. These questions could be answered only by counting and measuring.

How did people count in the dim and distant past, especially when they spoke different languages? Suppose you wanted to buy a chicken from some poor savage tribe. You might point toward some chickens and then hold up one finger. Or, instead of this, you might put one pebble or one stick on the ground. At the same time, you might make a sound in your throat, something like *ung*, and the savages would understand that you wanted to buy one chicken.

But suppose you wanted to buy two chickens or three bananas, what would you do? It would not be hard to make a sign for the number *two*. You could show two fingers or point to two shoes, to two pebbles, or to two sticks.

For *three* you could use three fingers or three pebbles, or three sticks. You see that even though you and the savages could not talk to one another, you could easily make the numbers *one*, *two*, and *three* known. It is a curious fact that much of the story of the world begins right here.

Have you ever tried to imagine what the world would be like if no one had ever learned how to count or how to write numerals? We are so in the habit of using numbers that we rarely think of how important they are to us.

For example, when we open our eyes in the morning, we are likely, first of all, to look at the clock, to see whether it is time to get up. But if people had never learned to count, there would be no clocks. We would know nothing of hours or minutes, or seconds. We could tell time only by the position of the sun or the moon in the sky; we could not know the exact time under the best conditions, and in stormy weather, we could only guess whether it was morning or noon, or night.

The clothes we wear, the houses we live in, and the food we eat, all would be different if people had not learned how to use numbers. We dress in the morning without stopping to think that the materials of which our clothing is made have been woven on machines adjusted to a fraction of an inch. The number and height and width of the stair steps on which we walk were carefully calculated before the house was built. In preparing breakfast, we measure so many cups of cereal to so many cups of water; we count the minutes it takes to boil the eggs, or make the coffee.

When we leave the house, we take money for bus fare unless we walk and for lunch unless we take it with us; but if people could not count, there would be no money. All day long, we either use numbers ourselves or use things that other people have made by using numbers.

It has taken people thousands of years to learn how to use numbers, or the written figures, which we call *numerals.* For a long time after men began to be civilized, such simple numbers as *two* and *three* were all they needed. For larger numbers, they used words in their various languages which correspond to expressions, such as *lots* of people, a *heap* of apples, a *school* of fish, and *a flock* of sheep. For example, a study of thirty Australian languages showed no number above *four*, and in many of these languages there were number names for only *one* and *two,* the larger numbers being expressed simply as *much* and *many.*

You must have heard about the numerals, or number figures, called *digits.* The Latin word *digiti* means *fingers.* Because we have five fingers on each hand, people began, after many centuries, to count by fives. Later, they started counting by tens, using the fingers of both hands. Because we have ten toes as well as ten fingers, people counted fingers and toes together and used a number scale of twenty. In the English language, the sentence "The days of a man's life are three score years and ten" the word *score* means twenty (so, the life span of humans was considered to be seventy).

Number names were among the first words used when people began to speak. The numbers from one to ten sound alike in many languages. The name *digits* was first applied to the eight numerals from 2 to 9. Nowadays, however, the first ten numerals, beginning with 0, are usually called the digits.

It took people thousands of years to learn to write numbers, and it took them a long time to begin using signs for the numbers; for example, to use the numeral 2 instead of the word *two.*

When people began to trade and live in prosperous cities, they felt a need for large numbers. So, they made up a set of numerals by which they could express numbers of different values, up to hundreds of thousands.

People invented number symbols. To express the number *one,* they used a numeral like our 1. This numeral, probably, came from the lifted finger, which is the easiest way of showing that we mean *one.*

The numerals we use nowadays are known as Arabic. But they have never been used by the Arabs. They came to us through a book on arithmetic which was written in India about twelve hundred years ago and translated into Arabic soon afterward. By chance, this book was carried by merchants to Europe, and there it was translated from Arabic into Latin. This was hundreds of years before books were first printed in Europe, and this arithmetic book was known only in manuscript form.

When people began to use large numbers, they invented special devices to make computation easier. The Romans used a counting table, or abacus, in which units, fives, tens and so on were represented by beads which could be moved in grooves. They called these beads *calculi,* which is the plural of *calculus,* or pebble. We see here the origin of our word *calculate.* In the Chinese abacus, the calculi slid along on rods. In Chinese, this kind of abacus is called a *suan* – pan; in Japanese it is known as the *soroban* and in the Russian language as the *s'choty.* The operations that could be rapidly done on the abacus were addition and subtraction. Division was rarely used in ancient times. On the abacus, it was often done by subtraction; that is, to find how many times 37 is contained in 74, we see that 74 – 37 = 37, and 37 – 37 = 0, so that 37 is contained twice in 74.

Our present method, often called *long division,* began to be used in the 15^{th} century. It first appeared in print in Calandri's arithmetic, published in Florence, Italy, in 1491, a year before Columbus discovered America.

The first machines that could perform all the operations with numbers appeared in modern times and were called *calculators.* The simplest types of calculators could give results in addition and subtraction only. Others could list numbers, add, subtract, multiply and divide. Many types of these calculators were operated by electricity, and some were so small that they could be easily carried about by the hand.

The twentieth century was marked by two great developments. One of these was the capture of atomic energy. The other is a computer. It may be rightly called the Second Industrial Revolution.

What is a computer? A computer is a machine that can take in, record, and store information, perform reasonable operations and put out answers. Such a machine must have a program, and specialists are needed to write programs and operate these machines.

Phonetics

1. Read the following words according to the transcription.

Arabic [ˈærəbik] – арабский
Arabs [ˈærəbz] – арабы
arithmetic [əˈriθmətik] – арифметика
arithmetic = arithmetical, *adj*. [ˌæriθˈmetik] – арифметический
calculate [ˈkælkjuleit] – вычислять
abacus [ˈæbəkəs] – счёты
calculator [ˈkælkjuleitə] – вычислитель, калькулятор
Chinese [ʧaiˈni:z] – китайский
Columbus [kəˈlʌmbəs] – Колумб
Calandri [kɑ:ˈlɑ:ndri] – Каландри
record [riˈkɔ:d] – записывать
reasonable [ˈri:znəbl] – разумный
manuscript [ˈmænjuskript] – рукопись

2. Transcribe the following words:
Clothes, civilized, woven, thousands, program, specialist, century, development

Vocabulary

3. Give the English for the four basic operations of arithmetic: *сложение, вычитание, умножение, деление.*

4. Supply the corresponding nouns for the following verbs. See the model.
Model*: to invent – invention*

to add; to subtract; to multiply; to explain; to calculate; to operate; to compute; to translate; to inform; to expect.

5. Give derivatives for the following words.

Model: *rare, rarely, rarity*

to measure; to perform; to suppose; to use; difference; symbolic; computer; to imagine; to vary; to develop; to publish; to prosper; expressive; high; wide; to prepare.

6. Match the following.

1. distant past	a) определять время
2. to tell time	b) далёкое прошлое
3. to perform operations	c) точное время
4. exact time	d) выполнять операции
5. rarely	e) изобретать
6. to invent	f) редко
7. digit	g) хранить информацию
8. to store information	h) однозначное число
9. to record	i) приспособление
10. device	j) записывать
11. ancient times	k) процветать
12. to prosper	l) древние времена
13. abacus	m) счётная доска
14. to print	n) счёты
15. counting table	o) печатать

7. Supply antonyms for the following words.

Subtract, before, hard, unknown, begin, unlikely, unimportant, alike, intentionally, small, ancient times, first, long, simple, easy, past, rapidly, often.

8. Find synonyms in the text.

To make *calculation* easier
to *do* operations
to *show* one finger
the *etymology* of the word *calculate*
to be *quickly* done
to be *seldom* used
no number *larger* than *four*
to be marked by two great *achievements*
first *printed* in Italy.

Grammar

9. Fill in each blank with an appropriate preposition: ***of, to, in, at, through, with, on***. **One preposition can be used several times.**

… our modern world, mathematics is related … a very large number … important human activities. Make a trip … any modern city, look …the big houses, plants, laboratories, museums, libraries, hospitals and shops, … the system … transportation and communication. You can see that there is practically nothing … our modern life which is not based … mathematical calculations. … co-operation … science, mathematics made possible our big buildings, railroads, automobiles, airplanes, spaceships, subways and bridges, artificial human organs, surgical operations and means of communication that in the past seemed fantastic and could never be dreamt … .

Text Comprehension

10. Answer the following questions:

1. What is the text about?
2. What signs did people use instead of numerals?
3. What is the role of numerals in our life?
4. What numbers sound alike in many languages?
5. What number names is the word *digit* applied to?
6. How long has it taken people to learn to use numbers?
7. What is a numeral?
8. How did the first arithmetic book appear in Europe?
9. What numbers were the most important for people in the remote past?
10. What devices did they invent to make computation easier?
11. What operations were done on the abacus?
12. When did long division appear?
13. What were the first counting machines called?
14. Could they perform all basic operations of arithmetic?
15. What development was the next step in counting?

Text 2. What is Mathematics?

Mathematics is the product of many lands and it belongs to the whole of mankind. We know how necessary it was even for the early people to learn to count and to become familiar with mathematical ideas, processes and facts. In the course of time, counting led to *arithmetic* and measuring led to *geometry*. *Arithmetic* is the study of number, while *geometry* is the study of shape, size and position. These two subjects are regarded as the foundations of mathematics.

It is impossible to give a concise definition of mathematics as it is a multifield subject. Mathematics in the broad sense of the word is a peculiar form of the general process of human cognition of the real world. It deals with the space forms and quantity relations abstracted from the physical world.

Contemporary mathematics is a mixture of much that is very old and still important (e. g., counting, the Pythagorean theorem) with new concepts such as sets, axiomatics, structure. The totality of all abstract mathematical sciences is called *Pure Mathematics*. The totality of all concrete interpretations is called *Applied Mathematics*. Together they constitute *Mathematics* as a science.

One of the modern definitions of mathematics runs as follows: mathematics is the study of relationships among quantities, magnitudes, and properties of logical operations by which unknown quantities, magnitudes and properties may be deduced.

In the past, mathematics was regarded as the science of *quantity*, whether of magnitudes, as in geometry, or of numbers, as in arithmetic, or the generalization of these two fields, as in algebra. Toward the middle of the 19th century, however, mathematics came to be regarded increasingly as the science of *relations,* or as the science that draws necessary conclusions. The latter view encompasses mathematical or symbolic logic, the science of using symbols to provide an exact theory of logical deduction and inference based on definitions, axioms, postulates, and rules for combining and transforming positive elements into more complex relations and theorems.

Phonetics

1. Read the following words according to the transcription.

Processes [ˈprousəsiz] – процессы
algebra [ˈælʤibrə] – алгебра
geometry [ʤɪˈɔmitri] – геометрия
cognition [kəgˈniʃən] – познание
deduce [diˈdju:s] –выводить (*заключение, следствие, формулу*)
encompass [inˈkʌmpəs] – заключать
symbolic [simˈbɔlik] – символический
deduction [diˈdʌkʃən] – вычитание
inference [ˈinfərəns] – вывод, заключение
postulate [‘pɔstjulit] – постулат
axiom [ˈæksiəm] – аксиома
theorem [ˈθiərəm] – теорема

Vocabulary

2. Match the words on the left with their translation on the right.

1. foundations	a) наука о
2. concise	b) измерение (*действие*)
3. the study of	c) прикладной
4. measuring	d) совокупность
5. to deal with	e) краткий
6. applied	f) основы
7. pure	g) множества
8. contemporary	h) понятие
9. concept	i) теоретический
10. mixture	j) рассматривать
11. to transform	k) величина
12. to regard	l) количество
13. to constitute	m) преобразовывать
14. magnitude	n) современный
15. sets	o) изучать
16. quantity	p) основы

Text Comprehension

3. Complete the following sentences

1. Contemporary mathematics is a mixture of …
2. In the past, mathematics was regarded as …
3. Toward the middle of the 19^{th} century, mathematics …
4. Mathematics deals with the space forms and quantity relations …
5. Arithmetic is the study of …
6. Geometry is the study of …
7. Mathematics is the product of …
8. One of the modern definitions of mathematics …

4. Copy out:

a) key words from each paragraph of the text;
b) sentences that convey the main idea of every paragraph.

5. Answer the following questions.

1. What two subjects did counting lead to?
2. What is mathematics in the broad sense of the word?
3. What does it deal with?
4. What is *Pure Mathematics?*
5. How is *Applied Mathematics* defined?
6. What is one of the modern definitions of mathematics?
7. How was mathematics interpreted in the past?
8. What is it considered to be now?

6. Read the text below and say if you share the views of the author.

Mathematics and Art

Mathematics and its creations belong to art rather than science. It is convenient to keep the old classification of mathematics as one of the sciences, but it is more appropriate to call it an art or a game. Unlike the sciences, but like the art of music or a game of chess, mathematics is foremost a free creation of the human mind. Mathematics is the sister, as well as the servant of the arts and is touched with the same genius.

In the age when specialization means isolation, a layman may be surprised to hear that mathematics and art are intimately related. Yet, they are closely identified from ancient times. To begin with, the visual arts are *spatial* by definition. It is, therefore, not surprising that geometry is evident in classic architecture or that the ruler and compass are as familiar to the artist as to the artisan.

Artists search for ideal proportions and mathematical principles of composition. Many trends and traditions in this search are mixed.

Mathematics and art are mutually indebted in the area of *perspective* and *symmetry* which express relations only now fully explained by the mathematical *theory of groups*, a development of the last centuries.

From the science of number and space, mathematics becomes the science of all *relations*, of *structure* in the broadest sense. A mathematician, like a painter or a poet, is a maker of *patterns*. The mathematician's patterns, like the painter's or the poet's, must be beautiful; the ideas, like the colours or the words, must fit together in a harmonious way. Beauty and elegance is the true test for both. The revolutions in art and mathematics only deepen the relations between them. It is a common observation that the emotional drive for creation and the satisfaction from success are the same, whether one constructs an object of art or a mathematical theory.

7. Make a summary of the text *Mathematics and Art* focusing on the following questions.

1. What do mathematics and art have in common?
2. How were mathematics and art related in ancient times?
3. What do artists search for in their creative activities?
4. Do mathematics and art both deal with perspective and symmetry?
5. What mathematical theory explains the relations expressed by these two notions?
6. Does art, like science, also deal with relations and structure?
7. Do patterns exist both in mathematics and art?
8. Do the laws of creation equally apply to the creative processes in mathematics and art?

Grammar

8. Fill in each blank with an appropriate preposition*: in, to, among, of, for, into, at.* One preposition may be used several times.

1. Mathematics ranks … the highest cultural developments … man.
2. Mathematical reasoning is … the highest level known …man.
3. Mathematical style aims … brevity and perfection.
4. Arithmetic, geometry, and astronomy were to the classical Greece music … the soul and art … the mind.
5. Most mathematicians claim that there is great beauty … their science.
6. …1933, George Birkhoff, one … the most distinguished mathematicians … his generation, attempted to apply mathematics … art.
7. Joseph Fourier showed that all sounds, vocal and instrumental, simple and complex, are completely describable … mathematical terms.
8. Each musical sound, however complex, is merely a combination … simple sounds.
9. Thus, thanks … Fourier, the nature … musical sounds is now clear … us.
10. The role of mathematics … music stretches even …the composition itself.
11. Masters, such as Bach, constructed and advocated vast mathematical theories … the composition … music.
12. … such theories, cold reason rather than feeling and emotions produce the creative pattern.
13. Through Fourier's theorem, music leads itself perfectly … mathematical description.

14. Hence, the most abstract … the arts can be transcribed … the most abstract … the sciences.

Text 3. Four Basic Operations of Arithmetic

There are four basic operations of arithmetic. They are: *addition, subtraction, multiplication* and *division.* In arithmetic, an operation is a way of thinking of two numbers and getting one number. An equation like 3 + 5 = 8 represents an operation of *addition*. Here you add 3 and 5 and get 8 as a result. 3 and 5 are *addends (*or *summands*) and 8 is the *sum.* There is also a plus (+) sign and a sign of equality (=). They are mathematical symbols.

An equation like 7 – 2 = 5 represents an operation of *subtraction.* Here 7 is the *minuend* and 2 is the *subtrahend.* As a result of the operation, you get the *difference*. There is also the mathematical symbol of the minus (-) sign. We may say that subtraction is the inverse operation of addition since 5 + 2 = 7 and 7 – 2 = 5.

The same may be said about division and multiplication, which are also inverse operations.

In *multiplication,* there is a number that must be multiplied. It is the *multiplicand.* There is also a *multiplier.* It is the number by which we multiply. If we multiply the multiplicand by the multiplier, we get the *product* as a result. In the equation 5 × 2 = 10 (five multiplied by two is ten) *five* is the multiplicand, *two* is the multiplier, *ten* is the product; (×) is the multiplication sign.

In the operation of *division,* there is a number that is divided and it is called the *dividend* and the number by which we divide that is called the *divisor.* When we are dividing the dividend by the divisor, we get the *quotient.* In the equation 6 : 2 = 3, *six* is the *dividend* , *two* is the divisor and *three* is the *quotient*; (:) is the division sign.

But suppose you are dividing 10 by 3. In this case, the divisor will not be contained a whole number of times in the dividend. You will get a part of the dividend left over. This part is called the *remainder.* In our case, the remainder will be 1. Since multiplication and division are inverse operations, you may check division by using multiplication.

Phonetics

1. Read the following words according to the transcription.

Addition [əˊdiʃən] – сложение
subtraction [səbˊtrækʃən] – вычитание
multiplication [ˏmʌltipliˊkeiʃən] – умножение
division [diˊviʒən] – деление
addend [əˊdend] – слагаемое суммы
summand [ˊsʌ mənd] – слагаемое суммы (любой член суммы)
minuend [ˊminjuend] – уменьшаемое
subtrahend [ˊsʌbtrəhend] – вычитаемое
inverse [inˊvə:s] – обратный
multiplier [ˊmʌltiplɑiə] – множитель

multiplicand [ˌmʌltipliˈkænd] – множимое
dividend [ˈdividənd] – делимое
divisor [diˈvɑizə] – делитель
equation [ɪˈkweiʃən] – уравнение
quotient [ˈkwəuʃənt] – частное

Text Comprehension

2. Answer the following questions.

1. What are the four basic operations of arithmetic?
2. What mathematical symbols are used in these operations?
3. What are inverse operations?
4. What is the remainder?
5. How can division be checked?

Vocabulary

3. Give examples of equations representing the four basic operations of arithmetic and name their constituents.

4. Match the terms in Table A with their Russian equivalents in Table B.

Table A	Table B
1. addend	a) уменьшаемое
2. subtrahend	b) слагаемое
3. minuend	c) частное
4. multiplier	d) уравнение
5. multiplicand	e) делимое
6. quotient	f) множимое
7. divisor	g) остаток
8. dividend	h) обратное действие
9. remainder	i) делитель
10. inverse operation	j) вычитаемое
11. equation	k) разность
12. product	l) произведение
13. difference	m) множитель

5. Read the following equations aloud. Give examples of your own.

Model:

9 + 3 = 12 (nine plus three is twelve)
10 – 4 = 6 (ten minus four is six)
15 × 4 = 60 (fifteen multiplied by four is sixty)
50 : 2 = 25 (fifty divided by two is twenty five)

1. 16 + 22 = 38
2. 280 – 20 = 260
3. 1345 + 15 = 1360

4. 2017 – 1941 = 76
5. 70 × 3 = 210
6. 48 : 8 = 6
7. 3419 × 2 = 6838
8. 4200 : 2 = 2100

6. The italicized words are all in the wrong sentences. Correct the mistakes.

1. *Multiplication* is an operation inverse of subtraction.
2. The product is the result given by the operation of *addition.*
3. The part of the dividend which is left over is called the *divisor.*
4. *Division* is an operation inverse of addition.
5. The difference is the result of the operation of *multiplication*.
6. The quotient is the result of the operation of *subtraction.*
7. The sum is the result of the operation of *division.*
8. *Addition* is an operation inverse of multiplication.

Grammar

7. Turn from *Active* into *Passive.*

Model:

1. Scientists *introduce* new concepts by rigorous definitions.
New concepts *are introduced* by rigorous definitions.
2. Mathematicians *cannot define* some notions in a precise and explicit way.
Some notions *cannot be defined* in a precise and explicit way.

1. People often use this common phrase in such cases.
2. Even laymen must know the foundations, the scope and the role of mathematics.
3. In each country, people translate mathematical symbols into peculiar spoken words.
4. All specialists apply basic symbols of mathematics.
5. You can easily verify the solution of this equation.
6. Mathematicians apply abstract laws to study the external world of reality.
7. A mathematical formula can represent interconnections and interrelations of physical objects.
8. Scientists can avoid ambiguity by means of symbolism and mathematical definitions.
9. Mathematics offers an abundance of unsolved problems.
10. Proving theorems and solving problems form a very important part of studying mathematics.
11. At the seminar, they discussed the recently published article.
12. They used a mechanical calculator in their work.
13. One can easily see the difference between these machines.
14. They are checking the information.

15.The researchers have applied new methods of research.
16.They will have carried out the experiment by the end of the week.

Text 4. Algebra

The earliest records of advanced, organized mathematics date back to the ancient Mesopotamian country of Babylonia and to the Egypt of the 3rd millennium BC. Ancient mathematics was dominated by arithmetic, with an emphasis on measurement and calculation in geometry and with no trace of later mathematical concepts such as axioms or proofs.

It was in ancient Egypt and Babylon that the history of algebra began. Egyptian and Babylonian mathematicians learned to solve linear and quadratic equations as well as indeterminate equations whereby several unknowns are involved.

The Alexandrian mathematicians Hero of Alexandria and Diophantus continued the traditions of Egypt and Babylon, but Diophantus' book *Arithmetica* is on a much higher level and gives many surprising solutions to difficult indeterminate equations.

In the 9th century, the Arab mathematician Al-Khwarizmi wrote one of the first Arabic algebras, and at the end of the same century, the Egyptian mathematician Abu Kamil stated and proved the basic laws and identities of algebra.

By medieval times, Islamic mathematicians had worked out the basic algebra of polynomials; the astronomer and poet Omar Khayyam showed how to express roots of cubic equations.

An important development in algebra in the 16th century was the introduction of symbols for the unknown and for algebraic powers and operations. As a result of this development, Book 3 of *La geometria* (1637) written by the French philosopher and mathematician Rene Descartes looks much like a modern algebra text. Descartes' most significant contribution to mathematics, however, was his discovery of analytic geometry, which reduces the solution of geometric problems to the solution of algebraic ones.

Phonetics

1. Read the following words according to the transcription.

Ancient [ˈeinʃənt] – древний
Mesopotamian [ˏmesəpəˈteimjən] – месопотамский
Babylonian [bæbiˈləunjən] –вавилонский
Egypt [ˈi:gipt] – Египет
Egyptian [ɪˈʤipʃən] – египетский
Alexandria [æligˈzɑ:ndriə] – Александрия
Diophantus [dɑiˈɔfəntəs] – Диофант
Al-Khwarizmi [ˈæl kəˈrizmi] – Аль Каризми
Abu Kamil [ɑ:ˈbu: kəˈmil] – Абу Камиль
Islamic [izˈlæmik] –мусульманский
Omar Khayyam [ɔuˈmɑ: keiˈæm] – Омар Хайям

Persian [ˊpə:ʃən] – персидский
polynomial [pɔliˊnɔumjəl] – многочлен
astronomer [əsˊtrɔnəmə] – астроном
algebraic [ælʤiˊbreiik] – алгебраический
philosopher [fiˊlɔsəfə] – философ
Rene Descartes [rəˊnə deiˊkɑ:t] – Рене Декарт

Text Comprehension

2. True or false?

1. In the 3rd millennium BC, mathematics was dominated by arithmetic.
2. The history of algebra began in Europe.
3. The book Arithmetica was written by Diophantus.
4. One of the first Arabic algebras was written by the Arab mathematician Al-Khwarizmi.
5. The basic algebra of polynomials was worked out by Rene Descartes.
6. Omar Khayyam introduced symbols for the unknown and for algebraic powers and operations.
7. Analytic geometry was discovered by Islamic mathematicians.

3. Answer the following questions.

1. What was characteristic of ancient Mathematics?
2. Where did the history of algebra begin?
3. What equations did Egyptian and Babylonian mathematicians learn to solve?
4. Who continued the traditions of Egypt and Babylon?
5. Who was algebra developed by in the 9^{th} century?
6. What mathematicians advanced algebra in medieval times?
7. What was an important development in algebra in the 16^{th} century?
8. What was the result of this development?
9. What was Rene Descartes' most significant contribution to mathematics?

Vocabulary

4. Match the words on the left with their Russian equivalents on the right.

1. contribution	a) решение
2. development	b) вклад
3. solution	c) достижение
4. records	d) степень
5. quadratic	e) кубический
6. to work out	f) разрабатывать
7. polynomial	g) открытие
8. unknown	h) неизвестное
9. discovery	i) многочлен
10. ancient	j) корень
11.indeterminate	k) древний
12.identity	l) неопределённый

13.root	m) тождество
14.power	n) письменные материалы
15.cubic	o) квадратный

Grammar

5. Put the adjective or adverb in brackets in the necessary degree of comparison.

1. The scholar's (significant) contribution to mathematics was his discovery of analytic geometry.
2. Diophantus' book was on (high) level than the works of Egyptian and Babylonian mathematics.
3. (early) records of organized mathematics date back to ancient times.
4. (simple) types of calculators could give results in addition and subtraction only.
5. (often used) numbers were *two* and *three.*
6. For numbers (large) than two and three, different word-combinations were used.
7. Even (primitive) people were forced to count and measure.
8. In the 19^{th} century, mathematics was regarded (much) as the science of relations.
9. Mathematics is said to be (close) to art than to science.
10. Mathematics becomes the science of *relations* and *structure* in (broad) sense.

Text 5. Geometry

Geometry (Greek; geo = earth, metria = measure) arose as the field of knowledge dealing with spatial relationships.

For the ancient Greek mathematicians, geometry was the crown jewel of their sciences, reaching a completeness and perfection of methodology that no other branch of their knowledge had attained. They expanded the range of geometry to many new kinds of figures, curves, surfaces, and solids; they changed its methodology from trial-and-error to logical deduction; they recognized that geometry studies "external forms", or abstractions, of which physical objects are only approximations; and they developed the idea of an "axiomatic theory" which, for more than 2000 years, was regarded to be the ideal paradigm for all scientific theories.

The Muslim mathematicians made considerable contributions to geometry, trigonometry and mathematical astronomy and were responsible for the development of algebraic geometry.

The 17^{th} century was marked by the creation of analytic geometry, or geometry with coordinates and equations, associated with the names of Rene Descartes and Pierre de Fermat.

In the 18^{th} century, differential geometry appeared, which was linked with the names of L. Euler and G. Monge.

In the 19^{th} century, Carl Frederich Gauss, Janos Bolyai and Nikolai Ivanovich Lobachevsky, each working alone, created non-Euclidean geometry. Euclid's fifth postulate states that through a point outside a given line, it is possible to draw only one line parallel to that line, that is, one that will never meet the given line, no matter how far the lines are extended in either direction. But Gauss, Bolyai and Lobachevsky demonstrated the possibility of constructing a system of geometry in which Euclid's postulate of the unique parallel was replaced by a postulate stating that through any point not on a given straight line an infinite number of parallels to the given line could be drawn.

Their works influenced later researchers, including Riemann and Einstein.

Phonetics

1. Read the following words according to the transcription.

Methodology [ˏmeθəˊdɔləʤi] – методология
trial-and-error [ˊtrɑiəl ənd ˊerə] – метод проб и ошибок
approximation [əˏproksiˊmeiʃən] – приближение
axiomatic [ˏæksiəuˊmætik] – аксиоматичный
external [ɪksˊtə:nəl] – внешний
paradigm [ˊpærədɑim] – парадигма
trigonometry [ˏtrigəˊnɔmitri] – тригонометрия
Muslim [ˊmʌzlim] – мусульманский
Pierre de Fermat [piˊer də ferˊmɑ:] – Пьер де Ферма
Euler [ˊɔilə] – Эйлер
Monge [ˊmɔŋʒ] – Монж
Carl Frederich Gauss [ˊkɑ:l ˊfredrik ˊgaus] – Карл Фридрих Гаусс
Janos Bolyai [ˊjænəs bɔˊlɑi] – Ян Боляй
Euclid [ˊju:klid] – Эвклид
Euclidean [ju:ˊkli:djən] – Эвклидовый
infinite [ˊinfinit] – бесконечный
Riemann [ˊri:mən] – Риман
Einstein [ˊɑinstɑin] – Эйнштейн

Text Comprehension

2. Answer the following questions.

1. What is the origin of the term *geometry?*
2. What does geometry deal with?
3. What was the contribution of Greek mathematicians to the science of geometry?
4. Who contributed to the development of algebraic geometry?
5. Who was analytic geometry created by?
6. Whose names was differential geometry associated with?
7. Whose names was the creation on non-Euclidean geometry linked with?
8. Whose works were later influenced by non-Euclidean geometry?

3. Complete the sentences below with the words and phrases from the box.

a) measurement and calculation b) the works of later researchers c) Euler and Monge	d) analytic geometry e) trigonometry and mathematical astronomy f) non-Euclidean geometry

1. The Muslim mathematicians made considerable contributions to …
2. In geometry, emphasis was made on …
3. The 17^{th} century was marked by the creation of …
4. Differential geometry was linked with the names of …
5. The 19^{th} century was marked by the creation of …
6. Non-Euclidean geometry influenced …

4. Put the terms below in the correct order to show the process of the development of geometry as a science:

A. analytic geometry
B. geometry
C. differential geometry
D. non-Euclidean geometry
E. algebraic geometry

Grammar

5. Find the sentences with the *ing-forms* in the text and translate them into Russian.

6. Transform the following sentences into Participle I constructions.

Model:
The sign that *stands* for an angle …
The sign *standing* for an angle …

1. The line which *passes* through these two points is a diameter.
2. If you *express* these statements in mathematical terms, you obtain the following equations.
3. A decimal fraction is a fraction which *has* a denominator of 10, 100, 1000 or some simple multiple of 10.
4. The mathematical language, which *codifies* the present day science so clearly, has a long history of development.
5. When we *amalgamate* several relationships, we express the resulting relation in terms of a formula.
6. If we *try* to do without mathematics, we lose a powerful tool for reshaping information.
7. Calculus, which *is* the main branch of modern mathematics, operates with the rules of logical arguments.
8. When we *use* mathematical language, we avoid vagueness and unwanted extra meanings of our statements.
9. When scientists *apply* mathematics, they codify their science more clearly and objectively.
10. The person who *looks* at a mathematical formula and *complains* of its abstractness, dryness and uselessness fails to grasp its true value.

11. The book is useful reading for students who *seek* an introductory overview to mathematics, its utility and beauty.
12. Math is a living plant which *flourishes* and *fades* with the rise and fall of civilizations, respectively.

Text 6. The Development of Mathematics in the 17^{th} Century

The scientific revolution of the 17^{th} century spurred advances in mathematics as well. The founders of modern science – Nicolaus Copernicus, Johannes Kepler, Galileo, and Isaac Newton – studied the natural world as mathematicians, and they looked for its mathematical laws. Over time, mathematics grew more and more abstract as mathematicians sought to establish the foundations of their fields in logic.

The 17^{th} century opened with the discovery of *logarithms* by the Scottish mathematician John Napier and the Swiss mathematician Justus Byrgius. Logarithms enabled mathematicians to extract the roots of numbers and simplified many calculations by basing them on addition and subtraction rather than on multiplication and division. Napier, who was interested in simplification, studied the systems of the Indian and Islamic worlds and spent years producing the tables of logarithms that he published in 1614. Kepler's enthusiasm for the tables ensured their rapid spread.

The 17^{th} century saw the greatest advances in mathematics since the time of ancient Greece. The major invention of the century was *calculus.* Although two great thinkers - Sir Isaac Newton of England and Gottfried Wilhelm Leibniz of Germany – have received credit for the invention, they built on the work of others. As Newton noted, "If I have seen further, it is by standing on the shoulders of giants." Major advances were also made in numerical calculation and geometry.

Gottfried Leibniz was born (1^{st} July, 1646) and lived most of his life in Germany. His greatest achievement was the invention of *integral and differential calculus*, the system of notation which is still in use today. In England, Isaac Newton claimed the distinction and accused Leibniz of plagiarism, that is stealing somebody else's ideas but stating that they are original. Modern-day historians, however, regard Leibniz as having arrived at his conclusions independently of Newton. They point out that there are important differences in the writings of both men.

Differential calculus came out of problems of finding tangents to curves, and an account of the method is published in Isaac Barrow's "*Lectiones geometricae*" (1670). Newton had discovered the method (1665-66) and suggested that Barrow include it in his book.

Leibniz had also discovered the method by 1676, publishing it in 1684. Newton did not publish his results until 1687. A bitter dispute arose over the priority for the discovery. In fact, it is now known that the two made their discoveries independently and that Newton had made it ten years before Leibniz, although Leibniz published first. The modern notation of *dy/dx* and the elongated *s* for integration are due to Leibniz.

The most important development in geometry during the 17^{th} century was the discovery of *analytic geometry* by Rene Descartes and Pierre de Fermat, working independently in France. Analytic geometry makes it possible to study geometric figures using algebraic equations.

By using algebra, Descartes managed to overcome the limitations of Euclidean geometry. That resulted in the reversal of the historical roles of geometry and algebra. The French mathematician Joseph Louis Lagrange observed in the 18^{th} century, “As long as algebra and geometry proceeded along separate paths, their advance was slow and their applications limited. But when these sciences joined company, they drew from each other fresh vitality and thenceforward marched on at a rapid pace toward perfection.”

Descartes’ publications provided the basis for Newton’s mathematical work later in the century. Pierre de Fermat, however, regarded his own work on what became known as analytic geometry as a reformulation of Appollonius’s treatise on conic sections. That treatise had provided the basic work on the geometry of curves from ancient times until Descartes.

Phonetics

1. Read the following words according to the transcription.

Nicolaus Copernicus [ˊnikələs kɔuˊpə:nikəs] – Николай Коперник
Johannes Kepler [jəˊhænis ˊkeplə] – Иоганн Кеплер
Galilei [gæliˊlei] – Галилей
Isaak Newton[ˊɑizək ˊnju:tən]- Исаак Ньютон
logarithms [ˊlɔgəriθms] – логарифмы
John Napier [ˊʤon ˊneipiə] – Джон Напир
Justus Byrgius [ˊʤastəs ˊbə:ʤəs] – Юстас Бирджес
Gottfried Wilhelm Leibniz [ˊgɔtfrid wɪlhelmˊlɑipnits] – Готфрид Вильгельм Лейбниц
integral [ˊintegrəl]- интеграл
Rene Descartes [rəˊnə deiˊkɑ:t] – Рене Декарт
Pierre de Fermat [piˊer də ferˊmɑ:] – Пьер де Ферма
Joseph Louis Lagrange [ʒəˊzef ˊlui ləˊgreinʒ] –Жозеф Луи Лагранж
treatise [ˊtri:tis] – трактат
conic [ˊkɔnik] - коническое сечение
Appollonius [əpəˊləunjes] – Аполлон

Vocabulary

2. Find the English equivalents in the text to the following Russian words and phrases.

1. первенство
2. сделать открытие
3. извлекать корни
4. упростить
5. плагиат
6. опубликовать
7. интегральные и дифференциальные исчисления

8. система обозначений
9. претендовать (*на что-л.)*
10. совершенство

Text Comprehension

3. Answer the following questions.

1. What scholars are considered to be the founders of modern science?
2. Why did mathematics grow more and more abstract?
3. Who were logarithms discovered by?
4. What did logarithms enable mathematicians to do?
5. What was the major invention of the 17th century?
6. What is the essence of analytic geometry?
7. Why did a dispute arise between Leibniz and Newton?
8. What enabled Descartes to overcome the limitations of Euclidean geometry?
9. Whose publications provided the basis for Newton's mathematical work later in the century?

4. Complete the sentences below with the words and phrases from the box.

a) Rene Descartes and Pierre de Fermat b) the discovery of calculus c) Kepler d) geometry and algebra	e) Newton and Leibniz f) the scientific revolution of the 17th century g) the tables of logarithms

1. The Scottish mathematician Napier spent years producing …
2. The rapid spread of the tables of logarithms was ensured by …
3. The development of analytic geometry was beneficial for both …
4. The invention of calculus is connected with the names of …
5. A bitter dispute arose over the priority for…
6. Advances in mathematics were facilitated by …
7. Analytic geometry was discovered by …

Grammar

5. Transform the following sentences using Participle II constructions.

Model:

1. *The reasons which are given* for the study of mathematics …
The reasons given for the study of mathematics …
2. *When they are expressed* in terms of symbols, these relations produce a formula.
Expressed in terms of symbols, these relations produce a formula. *Когда эти отношения выражены символами, они …*

1. *The procedure which was suggested* at the meeting of the team had a number of advantages.

2. *When they are used* as scientific terms, these concepts have different meanings.
3. *The formal language which is spoken* in this country is Russian.
4. *The tasks which were set* for the students to fulfill were rather difficult.
5. *If it is expressed* in mathematical terms, this theorem gives a general method of calculating the area.
6. *The sense which is implied* in this assertion is not quite clear.
7. *If it is designed* and *devised* in a proper way, the symbol language becomes universal.
8. *When math is used* in any science, it brings precision, rigour and objectivity about.
9. *The theory which was discussed* at the seminar aroused great interest.
10. *The code which has been designed* by the programmer is rather inconvenient.
11. *The statement which was made* by the researcher did not satisfy certain conditions.
12. *The rules that are learnt* by the students are very important for their future professional activities.

Text 7. 18th – 19th Century Mathematics

During the 18th century, calculus became the cornerstone of mathematical analysis on the European continent. Mathematicians applied the discovery to a variety of problems in physics, astronomy, and engineering. In the course of doing so, they also created new areas of mathematics.

In France, Joseph Louis Lagrange made substantial contributions in all fields of pure mathematics, including differential equations, the calculus of variations, probability theory, and the theory of equations. In addition, Lagrange put his mathematical skills to work in the solution of practical problems in mechanics and astronomy.

The greatest mathematician of the 18th century, Leonard Euler of Switzerland, wrote works that covered the entire fields of pure and applied mathematics. He wrote major works on mechanics that preceded Lagrange's work. He won a number of prizes for his work on the orbits of comets and planets, the field known as celestial mechanics. But Euler is best known for his works in pure mathematics. In one of his works, *Introduction to the Analysis of Infinites,* published in 1748, he approached calculus in terms of functions rather than the geometry of curves. Other works by Euler contributed to number theory and differential geometry (the application of differential calculus to the study of the properties of curves and curved spaces).

Mathematicians succeeded in firming the foundations of analysis and discovered the existence of additional geometries and algebras and more than one kind of infinity.

The 19th century began with the German mathematician Carl Frederich Gauss. He ranks as one of the greatest mathematicians of the world. His book *Inquiries into Arithmetic* published in 1801 marks the beginning of modern era in number theory.

Gauss called mathematics *the queen of sciences* and number theory *the queen of mathematics.*

Almost from the introduction of calculus, efforts had been made to supply a rigorous foundation for it. Every mathematician made some effort to produce a logical justification for calculus and failed. Although calculus clearly worked in solving problems, mathematicians lacked rigorous proof that explained why it worked. Finally, in 1821, the French mathematician Augustin Louis Cauchy established a rigorous foundation for calculus with his theory of limits, a purely arithmetic theory. Later, mathematicians found Cauchy's formulation still too vague because it did not provide a logical definition of *real number.* The necessary precision for calculus and mathematical analysis was attained in the 1850s by the German mathematician Karl T. W. Weierstrass and his followers.

Another important advance in analysis came from the French mathematician Jean Baptiste Fourier, who studied infinite series in which the terms are trigonometric functions. Known today as Fourier series, they are still powerful tools in pure and applied mathematics.

The investigation of Fourier series led another German mathematician, Georg Cantor, to the study of infinite sets and to the arithmetic of infinite numbers.

Georg Cantor began his mathematical investigations in number theory and went on to create set theory. In the course of his early studies of Fourier series, he developed a theory of irrational numbers. Cantor and another German mathematician, Julius W. R. Dedekind, defined the irrational numbers and established their properties. These explanations hastened the abandonment of many 19th century mathematical principles.

When Cantor introduced his theory of sets, it was attacked as a disease from which mathematics would soon recover. However, it now forms part of the foundations of mathematics. The application of set theory greatly advanced mathematics in the 20th century.

Phonetics

1. Read the following words according to the transcription.

European [ˌjuərəˈpiːən]- европейский
Joseph Louis Lagrange [ʒəˈzef ˈlui ləˈgreinʒ] –Жозеф Луи Лагранж
Leonard Euler [ˈlenərd ˈɔilər] – Леонард Эйлер
Switzerland [ˈswitsələnd] – Швейцария
celestial [siˈlestjəl] – небесный
differential [ˌdifəˈrenʃəl] – дифференциальный
succeed [səkˈsiːd] – преуспевать
Carl Frederich Gauss [ˈkɑːl ˈfredrik ˈgaus] – Карл Фридрих аусс
Georg Cantor [ˈʤiːəg ˈkæntə] – Георг Кантор
Augustin Louis Cauchy [ɔːˈgʌstin ˈlui ˈkəuʃi] – Августин Луи Коши
Karl Weierstrass [ˈkɑːl ˈwierʃtrɑːs] – Карл Вейерштрасс
Jean Baptiste Fourier [ˈʒɑːn bəpˈtist ˈfuːriə] – Жан Баптист Фурье
Julius Dedekind [ˈjuːljəs ˈdedəkind] – Юлиус Дедекинд

although [ɔ:lˈðou] – несмотря на то, что
trigonometric [ˌtrigənəˈmetrik] – тригонометрический
hasten [ˈheisn] – ускорять
abandonment [əˈbændənmənt] – отказ

Vocabulary

2. Translate the following words and word-combinations from the text into Russian.

1. cornerstone
2. substantial
3. major works
4. to rank as
5. to lack smth.
6. vague
7. precision
8. to attain
9. abandonment
10. to advance

Text Comprehension

3. Complete the sentences below with the words and phrases from the box.

a) preceded Lagrange's work b) number theory and differential geometry c) Karl T. W. Weierstrass d) celestial mechanics e) Cantor and Dedekind	f) Carl Frederich Gauss g) mechanics and astronomy h) Fourier series i) physics, astronomy, and engineering j) foundations of mathematics

1. Euler's major works on mechanics…
2. Mathematicians applied the discovery of calculus to…
3. Lagrange managed to solve some practical problems in …
4. Euler's works contributed to…
5. Euler won a number of prizes for his work on…
6. Mathematics was called *the queen of sciences* by…
7. A precise foundation for calculus was supplied by…
8. Cantor's study of infinite sets became possible due to the study of…
9. The properties of irrational numbers were established by…
10. Cantor's set theory became part of the…

4. Answer the following questions.

1. What did the discovery of calculus lead to?
2. What was Lagrange's contribution to pure and applied mathematics?
3. What did Euler's works contribute to?

4. What is the essence of differential geometry?
5. What event marked the beginning of modern era in number theory?
6. When was a rigorous foundation for calculus finally supplied?
7. What is the theoretical and practical value of Fourier series?
8. What was Georg Cantor's contribution to mathematical studies?
9. Who were irrational numbers investigated and defined by?
10. What was the first reaction to Cantor's set theory?
11. Was the attitude to the discovery later changed?

Grammar

5. Change each sentence using either an *adverbial clause of time* (*after…*) or *Perfect Participle Active* (*having …*).

Model:

After we had combined these two groups, we produced a new set.
Having combined these two groups, we produced a new set.
После того как мы объединили эти две группы, мы получили новое множество. Объединив эти две группы, мы получили новое множество.

1. *After we had considered* the phenomena separately, we managed to establish a proper correspondence between them.
2. *Having read* the text closely, we understood the problem correctly.
3. *After we had assigned* numerals to these points, we established two one-to-one correspondences between a set of numbers and a set of points.
4. *Having obtained* different results, we arranged a discussion.
5. *After we had carried out* the experiment, we understood that the machine had certain advantages.
6. *Having analysed* the situation properly, we found a solution to the problem.
7. *After we had intensified* the whole process, we managed to meet the deadline.
8. *After we had tested* the new computer, we came to the conclusion that it was more powerful than the old model.
9. *Having replaced* the variable with the proper numeral, we received a true sentence.
10. *After we had checked* the result, we could see that it agreed with the expected one.
11. *Having solved* the equation, they obtained the necessary data.

Text 8. 20th Century Mathematics

During the 20th century, mathematics became more solidly grounded in logic and advanced the development of symbolic logic. Philosophy was not the only field to progress with the help of mathematics. Physics, too, benefited from the contributions of mathematicians to relativity theory and quantum theory. Indeed, mathematics achieved broader applications than ever before, as new fields developed within mathematics (*computational mathematics, game theory, and chaos theory*), and other branches of knowledge, including economics and physics, achieved firmer grounding through the application of mathematics. Even the most abstract mathematics seemed to find application, and the boundaries between pure mathematics and applied mathematics grew ever fuzzier.

Mathematicians searched for unifying principles and general statements that applied to large categories of numbers and objects. In algebra, the study of structure continued with a focus on structural units called rings, fields, and groups, and at mid-century, it extended to the relationships between these categories. Algebra became an important part of other areas of mathematics, including analysis, number theory, and topology, as the search for unifying theories moved ahead. Topology – the study of the properties of objects that remain constant during transformation, or stretching, became a fertile research field, bringing together geometry, algebra and analysis.

Until the 20th century, the centres of mathematics research in the West were all located in Europe. Although the University of Göttingen in Germany, the University of Cambridge in England, the French Academy of Sciences and the University of Paris, and the University of Moscow in Russia retained their importance, the United States rose in prominence and reputation for mathematical research, especially the departments of mathematics at Princeton University and the University of Chicago.

In some ways, pure mathematics became more abstract in the 20th century, as it joined forces with the field of symbolic logic in philosophy. The scholars who bridged the fields of mathematics and philosophy early in the century were Alfred North Whiteland and Bertrand Russel, who worked together at Cambridge University. They published their major work, *Principles of Mathematics*, in three volumes from 1910 to 1913. In it, they demonstrated the principles of mathematical knowledge and attempted to show that all of mathematics could be deduced from a few premises and definitions by the rules of formal logic. In the late 19th century, the German mathematician Gottlob Frege had provided the system of notation for mathematical logic and paved the way for the work of Russel and Whitehead. Mathematical logic influenced the direction of 20th century mathematics, including the work of Hilbert.

Speaking at the Second International Congress of Mathematicians in Paris in 1900, the German mathematician David Hilbert made a survey of 23 mathematical problems that he felt would guide research in mathematics in the coming century. Since that time, many of the problems have been solved. When the news breaks that another *Hilbert problem* has been solved, mathematicians worldwide impatiently await further details.

Hilbert contributed to most areas of mathematics, starting with his classic *Foundations of Geometry*, published in 1899. Hilbert's work created the field of functional analysis (*the analysis of functions as a group*), a field that occupied many mathematicians during the 20th century. He also contributed to mathematical physics. From 1915 on, he fought to have Emmy Noether, a noted German mathematician, hired at Göttingen. When the university refused to hire her because of objections to the presence of a woman in the faculty senate, Hilbert countered that the senate was not the changing room for a swimming pool. Noether later made major contributions to ring theory in algebra and wrote a standard text on abstract algebra.

Several revolutionary theories, including relativity and quantum theory, challenged existing assumptions in physics in the early 20th century. The work of a number of mathematicians contributed to these theories.

The Russian mathematician Hermann Minkowski contributed to relativity the notion of the space-time continuum, with time as a fourth dimension. Hermann Weyl, a student of Hilbert's, investigated the geometry of relativity and applied group theory to quantum mechanics. Weyl's investigations helped advance the field of topology. Early in the century, Hilbert quipped, "Physics is getting too difficult for physicists."

Mathematics formed an alliance with economics in the 20th century as the tools of mathematical analysis, algebra, probability, and statistics illuminated economic theories. A specialty called *econometrics* links enormous numbers of equations to form mathematical models for use as forecasting tools.

Game theory began in mathematics, but had immediate applications in economics and military strategy. This branch of mathematics deals with situations in which some sort of decision must be made to maximize a profit – that is, to win. Its theoretical foundations were supplied by von Neumann in a series of papers written during the 1930s and 1940s. Von Neumann and the economist Oscar Morgenstern published the results of their investigations in *The Theory of Games and Economic Behaviour* (1944). John Nash, the Princeton mathematician profiled in the motion picture *A Beautiful Mind,* shared the 1994 Nobel Prize in economics for his work in game theory.

Phonetics

1. **Read the following words according to the transcription.**

Quantum [΄kwɔntəm] – квантовый
chaos [΄keiəs] – хаос, неупорядоченность
topology [tɔ΄pɔləʤi] – топология
fertile [΄fə:tɑil] – *зд.* благодатный
Princeton [΄prinstən] – Принстон
Chicago [ʃi΄kɑ:gɔu] – Чикаго
Cambridge [΄keimbriʤ] – Кэмбридж
Bertrand Russel [΄bə:trənd ΄rʌsəl] – Бертранд Рассел
premise [΄premis] – предпосылка
Hermann Weyl [΄hə:mən ΄weil] – Герман Вэйль
Emmy Noether [΄emi ΄nə:tə] –Эмми Нётер
econometrics [ˏikənə΄metriks] – эконометрика
maximize [΄mæksimɑiz] – предельно увеличить
Von Neumann [fɔn ΄nɔimən] – фон Нойман
series [΄siəri:z] – ряд
supply [sə΄plɑi] – *зд.* разработать
profiled [΄prəufɑild] – изображённый (в фильме)

the Nobel Prize [ðə nəu´bel ´prɑiz] – нобелевская премия

Vocabulary

2. Match the synonyms.

1. to work out	a) concept
2. to await	b) to take on
3. to apply	c) to use
4. notion	d) to anticipate
5. to hire	e) distinguished
6. to attempt	f) to try
7. noted	g) to develop
8. to break the news	h) scientist
9. to challenge	i) main
10. to research	j) to begin
11. scholar	k) prognosis
12. forecast*, n*	l) to solve problems connected with
13. to start	m) to investigate
14. major	n) to announce
15. to deal with	o) to put to doubt

Text Comprehension

3. True or false?

1. In the 20th century, mathematics achieved broader applications than ever before.
2. Abstract mathematics failed to find application.
3. Mathematicians searched for unifying principles and theories.
4. Alongside with Europe, the United States became one of the centers of mathematical research.
5. Mathematical logic influenced the work of the outstanding German mathematician David Hilbert.
6. The University of Göttingen refused to take Emmy Noether on the faculty staff on academic ground.
7. Mathematics helped reconsider relativity and quantum theories.
8. David Hilbert made a survey of 26 problems that played the key role in mathematical research in the 20th century.
9. Game theory was originally applied in the sphere of entertainment.

4. Answer the following questions.

1. The development of what science did mathematics advance in the 20th century?
2. What two famous theories in physics did mathematics contribute to?
3. What new fields developed within mathematics?

4. Was there a great difference between pure and applied mathematics in the 20^{th} century?
5. What role did algebra play in other areas of mathematics?
6. Why did topology become a fertile research field for mathematicians?
7. What universities became centers of mathematical research in the US?
8. What branch of mathematical science influenced the direction of 20^{th} century mathematics?
9. What notion did the Russian mathematician Hermann Minkowski contribute to the theory of relativity?
10. How did mathematics advance economics in the 20^{th} century?
11. What does game theory deal with?
12. Who were the theoretical foundations of game theory supplied by?

Grammar

5. Change the sentences according to the model using the Complex Subject pattern.

Model:

It is believed that *he* is an efficient specialist.

He is believed to be an efficient specialist. Считается, что он опытный специалист.

1. *It is expected* that *they* will detect the error.
2. *It is believed* that *he* is very accurate in making calculations.
3. *It is known* that *they* have foreseen all the possible mistakes.
4. *It is likely* that *he* has given them explicit instructions.
5. *It is unlikely* that *they* have supplied the laboratory with such complex equipment.
6. *It appears* that *they* are unable to account for this absurd situation.
7. *It seemed* that *he* was an experienced researcher.
8. *It happened* so that *the error* was quickly detected.
9. *It appears* that *the law* holds for all the equations.
10. *It is unlikely* that *most fundamental processes of arithmetic and algebra* should change a great deal.
11. *It was expected* that *the students* knew the law.
12. *It is known* that *these laws* are applied to all kinds of exponents.
13. *It is expected* that *the students* remember these proportions.
14. *It appeared* that *the procedure* was appropriate.
15. *It seems* that *the computation* is correct.
16. *It appears* that *these statements* are mathematically correct.
17. *It is expected* that *the scientists* will establish an appropriate pattern.
18. *It is believed* that *the result* is of great importance.
19. *It is expected* that *he* will speak on number relations.
20. *It is unlikely* that *he* will speak on the coordinate system.

Text 9. Mathematics – the Language of Science

One of the foremost reasons given for the study of mathematics is that mathematics is the language of science. This does not mean that mathematics is useful only to those who specialize in science. It implies that even a layman must know something about the foundations, the scope and the basic role played by mathematics in our scientific age.

The language of mathematics consists mostly of signs and symbols, and, in a sense, is an unspoken language. There can be no more universal or simpler language. It is the same throughout the civilized world, though the people of each country translate it into their own particular language. For instance, the symbol 5 means the same to a person in England, Spain, Italy or any other country, but in each country it may be called by a different spoken word. Some of the best known symbols of mathematics are the numerals 1, 2, 3, 4, 5, 6, 7, 8, 9, 0 and the signs of addition (+), subtraction (-), multiplication (×), division (:), equality (=) and the letters of the alphabets: Greek, Latin, Gothic and Hebrew (rather rarely).

Symbolic language is one of the basic characteristics of modern mathematics for it determines its true aspect. With the aid of symbolism, mathematicians can make transitions in reasoning almost mechanically by the eye and leave their minds free to grasp the fundamental ideas of the subject matter. Just as music uses symbolism for the representation and communication of sounds, so mathematics expresses quantitative relations and spatial forms symbolically. Unlike the common language, which is the product of custom, as well as social and political movements, the language of mathematics is carefully, purposefully and often ingeniously designed. By virtue of its compactness, it permits a mathematician to work with ideas which, when expressed in terms of common language, are unmanageable. This compactness makes for efficiency of thought.

Mathematics is a special kind of language. The language so perfect and abstract that, possibly, it may be understood by intelligent creatures throughout the universe, no matter how different their organs of sense and perception may be. The grammar of the language – its proper usage – is determined by the rules of logic. Its vocabulary consists of symbols, such as numerals for numbers, letters for unknown numbers, equations for relationships between numbers and many other symbols, including the ones used in higher mathematics.

All of these symbols are tremendously helpful to the scientist because they serve to cut-short his thinking.

Albert Einstein wrote: “What distinguishes the language of science from language as we ordinarily understand the word? How is it that scientific language is international? The supernational character of scientific concepts and scientific language is due to the fact that they are set up by the best brains of all countries and all times.”

Phonetics

1. Read the following words according to the transcription.

Hebrew [ˈhiːbruː] – древнееврейский
Gothic [ˈgɔθik] – готский

spatial [ˊspeiʃəl] – пространственный
ingeniously [inˊʤjniəsli] – гениально
tremendously [triˊmendəsli] – *зд.* очень
compactness [kəmˊpæktnis] – сжатость, лаконичность
universe [ˊju:nivə:s] –вселенная
Einstein [ˊɑinstɑin] – Эйнштейн

Vocabulary

2. Match the following.

1. foremost	a) древнееврейский язык
2. Gothic	b) главный
3. Hebrew	c) готский язык
4. aid	d) переход
5. transition	e) в отличие от
6. reasoning	f) благодаря
7. spatial	g) гениально
8. unlike	h) лаконично
9. common	i) пространственный
10. by virtue of	j) обычный
11. ingeniously	k) ускорять мышление
12. compactness	l) непрофессионал
13. efficiency	m) восприятие
14. to cut-short thinking	n) точность
15. perception	o) мышление
16. layman	p) помощь

Text Comprehension

3. Answer the following questions.

1. What does the language of mathematics consist of?
2. Why is mathematics called a universal language?
3. What are the best known mathematical symbols?
4. How can mathematics be likened to music?
5. What is the most characteristic feature of the language of mathematics?
6. What are the grammar and the vocabulary of mathematics as the language of science?
7. How do mathematical symbols help the scientists in their research work?
8. How did Einstein explain the international, or supernational, character of the language of science?

Grammar

4. Say the same in a different way using conditional sentences. See the model.

Model:

If it were not for the works of the preceding scholars, the scientists of the following generations would not have made their discoveries.

But for the works of the preceding scholars, the scientists of the following generations would not have made their discoveries.

Если бы не труды учёных прошлых времён, современные учёные не смогли бы сделать свои открытия.

1. *If it were not for* a trifling error, the experiment might have been a success.
2. *But for* Babylonian and Mesopotamian mathematicians, Alexandrian scholars would not have achieved such remarkable results.
3. *If it were not for* the unreliable equipment, there would be fewer mistakes in print.
4. *But for* the absurdity of the solution, we might not have noticed the error.
5. *If it were not for* the discovery of logarithms, the scholars of the 18^{th} century would not have been able to make such great and successful advances.
6. *But for* Kepler's enthusiasm, the tables of logarithms would not have so rapidly spread.
7. *But for* mathematics, the present day achievements in science and technology would have been impossible.
8. *If it were not for* the greatest discoveries of world-famous scholars, our life would not be so comfortable as it is now.
9. *But for* the computer, many sciences would not have advanced so far.

5. Identify the non-finite forms of the verb in the following text: *the gerund, the participle* or *the infinitive.*

The Value of Solving Problems in Mathematics

There is much *thinking* and *reasoning* in mathematics. The students master the subject matter not only by *reading* and *learning*, but by *proving* theorems and *solving* problems. The problems, therefore, are an important part of *teaching*, because they make the students *discuss* and *reason* and *polish up* their own knowledge.

To understand how experimental knowledge is matched with theory and how new results are obtained, the students need *to do* their own *reasoning* and *thinking*. Of course, it is easier for both teacher and student if the text states all the results and outlines all the *reasoning*; but it is hard *to remember* such teaching for long, and harder still *to get* a good *understanding* of science from it.

Solving problems, you do your own *thinking*, and for this reason, problems form a very important part of *teaching*.

Some questions *raised* by the problems obviously do not have a single, unique or completely correct answer. More than that, the answers to them may be sometimes *misleading*, *demanding* more *reasoning* and further *proving*. Yet, *thinking* your way through them and *making* your own choice and *discussing* other choices are part of a good education in science and a good method of *teaching*.