МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
СХІДНОУКРАЇНСЬКИЙ НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ
імені ВОЛОДИМИРА ДАЛЯ

Методичні матеріали
до аудиторного читання з дисципліни
«Іноземна (англійська) мова»
для студентів 1-2 курсів (напрям підготовки 6.040301 «Прикладна математика»)

З А Т В Е Р Д Ж Е Н О
на засіданні кафедри іноземних мов
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Методичні матеріали до аудиторного читання з дисципліни «Іноземна (англійська) мова» для студентів 1-2 курсів (напрям підготовки 6.040301 «Прикладна математика») /Укладач: Н. А. Сура. – Сєвєродонецьк: вид-во СНУ ім. В. Даля, 2015. – 43 с.

Методичні матеріали до аудиторного читання з дисципліни «Іноземна (англійська) мова» для студентів 1-2 курсів (напрям підготовки 6.040301 «Прикладна математика») мають на меті навчити студентів читати та розуміти оригінальні тексти іноземною мовою з математики. Ціль методичних матеріалів – навчити студентів читати та розуміти оригінальні тексти іноземною (англійською) мовою з математики. В методичних матеріалах реалізується основний методичний принцип навчання читання іноземною мовою – комплексне навчання всіх видів читання. Тексти узяті в основному з англійських та американських видань, зокрема «Sky and Telescope», «Reader of Popular Scientific Essays», «Scientific American», «The Moon», «Illustrated London News», «Scientifically Speaking», а також із газети «Moscow News». До текстів подано коментарі і вправи, основним призначенням яких є активізація спеціальної лексики й витяг додаткової інформації, що може стати в пригоді для написання курсових і дипломних робіт.

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UNIT 1
THE DIFFERENCIAL CALCULUS

Pre-reading exercises.

1. What is the differential calculus?
2. What is the differential calculus concerned with?
3. What role does the differencial calculus play in our daily life?

No elementary school child gets a chance of learning the differential calculus, and very few secondary school children do so. Yet I know from my own experience that children of twelve can learn it. As it is a mathematical tool used in most branches of science, this forms a bar between the workers and many kinds of scientific knowledge. I have no intention of teaching the calculus, but it is quite easy to explain what it is about, particularly to skilled workers. For a very large number of skilled workers use it in practice without knowing[1] that they are doing so.

The differential calculus is concerned with rates of change. In practical life we constantly come across pairs of quantities, which are related, so that after both have been measured, when we know one, we know the other. Thus if we know the distance along the road from a fixed point we can find the height above sea level from a map with contours[2]. If we know the time of day we can determine the air temperature on any particular day from a record of a thermometer made on that day. In such cases we often want to know the rate of change of one relative to the other.

If x and y are the two quantities, then the rate of change of y relative to x is written $\frac{dy}{dx}$. For example if x is the distance of a point on a railway from London, measured in feet, and y the height above sea level, $\frac{dy}{dx}$ is the gradient of the railway. If the height x increases by 1 foot while the distance x increases by 172 feet, the average value of $\frac{dy}{dx}$ is $\frac{1}{172}$.

We say that the gradient is 1 in 172. If x is the time measured in hours and fractions of an hour, and y the number of miles gone, then $\frac{dy}{dx}$ is the speed in miles per hour. Of course the rate of change may be zero, as on a level road, and negative when the height is diminishing as the distance x increases.

To take two more examples, if x is the temperature, and y the length of a metal bar, $\frac{dy}{dx} : y$ is the coefficient of expansion, that is to say the proportionate increase in length per degree. And if x, is the price of a commodity, and y the amount bought per day, then $\frac{dx}{dx}$ is called the elasticity of demand.

For example people must buy bread, but cut down on jam, so the demand for jam is more elastic than that for bread[3]. This notion of elasticity is very important in the academic economics taught in our universities. Professors say that Marxism is out of date[4] because Marx did not calculate such things. This would be a serious criticism if the economic «laws» of 1900 were eternal truths. Of course Marx saw that they were nothing of the kind, and «elasticity of demand» is put of date in England today for the very good reason that most commodities are controlled or rationed.

The mathematical part of the calculus is the art of calculating $\frac{dx}{dy}$ if y has some mathematical relation to x, for example is equal to its square or logarithm. The rules have to be learned like those for the area and volume of geometrical figures[5], and have the same sort of value. No area is absolutely square, and no volume is absolutely cylindrical. But there are things in real life like enough to squares and cylinders to make the rules about them worth learning[6].

So with the calculus. It is not exactly true that the speed of a falling body is proportional; to the time it has been falling. But this is close enough to the truth for many purposes.

The differential calculus goes a lot further[7]. Think of a bus going up a hill, which gradually gets steeper. If *x* is the horizontal distance, and *y* the height, this means that the slope $\frac{dy}{dx}$ is increasing.

The rate of change of $\frac{dy}{dx}$ with regard to *y* is written $\frac{d^2y}{dx^2}$ In this case it gives a measure of the curvature of the road surface. In the same way if *x* is time and *y* is distance, $\frac{d^2y}{dx^2}$ is the rate of change of speed with time, or acceleration. This is a quantity that good drivers can estimate pretty well, though they do not know they are using the basic ideas of the differential calculus.

If one quantity depends on several others, the differential calculus shows us how to measure this dependence. Thus the pressure of a gas varies with the temperature and the volume.

Both temperature and volume vary during the stroke of a cylinder of a steam or petrol engine, and the calculus is needed to an accurate theory of their action.

Finally, the calculus is a fascinating study for its own sake. In February 1917 I was one of a row of wounded officers lying on stretchers on a steamer going down the river Tigris in Mesopotamia. I was reading a mathematical book on vectors, the man next me was reading one on the calculus. As antidotes[8] to pain we preferred them to novels. Some parts of mathematics are beautiful, like good verse or painting. The calculus is beautiful, but not because it is a product of «pure thought». It is not a product of pure thought. It was invented as a tool to help men to calculate the movements of stars and cannon balls[9]. It has the beauty of a really efficient machine.

To judge from the technical books which sell by tens of thousands in the Soviet Union, a bigger fraction of the people understand it there than here. In a society where workers are encouraged to understand their work it is natural that it should be widely studied. Those who are working to build such a society in our own country, even if they cannot yet learn it, should know a little what it means.

(From J. B. S. Haldane «Reader of Popular Scientific Essays»)

Comments

1. without knowing - не знаючи;
2. a map with contours - контурна карта;
3. the demand for jam is more elastic than that for bread. Тут that ужито замість слова demand. ... попит на варення менш стійкий, ніж попит на хліб.
4. out of date - застарілий;
5. The rules have learned to be like those for the area and volume of geometrical figures. Тут those вживається замість слова rules. Необхідно вивчити такі правила, як правила визначення площі та об'єму геометричних фігур.
6. worth learning - заслуговують того (варті того, щоб їх (rules - правила) вчили;
7. a lot further - значно далі;
8. antidotes - протиотуйні препарати;
9. cannon balls - гарматні ядра.

Exercises

1. Read the text. Try to understand as much as possible of its content. See the comments.

2. Practice the active vocabulary. Translate the sentences into Ukrainian.

No elementary school child gets a chance of learning the differential calculus, and very few secondary school children do so.

As it is a mathematical tool used in most branches of science, this forms a bar between the workers and many kinds of scientific knowledge.

The calculus is beautiful, but not because it is a product of «pure thought». It is not a product of pure thought.

The speed of a falling body is proportional to the time it has been falling.

Finally, the calculus is a fascinating study for its own sake.

3. Complete the following sentences using the expressions you memorized after studying the text.

Thus if we know the distance along the road from, a fixed-point, we can find ….

If we know the time of the day, we can determine .…

The differential calculus is concerned with...

The notion of elasticity is very important in.…

The calculus was invented as a tool to help men to calculate.…

4. Answer the following questions.

What is the calculus about?

What is called the elasticity of demand?

Why do professors say that Marxism is out of date in England?

Is the calculus a product of pure thought?

Was the calculus invented as a tool to help men to calculate the movements of stars and cannon balls?

UNIT 2
GEOMETRICAL CONSTRUCTIONS

Pre-reading exercises

1. What is one of the most famous of classical construction problems?
2. Are there any classical Greek problems for which solution has been sought in vain?
3. How can all constructive problems be completely characterized?

Construction problems have always been a favourite subject in geometry. With ruler and compass alone a great variety of constructions may be performed; as the reader will remember from school: a line, segment or an angle may be bisected[1], a line may be drawn from a point perpendicular to a given line, a regular hexagon may be inscribed in a circle, etc.

In all these problems the ruler is used merely as a straightedge, an instrument for drawing a straight line but not for measuring or making off distances. The traditional restriction to ruler and compass alone goes back to antiquity, although the Greeks themselves did not hesitate to use other instruments.

One of the most famous of the classical construction problems is, the so-called contact problems of Apollonius (circa 200 B. C.[2]) in which three arbitrary circles in the plane are given and a fourth circle tangent to all three is required.

In particular, it is permitted that one or more of the given circles have degenerated into a point or a straight line (a «circle» with radius zero or. «infinity» respectively). For example, it may be required to construct a circle tangent to two given straight lines and passing through a given point. While such special cases are rather easily dealt with, the general problem is considerably more difficult.

Of all construction problems, that of constructing with ruler and compass, a regular polygon of n sides has perhaps the greatest interest. For certain values of n - e.g. $n = 3, 4, 5, 6$ - the solution has been known since antiquity. But for the regular heptagon $(n = 7)$ the construction has been proved impossible.

There are three other classical Greek problems for which a solution has been sought in vain: to trisect[3] an arbitrary given angle, to double a given cube (i. e. to find the edge, of a cube whose volume shall be twice that of a cube with a given segment as its edge) and to square the circle (i. e. to construct a square having the same area as a given circle). In all these problems, ruler and compass are the only instruments permitted.

Unsolved problems of this sort gave rise to one of the most remarkable and novel developments in mathematics, when, after centuries of futile search for solutions, the suspicion grew that these problems might be definitely unsolvable. Thus mathematicians were challenged to investigate the question: How is it possible to prove that certain problems cannot be solved?

In algebra, it was the problem of solving equations of degree 5 and higher, which led to this new way of thinking. During the sixteenth century mathematicians had learned that algebraic equations of degree 3 or 4 could be solved by a process similar to the elementary method for solving quadratic equations. All these methods have the following characteristic in common: the solutions or «roots» of the equation can be written as algebraic expressions obtained from the coefficients of the equation by a sequence of operations, each of which is either a rational operation - addition, subtraction, multiplication for division - or the extraction of a square root, cube root, or fourth root.

One says that algebraic equations up to the fourth degree can be solved by «radicals» *(radix* is the Latin word for *root).* Nothing seemed more natural than to extend this, procedure to equations of degree 5 and higher, by using roots of higher order. All such attempts failed. Even distinguished mathematicians of the eighteenth century deceived themselves into thinking[4] that they had found the solution. It was not until early in the nineteenth century that the Italian Ruffini (1765-1822) and the Norwegian genius N. H. Abel (1802-1829) conceived the then revolutionary idea of proving the impossibility of the solution of the general algebraic equation of degree by means of radicals. One must clearly understand that the question is not whether any algebraic equation of degree possesses solutions. This fact was first proved by Gauss in his doctoral thesis[5] in 1799. So there is no doubt about the existence of the roots of an equation, especially since these roots can be found by suitable procedures to any degree of accuracy. The art of the numerical solution of equations is, of course, very important and highly developed.

But the problem of Abel and Ruffini was quite different: can the solution be effected by means of rational operations and radicals alone? It was the desire to attain full clarity about this question that inspired the magnificent development of modern algebra and group theory started by Ruffini, Abel and Galois.

The question of proving the impossibility of certain geometrical constructions provides one of the simplest examples of this trend in algebra. By the use of algebraic concepts we shall be able to prove the impossibility of trisecting the angle, constructing the regular heptagon, or doubling the cube, by ruler and compass alone. (The problem of squaring the circle is much more difficult to dispose of.) Our point of departure will be not so much the negative question of the impossibility of certain constructions, but rather the positive question: How can all constructive problems be completely characterized? After we have answered this question, it will be an easy matter to show that the problems mentioned above do not fall into this category.

At the age of seventeen Gauss investigated the constructibility of regular «polygons» (polygons with *p*-sides), where *p* is a prime number. The construction was the known only for $p = 3$ and $p = 5$. Gauss discovered that the regular polygon is constructible if and only if *p* is a prime «Fermat number», $p = 2^{2^n} + 1$.

The first Fermat numbers are 3, 5, 17, 257, 65 537. So overwhelmed was young Gauss by his discovery that he at once gave up his intention of becoming a philologist[6] and resolved to devote his life to mathematics and its application. He always looked back on this first of his great feats with particular pride. After his death, a bronze statue of him was erected in Goettingen, and the pedestal was shaped in the form of a regular 17-gon.

When dealing with a geometrical construction[7], one must never forget that the problem is not that of drawing figures in practice with a certain degree of accuracy, but of whether, by the use of straightedge and compass alone, the solution can be found theoretically, supposing our instruments to have perfect precision[8]. What Gauss proved is that his constructions could be performed in principle. His theory does not concern the simplest way actually to perform them or the devices, which could be used to simplify and to cut down the number of necessary steps. This is a question of much less theoretical importance. From a practical point of view, no such construction would give[9] as satisfactory result as could be obtained by the use of a good protractor. Failure properly to understand the theoretical character of the question of geometrical construction and stubbornness in refusing to recognize well-established scientific facts are responsible for the persistence of an unending line of angle-trisectors and circle-squares.

Once more it should be emphasized that in some ways our concept of geometrical construction seems artificial. Ruler and compass are certainly the simplest instruments for drawing, but the restriction to these instruments is by no means inherent in geometry. As the Greek mathematicians recognized long ago, certain problems - for example that of, doubling, the cube - can be solved if, e.g. the use of a ruler in the form of a right angle is permitted; it is just as easy to invent instruments other than the compass by means of which one can draw ellipses, hyperbolas, and more complicated curves and whose, use enlarges considerably the domain of constructible figures.

Comments

1. may be bisected - може бути розділений навпіл;
2. circa 200 B. C. - близько 200 р. до н. е.;
3. to trisect - ділити на три рівні частини;
4. deceived themselves into thinking - помилково вважали;
5. doctoral thesis - докторська дисертація;
6. his intention of becoming a philologist - його намір стати філологом;
7. when dealing with a geometrical construction - займаючись (роблячи) геометричну конструкцію;
8. supposing our instruments to have perfect precision - за умови, що у нас є дуже точні прилади;
9. no such construction would give - жодна така конструкція не призвела б…

Exercises

1. Read the text. Try to understand as much as possible of its content. See comments.

2. Define the paragraph, which contains the main idea.

3. Find the sentences, which answer the following questions:

What is the essence of the Apollonius problem?

How many solutions of the problem are there?

What does the Apollonius circle degenerate into?

UNIT 3
NUMERALS

Pre-reading exercises.

1. Where do our numerals come from?
2. Why are Arabic numerals more useful than other numerals?
3. What effect did Arabic numerals have on the world?

We cannot live a day without numerals. Numbers and numerals-are everywhere. On this page you will see number names and numerals. The number names are: zero, one, two, three, four and so on[1]. And here are the corresponding numerals: 0, 1, 2, 3, 4, and so on. In a numeration system[2] numerals are used to represent numbers and the numerals are grouped in a special way[3]. The numbers used in our numeration system are called digits.

In our Hindu Arabic system[4] we use only ten digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 to represent any number. We use the same ten digits over and over again[5] in a place value system[6] whose base is ten.

These digits may be used in various combinations. Thus, for example, 1, 2, and 3 are used to write 123, 213, 132 and so on.

One and the same[7] number could be represented in various ways.-For example, take 3. It can be represented as the sum of the numbers 2 and 1 or the difference between the numbers 8 and 5 and so on.

A very simple way to say that each of the numerals names the same number is to write an equation – a mathematical sentence that has an equal sign (=) between these numerals. For example, the sum of the numbers 3 and 4 equals the sum of the numbers 5 and 2. In this case we say: three plus four (3+4) is equal to five plus two (5+2). One more example of an equation is as follows: the difference between numbers 3 and 1 equals the difference between numbers-6 and 4.

That is three minus one (3 – 1) equals six minus four (6 – 4). Another example of an equation is 3+5=8. In this case you have three numbers. 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.

Now let us turn to the basic operations of arithmetic. There are four basic operations that you all know of. They are addition, subtraction, multiplication and division. In arithmetic an operation is a way of thinking[8] of two numbers and getting one number. We were just considering an operation of addition. An equation like 7 – 2=5 represents an operation of subtraction.

Here seven is the minuend and two is the subtrahend. As a result of the operation you get five. It is the difference, as you remember from the above[9]. We may say that subtraction is the inverse operation of addition since 5+2= 7 and 7 –2=5.

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

In multiplication there is a number that must be miltiplied. It is the multiplicand. There is also a multiplier. It is the number by which we multiply. When we are multiplying the multiplicand by the multiplier we get the product as a result. When two or more numbers are multiplied, each of them is called a factor. In the expression five multiplied by two (5x2), the 5 and the 2 will be factors. The multiplicand and the multiplier are names for factors.

In the operation of division there is a number that is divided and it is called the dividend; the number by which we divide is called the divisor. When we are dividing the dividend by the divisor we get the quotient. But suppose you are dividing 10 by 3. In this case the divisor will not be contained a whole number of times[10] in the dividend. You will get a part of the dividend left over[11]. 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[12].

There are two very important facts that must be remembered about division. a) The quotient is 0 (zero) whenever the dividend is 0 and the divisor is not 0. That is, *0: n* is equal to 0 for all values of n except *n=0.* b) Division by 0 is meaningless. If you say that you cannot divide by 0 it really means that division by 0 is meaningless. That is, *n:0* is meaningless for all values of *n.*

Comments

1. so on - так далі;
2. in a numeration system - у системі чисел;
3. the numerals are grouped in a special way. - числа, згруповані особливим способом;
4. in our Hindu Arabic system - у нашій арабській системі чисел;
5. over and over again - знову і знову;
6. in a place value system - у системі оцінювання;
7. one and the same - одне і те ж;
8. a way of thinking - спосіб міркування (рішення);
9. as you remember from the above-як ви пам'ятаєте з попереднього (вищевикладеного);
10. whole number of times in the dividend - загальна кількість разів у ділимом;
11. you will get a part of the dividend left over.- Ви отримуєте частину від ділимого;
12. you may check division by using multiplication - ділення перевіряють множенням.

Exercises

1. Read the text. Try to understand as much as possible of its content. See comments.

2. Define the main idea of the text.

3. Formulate the main outlines of the text.

UNIT 4
PROBABILITY OF OCCURENCE

Pre-reading exercises.

1. What is the probability of success in the mathematical language?
2. What is the probability of failure in the mathematical language?
3. What is the probability of occurrence?

Here are nine circles. Look at them. Five are black; four are white. If you were told to cover one circle with your finger, you might choose any one of the nine. But you are more likely to choose a black circle than a white, because there are more black circles than white ones. Indeed, the probability that you will cover a black circle is $\frac{5}{9}$, the ratio of the number of black circles to the total number of circles.

In mathematical language the choice, the probability of success is the ratio of the number of ways in which the trial can succeed to the total number of ways in which the trial can result. Here nothing favors the choice of any particular circle; they are all on the same page, and you are just as likely to cover one as another. The trial can succeed in five ways; there are five black circles.

The trial can result in nine ways; there are nine circles in all[I]. If *p* represents the possibility of success, the $p = \frac{5}{9}$.

Similarly, the probability of failure is the ratio of the number of ways in which the trial can fail to the total number of ways in which it can result.

If *q* represents the probability of failure,

in this case $q = \frac{4}{9}$. Notice that the sum of probabilities of success and failure is 1. If you put your finger on a circle, it is certain to be either a black circle or a white one, for no other kind of circles is present. Thus $p+q=\frac{5}{9}+\frac{4}{9}=1$.

The probability an event will occur cannot be more than 1. When p=l, success is a certainty. When q=l, failure is sure.

Let 5 represent the number of ways in which a trial can succeed. And let *f* represent the number of ways in which a trial can fail.

$$p=\frac{S}{S+f};\ q=\frac{S}{S+f};\ p+q=\frac{S}{S+f}+\frac{S}{S+f}=1$$

When S is greater than /, the odds are S to *f* in favor of success[2], thus the odds in favor of covering a black circle are 5 to 4.

Similarly, when / is greater than 5, the odds are *f to S* against success[3]. And when S and / are equal, the chances are even success and failure are equally likely. Tossing a coin illustrates a case in which *S* and *f* are equal.

There are two sides to a coin, and there is no reason why[4] a normal coin should fall one side up rather than[5] the other. So if you toss a coin and call heads, the probability that it will fall heads is $\frac{1}{2}$.

Suppose you toss a coin a hundred times. For each of the hundred trials the probability that the coin will come down heads is. You might expect fifty of the tosses to be heads. Of course, you may not get fifty heads. But the more times you toss a coin, the closer you come to the realization of what you expect.

If *p* is the probability of success on one trial, and *K.* is the number of trials, then the expected number is *Kp.* Mathematical expectation in this case is defined as *Kp.*

Comments

1. in all - усе, загалом;
2. in favor of success - у разі успіху, якщо пощастить;
3. success against - не сприяти успіху;

4. there is no reason why a normal coin should fall one side up rather than the other - і не існує пояснення того (тієї причини) чому звичайна монета частіше падає на одну сторону.

Exercises

1. Read the text. Try to get the main idea of the text.

2. Divide the text into logical parts. Entitle each of them.

3. Find professional oriented words in the text and give their Ukrainian equivalents.

4. Write a short plan of the text to help you while speaking on the Probability of Occurrence.

UNIT 5

DEPENDENT, MUTUALLY EXCLUSIVE AND INDERPENDENT EVENTS

Pre-reading exercises.

1. When does in mathematics one event depend on another?
2. When are two events mutually exclusive?
3. When are two events independent?

Sometimes one event is dependent on another. Consider a group of your class-mates drawing (витягає) slips (листки) of paper numbered from 1 to 20. Suppose that anyone drawing a number exactly divisible by 5 is rewarded that is there are four ways of succeeding and twenty possible results. *X* draws first, you draw next. If *X* were successful, your chances of success would be decreased; if *X* were unsuccessful your chances would be increased.

Probability of *X's* trial succeeding: $p=\frac{4}{20}$. Probability for you, if *X* succeeds: $p=\frac{3}{19}$. Probability for you if *X* fails: $p=\frac{4}{19}$. Some events are mutually (на взаєм) exclusive (взаємовиключні). Thus, there might be a penalty attached to drawing the number 13 in the situation described above. But no one can draw both the number 13 and at the same time draw a number divisible by 5; drawing one excludes (виключає) the possibility of drawing the other. Of course, the probability of *X's* getting either a reward (нагороду) or a penalty is - $\frac{5}{20}$; if she got neither, the 20 probability that you would get one or the other is $\frac{5}{19}$. When two events are mutually exclusive the probability that either *one or the other* will occur is the sum of the separate probabilities. Many events with which people must deal are independent; they occur without affecting each other in any way. Thus if two coins were tossed at the same time or one after the other, the fact that one fell (впала) heads would not affect the way the other fell. Suppose you toss two coins. If you call them coin *A* and coin *B*, it is easy to see that the trial can result in four ways. (1) Both coins, Л and B, might come down heads. (2) Both coins, *A* and *B*, might come down tails. (3) Coin *A* might show heads and coin *B* might show tails. (4) Coin *A* might show tails and coin *B* might show heads. Since there are four possible results, the probability of any one result is $\frac{1}{4}$. This probability is the product of the separate probabilities in each case. 21. For instance (наприклад), take the first case. For coin *A* to come down heads: $p = \frac{1}{2}$. For coin *B* to come down heads: $p = \frac{1}{2}$. For both coins to show heads: $p = \frac{1}{2} + \frac{1}{2} = \frac{1}{4}$.

When two events are independent, the probability that one as *well as the other* will occur is the product of the separate probabilities.

Of course, you might not be able to distinguish (відрізняти) between the third and the fourth result; perhaps you could observe only that one coin shows heads and the other tails. Since there are two ways in which this situation can occur, out of four possible results, $p = \frac{2}{4}$.

Exercises

1. Read the text and define the main idea of it.

2. Divide the text into logical parts. Entitle each of them.

3. Ask questions on the text.

4. Answer the questions in connections with the text. Be ready to retell the text:

1. Slips of paper numbered 1, 2, 3, 4, and 5 are placed face down on the table. The slip is chosen at random (довільно).

What is the probability tails the number of the slip is 4?

What is the probability that tails number of the slip is odd?

What is the probability that the number of the slip is even?

2. Suppose you are shown 10 boxes, one of which contains something while others are empty. You'are allowed to choose one box. What is your mathematical expectation?

3. Four coins are tossed. What is the probability that all will fall tails?

Unit 6
COMPUTERS

Pre-reading exercises.

1. What do you know about the computers?

2. Would you list the essential constituent parts of a digital general-purpose computer?

3. What is the usual method for inputting data for processing into a computer?

We might list the essential constituent parts of a digital general-purpose computer as follows. First, core store[1] (sometimes called memory) for holding, numbers, both those forming the data of the problem and those generated in the course of the calculation. It is also used for storing program instructions[2.] Second, an arithmetic unit, and a device for performing calculations on those numbers. Third, a control unit[3], a device for causing the machine to perform the desired operations in the correct sequence. Fourth, input devices[5] whereby numbers and operating instructions[4] can be supplied to the machine, and fifth, output devices for displaying the results of a calculation. The input and output devices are called-peripherals[5].

The usual method for inputting data for processing into a computer is via an input peripheral such as a punched card reader[6] or punched paper tape recorder or from magnetic tape. The computer is programmed to accept data in any or all of these media. The computer operator, in order to start the input process, will type a «go» message on the console typewriter[7]. For real time processing the operator will use an interrogating typewriter. This asks a question of the computer about the state of specific files of data already on toe to the computer. The data may be stored, or it may be sorted according to a plan desired by the programmer. It may be merged with existing information already in the store. Or, if we want immediate answers' or output it could be by printer[7], that is an output device for spelling out computer results as numbers, symbols or words. These vary from high-speed printers to electric typewriters.

THE MAIN PARTS OF THE SYSTEM

There are many hardware pieces in a computer system. Some are: the system board, power supply, keyboard, mouse, hard drive, monitor and the video card and its drivers.

THE CASE

The large metal box that is the main part of the computer is called the case. The case and its contents (power supply, system board, etc.) is called the system unit. The case has several functions:

- protects the delicate electronics inside.
- keeps electromagnetic emissions inside so your TV, cordless phone, and stereo don't go haywire when you power up the computer.
- can also hold the monitor.

Don't remove the case's cover unless you need to do something inside the unit, and always replace the cover when you are done.

THE KEYBOARD

You communicate with your computer with the keyboard.

With it, you type instructions and commands for the computer, and information to be processed and stored. Many of the keys on the keyboard are like those on a typewriter; letter keys, punctuation keys, shift keys, tab, and the spacebar, your keyboard also has many specialized keys.

The instruction manuals for most software applications contain a section describing the functions of each key or combination of keys.

THE MOUSE

The mouse works by sliding it around (ball down) on a flat surface. The mouse does not work if you hold it in the air like a remote control! The desktop is fine, but a ready-made mouse pad is the best surface to roll the mouse on. Its surface is flat and usually somewhat textured. If a surface is too smooth or rough, the ball inside can slip. As you glide the mouse, the ball inside moves in the direction of your movement. You will see the arrow on your screen moving in unison. The arrow is called a pointer, and the most important part is the very tip of its point. That's the only part the computer pays attention to. To use the mouse, slide it on the mouse pad until the pointer's point is on something, like a button or an icon. Then:

Click – position the mouse pointer over an element and press and release the left mouse button one time.

Double-click – same as above except press the mouse button twice in quick succession without moving the mouse between clicks. It may take a little practice to not twitch the mouse when you first start double-clicking. Usually you double-click on an icon to start the program.

Drag – position the mouse pointer over an element, press and hold the left mouse button, and drag the mouse across the screen. The pointer moves, dragging the element. At the desired location, release the mouse button. The pointer lets go of whatever it was dragging. An excellent way to practice using the mouse is to play the Solitaire game that comes with Windows.

THE MONITOR

Your computer is not complete without the monitor, a TV-like device that usually sits on top of the computer. The monitor displays text characters and graphics. It allows you to see the results of the work going on inside your system unit. The image that you see is made up of tiny dots called pixels. The sharpness of the picture depends on the number and size of these pixels.

The more pixels, the sharper the image. This is called resolution. A display adapter card is actually what builds the video images; the monitor simply displays them. The display adapter for your system is either built onto the system board or is an expansion card plugged into your system board.

Comments

1. core store (memory) - запам'ятовуючий пристрій;
2. storing program instructions - зберігання (запам'ятовування) команд;
3. control unit - пристрій (блок) управління;
4. operating instruction - операційна команда;
5. input/output devices (peripherals) - пристрій вводу/виводу;
6. punched card reader - пристрій (для) зчитування з перфокарти;
7. console typewriter, printer - друкуючий пристрій.

Exercises

1. Read the text. Be ready to list the essential parts of a digital general-purpose computer.

2. Ask questions with reference to the parts of a computer.

3. Entitle each paragraph.

4. Read the text about the main components of the computer and fill in the chart. Check the time required to read the text Are you reading faster than you used to?

Chart 1

The part	Its function

UNIT 7
THE PERSONAL COMPUTER

Pre-reading exercises.

How do you define the term “a personal computer”?

What are the major characteristics of a personal computer?

Do you have a personal computer at home?

A personal computer is a small computer based on a microprocessor; it is a microcomputer. Not all microcomputers, however, are personal computers. A microcomputer can be dedicated to a single task such as controlling a machine[1] tool or matering the, injection of fuel into an automobile engine; it can be a word processor[2], a. video game or a “pocket computers” that is not quite a computer. A personal computer is something different: a stand-alone computer[3] that puts a wide array of capabilities at the disposal of an individual. We define a personal computers a system that has all the following characteristics.

The price for the computer system within the reach of[4] individual buyers.

The system either includes or can be linked to secondary memory[5] in the form of cassette tapes or disks.

The microprocessor can support a primary-memory capacity[6] of 64 kilobytes or more. (A kilobyte is equal to 2^{10} , or 1,024 bytes. A byte is a string of eight bits, or binary digits. One byte can represent one alphabetic character[7] or one or two decimal digits A 64-kilobyte memory can store 65,536 characters, or some 10,000 words of English text).

The computer can handle at least one high-level language, such as Basic, Fortran or Cobol. In a language of this kind instructions can be formulated at a fairly high level of abstruction and without taking into account the detailed operations of the hardware[8].

The operating system facilitates an interactive dialogue; the computer responds immediately (or at least quickly) to the user's actions and requests.

Distribution is a largely trough mass-marketing channels, with emphasis on sales to people who have not worked with computer before.

The system is flexible enough to accept a wide range of programs serving varied applications; it is not designed for a single purpose or a single category of purchasers.

The definition will surely changed as improved technology makes possible – and as the marketplace demands – the inclusion of more memory and of more special hardware and software[9] features in the basic system.

Comments

1. controlling a machine - управління машиною;
2. word processor - процесор (для) обробки текстів, текстовий процесор;
3. stand-alone computer - автономний комп'ютер;
4. ....is within the reach of - у межах досяжності;
5. secondary memory - вторинна пам'ять, пам'ять другого рівня;
6. primary-memory capacity-первинна пам'ять;
7. alphabetic character - знак алфавіту (мови);
8. hardware - апаратні засоби (на відміну від програмних);
9. software - програмне забезпечення.

Exercises

1. Read the text. Be ready to speak on the main characteristics of a personal computer.

2. Read the new words aloud and get to know their Ukrainian equivalents Define the meaning of the new words in the sentences.

1. HARDWARE апаратне забезпечення	My friend is a specialist in computer hardware.
2. BOARD дошка SYSTEM BOARD системна плата	The floor of the house was covered with boards.
3. POWER сила, потужність, енергія; призводити до руху	What is the power of this engine?
4. KEYBOARD клавіатура	The computer is already on the desk, but the keyboard has not been unpacked yet.
5. MOUSE 1)мыша 2) мыша (пристрій для позначення)	1)Women were afraid that there might be mice in the house. 2) Usually it takes some time to learn to use a mouse.

6. TO PROCESS обробляти PROCESSOR процесор	Thanks to computers we can process I information millions times quicker CPU stands for the central processor unit.
7. DRIVE дисковод	The drives can read and write on diskettes.
8. DRIVER програма з керування пристріями	Drivers are one of the components of a computer.
9. CASE 1) випадок 2) коробка, футляр, кожух	1)Telephone the safety engineer in case of emergency. 2) We decided against moving the case's cover.
10. CONTENTS зміст	I do not know the contents of this book. You can find the necessary information in the contents of the book.
11. TYPE друкувати	The text of the contract will be ready in an hour, the secretary is already typing it.
12. KEY клавіша	How many letter keys are there on this computer keyboard?
13. MANUAL 1) довідник, ручний	1) Two manuals come with this computer. 2) Automation makes manual labour unnecessary.
14. SOFTWARE Програмне забезпечення	You can buy a computer and the necessary software as well.
15. APPLICATION застосування	Nobody expected that the application of this device is so wide.
16. SLIDE ковзати	The surface was wet and nothing could prevent the machine from sliding down.
17. REMOTE віддалений, далекий	This remote control needs 4 batteries to power it. He is a remote relative of mine.
18. ROUGH нерівний, шорсткий	Tractors can easily drive along rough ground.
19. ARROW стрілочка	Draw an arrow on the map to show the direction of the movement.
20. SCREEN екран	The music started playing and everybody looked at the screen
21. POINTER покажчик, указка	You can move the pointer on the screen with the help of the mouse.
22. BUTTON 1) гудзик 2) кнопка	1) The boy has lost a button from his jacket. 2) Press the button to switch on the device.
23. GAME гра	What sports games do you like playing?
24. DISPLAY виставляти, показувати	The British tend not to display much emotion in public. A few figures were displayed on the screen.

25. CHARACTER символ	You can type letters and other characters using this keyboard.
26. DOT крапка	A dot is one of the two characters of the famous Morse code.
27. SHARP гострий, різкий	There were many Sharp arrows prepared for the competition. Those scissors are sharp. The TV picture isn't very sharp.
28. RESOLUTION Розрішувальна здатність	Resolution is one of the characteristics of the monitor.
29. PLUG затикати PLUG IN вставити штепсель (у розетку)	Of course the radio is not working, you have not plugged it in.
30. STRAIN натяг, напруга, навантаження	Not all the people can stand the strains of cosmic flights.
31. REDUCE зменшувати, знижувати	Much is being done to reduce air pollution in large cities.
32. ADJUST пристосовувати(ся)	The body quickly adjusts to changes in temperature. If the chair is too high you can adjust it to suit you.
33. ANGLE кут	They have measured the angles of the triangle.
34. A SCREEN SAVER режим вимкнення екрану при паузах в роботі	Nobody knew how to set a screen saver to switch off the monitor screen.
35. IDLE незайнятий; *(техн.)* холостий (хід), робота в холосту	Being idle for a long time is not good for teenagers. The idling speed can be adjusted by turning this handle.

3. Read and translate the sentences into your native language.

1. a) There were a lot files on the desk.

b) It took operator some time to find the necessary file.

2. a) You can use only floppy disks with this computer

b) This hard disk holds more information than 100 floppies.

3. a) This floppy drive is usually referred to as drive A:.

b) All the references are usually located at the end of the article.

4. a) According to the readings of the instrument a considerable amount of fuel was stored in the tank.

b) The speed of the rocket carrier amounts to eight kms per second.

5. a) The access to the mountain village was extremely difficult because of many rapid rivers.

b) You can get access to a great amount of information with the heb of CD-ROM.

6. a) This computer is not IBM-compatible.

b) The account section has been completely computerized.

4. Describe the essential components of a personal computer in detail.

5. Ask questions with the reference to the parts of a personal computer.

6. Retell the text following the outlines given below.

- the subject of the text;
- the definition of a personal computer;
- the microprocessor of a computer;
- the operating system.

UNIT 8
TEXT 1
DO TRANSLATING MACHINES EXIST?

Pre-reading exercises.

1. Electronic, computers are the only kind of machine with which one could hope to translate one language into another. Comment on this statement, please.
2. What is the first step for machine in the translation process?
3. Why have the resulting “translations” been sometimes bizarre?

Translating machines have been built many times. None of them, however, has done its job well enough to be put into practical use. However, research on translating machines has gone on continuously, ever since the birth of the electronic computer in the late 1940s. Electronic, computers are the only kind of machine with which one could hope to translate one language into another. Most attempts to do so have used general-purpose computers**[1]**; the problem, then, is to write programmes, or lists of instructions, which will enable the computer to carry out the many logical processes involved in translating**[2]**.

Let, us suppose**[3]** that we have a French text to be translated into English, and it is in a form which the; machine can read – it might be on paper tape with holes punched in it**[4]**. The first step in the translation process is for the machine to *«look up»* each French word in its own internal dictionary. Of course, merely substituting an equivalent English word doesn't produce an intelligible translation. The machine also has to know**[5]** something about grammar, in order to analyze the relations between the words, of each French sentence and then construct a corresponding English sentience. Machines, which can do this, with various languages, have been built in several countries. However, the resulting «translations» have sometimes been bizarre. The commonest problem is where a word could mean either of two different things. A human translator would know which meaning to choose, from the context. But machines have been known to make the wrong choice**[6]** with hilarious results.

If a machine is to make usable translations, the machine itself must be able to extract some, at least, of the meaning of the text. This is what scientists are now trying to achieve in several countries including the USA, Britain and France. Most of them are doing theoretical work - they aren't yet ready to try to build working translating machines. Such machines appeared in 1980s. Their task is to produce comprehensible, if not elegant, translations of vast masses of technical literature. But machines, which can translate speech, are much further off; and a machine, which can make an aesthetically satisfying translation of Shakespeare's plays, is unlikely ever to be built[7].

Comments

1. general-purpose computer – універсальна обчислювальна машина
2. many logical process involved in translating - багатологічні процеси включені у переклад
3. let us suppose - припустімо
4. on paper tape with holes punched in it - на перфорованій паперовій стрічці
5. has to know - повинен знати
6. but machines have been known to make the wrong choice - але відомо що машини вибирають не те значення, яке підходить за контекстом
7. .....is unlikely ever to be built - певно ніколи не буде створений

Exercises

1. Ask questions on the text.

2. Divide the text into logical parts. Entitle each of them.

3. Give a summary of the text.

TEXT 2
COMPUTERS – MASTERS OR SERVANTS

Pre-reading exercises.

1. What is the «Reading Evening Post»?
2. Computers are going to be the driving force behind a second industrial revolution, just as the steam engine was in the first. Is it relevant?
3. Modern computers…… . Masters or servants?

The «Reading Evening Post» is a newspaper that might never have been born if it were not for computers[1]. Up to the moment when the reporters' stories are ready to be set up in type[2], it is very like any other local newspaper but from then on it is unique. Instead of the usual row of noisy, dirty typesetting machines[3], casting molten metal into a line at a time, there are 12 men in clean white collars sitting at a typewriter keyboards. And the 12 operators get through a quantity of work, which would have required[4] 23 men using ordinary typesetting machines.

For example, instead of talking *a* quarter of an hour to change from one type face and length of line to another, it takes only seconds to type out the necessary instructions to the computer.

Computers are going to be the driving force[5] behind a second industrial revolution, just as the steam engine was in the first. Many people will be reduced to acting as servants of a computer, doing jobs such as reading handwriting, which it is difficult or impossible to build a machine to do.

At the other end of the scale there will be the elite who design the computers write the programmes, and decide what work the machine should be put to[6].

The computer servants will get good money and short hours in return for their drudgery[7], but no prospect of satisfaction or advancement through their work. The alternative is to plan computer systems so that everyone plays a part in directing the machine as well as serving it.

Comments

1. if it were not for computers - якщо б не комп'ютери
2. ready to be set up in type - готові до друкування
3. typesetting machines - лінотипи
4. would have required - вимагало б…
5. computers are going to be driving force - обчислювальні машини стануть рушійною силою
6. decide what work the machine should be put to - вирішити, яку роботу покласти на машину
7. drudgery - важка, нудна робота

Exercises

1. **Look through the text. Try to understand its content.**
2. **See comments to the text and define the main idea of it.**
3. **Ask questions on the text.**
4. **Give a summary of the text.**

TEXT 3
THE COMPUTER WE USE AT UNIVERSITY

At the university you have a special subject – computer science where you leam to use computers properly. You also use computers studying other subjects.

Task 1. Speak on the computer you work on:

- the model of the computer you use;
- the type and number of disks it has;
- the volume of memory;
- the type of extras;
- the kind of monitor;
- what machines it is compatible with;
- what programs you can use with it;
- the advantages and disadvantages this computer has.

Task 2. Pairwork. You are in the shop which sells electrical goods.

Customer: Choose what you are going to buy (a video, a computer, a sound system), fill in the form below and then visit several shops to find and buy the thing you want.

CUSTOMER Type of equipment
Model
Price range
Other requirements

Shop assistant: Choose what you are going to sell (videos, computers, sound systems), fill in the form below.

In the shop give all the necessary information to the customer and try to sell the equipment.

SHOP ASSISTANT
Type of equipment
Models
Prices
Other details

Task 3. Discussion. More and more people begin using computers in their work. Some of them cannot imagine their life without this invention of the 20th century. Children find computer games very interesting. Are computers one of the greatest or the most dangerous inventions?

Say whether you use a computer in your work or for playing computer games. Do you use your computer in any other way or for any other purposes?

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

Computers are one of the greatest inventions	**Computers are one of the most dangerous inventions**
1. They save a lot of time.	1. They are dangerous for your health.
2. They can do calculations and other things which are not interesting for people to do.	2. People waste a lot of time playing computer games.
3. They help you to process information.	3. You can lose the results of your work if something goes wrong with the computer.
4. You can learn many things using a computer as a tutor. 5. You can relax playing computer games.	4. Some people live in a virtual reality not in the real world. 5. Children cannot do the simplest arithmetic sums because they rely on computers

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

c) Fill in the chart and give your reasons.

Arguments	**Group 1**	**Group 2**	**Group 3**	**Group 4**
Computers are one of the greatest inventions				
Computers are one of the most dangerous inventions				

TEXT 4
APPLICATION OF COMPUTERS

Pre-reading exercises.

1. What is the computer system connected with?
2. What does a railway's computer system get on a typical day?
3. Railway computer systems are not used for reservations alone, are they?

Railways use large computer systems to control ticket reservations and to give immediate information on the status of its trains. The computer system is connected by private telephone lines to terminals in major train stations and ticket reservations for customers are made through there. The passenger's name, type of accommodation and the train schedule is put into computer's memory.

On a typical day, a railway's computer system gets thousands of telephone calls about reservations, space on other railways, and requests for arrivals and departures. A big advantage of the railway computer ticket reservation system is its rapidity because a cancelled booking can be sold anywhere in the system just a few seconds later. Railway computer systems are not used for reservations alone.

They are used for a variety of other jobs including schedule, planning, freight and cargo loading, meal planning, personnel availability, accounting and stock control.

Exercises

1. Read and translate the text using a dictionary.

2. Retell the text: а) in a brief form; б) in details.

UNIT 9

Text 1. Short introduction to mathematics

The greatest mathematicians like Archimedes, Newton and Gauss have always been able to combine theory and applications into one.

Felix Klein (1849–1925)

Mathematics has more than 5000 years of history. It is the most powerful instrument of the human mind, able to precisely formulate laws of nature. In this way it is possible to dwell into the secrets of nature and into the incredible, unimaginable extension of the universe.

Mathematics is the study of quantity, structure, space, and change. Mathematicians seek out patterns, formulate new conjectures, and establish truth by rigorous deduction from appropriately chosen axioms and definitions.

There is debate over whether mathematical objects such as numbers and points exist naturally or are human creations. The mathematician Benjamin Peirce called mathematics "the science that draws necessary conclusions". Albert Einstein, on the other hand, stated that "as far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality."

Through the use of abstraction and logical reasoning, mathematics evolved from counting, calculation, measurement, and the systematic study of the shapes and motions of physical objects. Practical mathematics has been a human activity for as far back as written records exist. Rigorous arguments first appeared in Greek mathematics, most notably in Euclid's Elements. Mathematics continued to develop, in fitful bursts, until the Renaissance, when mathematical innovations interacted with new scientific discoveries, leading to an acceleration in research that continues to the present day.

Fundamental branches of mathematics are: algebra, geometry and analysis.

Algebra is concerned with, at least in it original form, the solution of equations. Cuneiform writing from the days of King Hammurapi (eighteenth century BC) document that the practical mathematical thinking of the Babylonians was strongly algebra-oriented. On the other hand, the mathematical thought of ancient Greece, whose crowning achievement was the appearance of Euclid's The Elements (around 300 BC), was strongly influenced by geometry. Analytical thinking, based on the notion of limit, was not systematically developed until the creation of calculus by Newton and Leibniz in the seventeenth century.

Important branches of applied mathematics are aptly described by the following indications:

- ordinary and partial differential equations (describing the change in time of systems of nature, engineering and society),
- the calculus of variations and optimization,
- scientific computing (the approximation and simulation of processes with more and more powerful computing machines).

Foundations of mathematics are concerned with mathematical logic and set theory. These two branches of mathematics did not exist until the nineteenth century. Mathematical logic investigates the possibilities, but also the limits of mathematical proofs. Because of its by nature very formal development, it is well-equipped to describe processes in algorithms and on computers, which are free of subjectivity. Set theory is basically a powerful language for formulating mathematics.

Today, mathematics is used throughout the world as an essential tool in many fields, including natural science, engineering, medicine, and the social sciences. Applied mathematics, the branch of mathematics concerned with application of mathematical knowledge to other fields, inspires and makes use of new mathematical discoveries and sometimes leads to the development of entirely new disciplines. Mathematicians also engage in pure mathematics, or mathematics for its own sake, without having any application in mind, although practical applications for what began as pure mathematics are often discovered later.

In modern mathematics there are opposing tendencies visible. On the one hand, we observe an increase in the degree of specialization. On the other hand, there are open questions coming from the theory of elementary particles, cosmology and modern technology which have such a high degree of complexity that they can only be approached through a synthesis of quite diverse areas of mathematics. This leads to a unification of mathematics and to an increasing elimination of the non-natural split between pure and applied mathematics.

The history of mathematics is full of the appearance of new ideas and methods. We can safely assume that this tendency with continue on into the future.

Glossary

abstraction - абстракція

algorithm - алгоритм

appropriately chosen аксіом and definitions - ретельно відібрані аксіоми та визначення

approximation - апроксимація, наближення

assume safely - з упевненістю припускати

be aptly described - бути вміло описаними

be concerned with smth – мати відношення до чогось, бути обізнаним у чомусь

be free of subjectivity - бути позбавленим суб'єктивності

calculation - розрахунок

calculus (also: нескінченно calculus) - обчислення нескінченно малих значень, диференціальне та інтегральне числення; математичний аналіз

counting - підрахунок

crowning achievement - головне досягнення
cuneiform writing - клинопис
develop in fitful bursts - розвиватися стрибкоподібно
dwell into the incredible, unimaginable extension of universe - пізнавати неймовірне, неймовірний простір всесвіту
dwell into the secrets of nature - пізнавати секрети природи
elimination of non-natural split between smth - усунення неприродного поділу поміж чимось
formulate new гіпотези - формулювати нові гіпотези
lead to an acceleration - призводити до прискорення
measurement - вимір
ordinary and partial differential equation - просте і парціальне диференціальне рівняння
point - крапка
precisely formulate laws of nature - точно формулювати закони природи
rigorous deduction - точний висновок synthesis of smth - синтез чого-небудь
systematic study of the shapes and motions of physical objects - планомірне вивчення форм і рухів фізичних об'єктів
unification - об'єднання

Exercises

1. Can you remember these phrases and expressions from the article you've just read? They are in the order they appeared.

1) to seek out p …
2) to draw necessary c …
3) to refer to r …
4) to interact with new scientific d …
5) s … of equations
6) s … of process
7) mathematical l … and set t …
8) application of mathematical k …
9) development of entirely new d …
10) theory of e … particles
11) high d … of complexity
12) diverse a … of mathematics

2. Match the following words from the text to form word partnerships. Refer to the text only if you need to.

1) logical	arguments
2) rigorous	mathematics
3) analytical	science
4) essential	application
5) natural	reasoning
6) applied	mathematics
7) pure	tool
8) practical	tendency
9) opposing	thinking

3. The following nouns form strong partnerships with the word mathematical. Find 3 more in the article you have just read.

mathematical

knowledge

discovery

4. Answer the following questions.

1) How can the term “mathematics” be defined?

2) What does mathematician’s job involve?

3) What are the opposite views on mathematical objects?

4) How did mathematics evolve?

5) What are the fundamental branches of maths and their basic notions?

6) What are the main indications of applied Mathematics?

7) When did mathematical logic and set theory appear? What do these branches deal with?

8) What fields is maths used nowadays in?

9) Why is pure mathematics called “maths for its own sake”?

UNIT 10

Text 2. History of mathematics

The word "mathematics" comes from the Greek μάθημα (máthēma), which means learning, study, science, and additionally came to have the narrower and more technical meaning "mathematical study", even in Classical times. Its adjective is μαθηματικός (mathēmatikós), related to learning, or studious, which likewise further came to mean mathematical. In particular, μαθηματικ τέχνη (mathēmatik tékhnē), in Latin ars mathematica, meant the mathematical art.

The apparent plural form in English, like the French plural form les mathématiques (and the less commonly used singular derivative la mathématique), goes back to the Latin neuter plural mathematica (Cicero), based on the Greek plural τα μαθηματικά (ta mathēmatiká), used by Aristotle, and meaning roughly "all things mathematical"; although it is plausible that English borrowed only the adjective mathematic(al) and formed the noun mathematics anew, after the pattern of physics and metaphysics, which were inherited from the Greek. In English, the noun mathematics takes singular verb forms. It is often shortened to maths, or math in English-speaking North America.

The evolution of mathematics might be seen as an ever-increasing series of abstractions, or alternatively an expansion of subject matter. The first abstraction, which is shared by many animals, was probably that of numbers: the realization that two apples and two oranges (for example) have something in common.

In addition to recognizing how to count physical objects, prehistoric peoples also recognized how to count abstract quantities, like time – days, seasons, years. Elementary arithmetic (addition, subtraction, multiplication and division) naturally followed.

Further steps needed writing or some other system for recording numbers such as tallies or the knotted strings called quipu used by the Inca to store numerical data. Numeral systems have been many and diverse, with the first known written numerals created by Egyptians in Middle Kingdom texts such as the Rhind Mathematical Papyrus. The Indus Valle civilization developed the modern decimal system, including the concept of zero.

The earliest uses of mathematics were in trading, land measurement, painting and weaving patterns and the recording of time and nothing much more advanced until around

3000BC onwards when the Babylonians and Egyptians began using arithmetic, algebra and geometry for taxation and other financial calculations, building and construction and astronomy. The systematic study of mathematics in its own right began with the Ancient Greeks between 600 and 300BC.

Mathematics has since been greatly extended, and there has been a fruitful interaction between mathematics and science, to the benefit of both.

Mathematical discoveries have been made throughout history and continue to be made today. According to Mikhail B. Sevryuk, in the January 2006 issue of the Bulletin of the American Mathematical Society, "The number of papers and books included in the Mathematical Reviews database since 1940 (the first year of operation of MR) is now more than 1.9 million, and more than 75 thousand items are added to the database each year. The overwhelming majority of works in this ocean contain new mathematical theorems and their proofs."

Glossary

additionally - крім того
anew - заново
apparent - очевидний
be plausible - бути імовірним
borrow - позичати
ever-series of increasing abstractions - строго зростаюча послідовність абстракцій
expansion of subject matter - розширення теми
extend - розширюватися
go back - сходити
inherit - успадкувати, перейняти
knotted strings - зав'язані мотузки
land measurement - топографічна зйомка
likewise further - також в подальшому
mean roughly - приблизно означати
narrow meaning - вузьке значення
quipu - кіпу (вузликове письмо у древніх перуанців)
store чисельного data - зберігати числові дані
tally - одиниця рахунку
trading - торгівля
weaving - ткацтво

Exercises

1. What do you think the following terms from the article mean?
Check in the article if you need to.

1) addition (paragraph 4)
2) subtraction (paragraph 4)
3) multiplication (paragraph 4)
4) division (paragraph 4)
5) taxation (paragraph 6)
6) construction (paragraph 6)

2. Match the following words from the text to form word partnerships. Refer to the text only if you need to.

1) plural arithmetic
2) singular calculations
3) physical derivative
4) elementary discovery
5) decimal majority
6) financial theorem
7) fruitful form
8) mathematical system
9) overwhelming object
10) mathematical interaction

3. Work with a partner. Without referring back to the article, can you remember in what context the following figures were mentioned?

1) 3000 BC
2) 600–300 BC
3) 1940
4) 1,9 million
5) 75 thousand

Search in the text for the ones you have forgotten.

4. Answer the following questions.

1) What is the origin of the word "mathematics"?
2) How did the word "mathematics" appear in English language?
3) How is the evolution of maths treated?
4) Where were the first known numerals created?
5) What spheres were the first elements of maths applied in?
6) When did the systematic study of mathematics start?
7) What is the main trend in maths as science nowadays?

UNIT 11

Text 3. History of geometry

The earliest recorded beginnings of geometry can be traced to ancient Mesopotamia, Egypt, and the Indus Valley from around 3000 BCE. Early geometry was a collection of empirically discovered principles concerning lengths, angles, areas, and volumes, which were developed to meet some practical need in surveying, construction, astronomy, and various crafts. The earliest known texts on geometry are the Egyptian Rhind Papyrus and Moscow Papyrus, the Babylonian clay tablets, and the Indian Shulba Sutras, while the Chinese had the work of Mozi, Zhang Heng, and the Nine Chapters on the Mathematical Art, edited by Liu Hui.

Euclid's Elements (c. 300 BCE) was one of the most important early texts on geometry, in which he presented geometry in an ideal axiomatic form, which came to be known as Euclidean geometry. The treatise is not, as is sometimes thought, a compendium of all that Hellenistic mathematicians knew about geometry at that time; rather, it is an elementary introduction to it; Euclid himself wrote eight more advanced books on geometry. We know from other references that Euclid’s was not the first elementary geometry textbook, but the others fell into disuse and were lost.

In the Middle Ages, mathematics in medieval Islam contributed to the development of geometry, especially algebraic geometry and geometric algebra. Al-Mahani conceived the idea of reducing geometrical problems such as duplicating the cube to problems in algebra. Thābit ibn Qurra (known as Thebit in Latin) (836-901) dealt with arithmetical operations applied to ratios of geometrical quantities, and contributed to the development of analytic geometry. Omar Khayyám (1048-1131) found geometric solutions to cubic equations, and his extensive studies of the parallel postulate contributed to the development of non-Euclidian geometry. The theorems of Ibn al-Haytham (Alhazen), Omar Khayyam and Nasir al-Din al-Tusi on quadrilaterals, including the Lambert quadrilateral and Saccheri quadrilateral, were the first theorems on elliptical geometry and hyperbolic geometry, and along with their alternative postulates, such as Playfair's axiom, these works had a considerable influence on the development of non-Euclidean geometry among later European geometers, including Witelo, Levi ben Gerson, Alfonso, John Wallis, and Giovanni Girolamo Saccheri.

In the early 17th century, there were two important developments in geometry. The first, and most important, was the creation of analytic geometry, or geometry with coordinates and equations, by René Descartes (1596–1650) and Pierre de Fermat (1601–1665). This was a necessary precursor to the development of calculus and a precise quantitative science of physics. The second geometric development of this period was the systematic study of projective geometry by Girard Desargues (1591–1661). Projective geometry is the study of geometry without measurement, just the study of how points align with each other.

Two developments in geometry in the 19th century changed the way it had been studied previously. These were the discovery of non-Euclidean geometries by Lobachevsky, Bolyai and Gauss and of the formulation of symmetry as the central consideration in the Erlangen Programme of Felix Klein (which generalized the Euclidean and non Euclidean geometries). Two of the master geometers of the time were Bernhard Riemann, working primarily with tools from mathematical analysis, and introducing the Riemann surface, and Henri Poincaré, the founder of algebraic topology and the geometric theory of dynamical systems.

As a consequence of these major changes in the conception of geometry, the concept of "space" became something rich and varied, and the natural background for theories as different as complex analysis and classical mechanics. The traditional type of geometry was recognized as that of homogeneous spaces, those spaces which have a sufficient supply of symmetry, so that from point to point they look just the same. Although various laws concerning lines and angles were known to the Egyptians and the Pythagoreans, the systematic treatment of geometry by the axiomatic method began with the Elements of Euclid.

From a small number of explicit axioms, postulates, and definitions Euclid deduces theorems concerning the various figures of geometrical interest. Until the 19th century this work stood as a supreme example of the exercise of reason, which all other intellectual achievements ought to take as a model. With increasing standards of formal rigor it was recognized that Euclid does contain gaps, but fully formalized versions of his geometry have been provided. For example, in the axiomatization of David Hilbert, there are six primitive terms, in that of E. V. Huntington only two: sphere’ and ‘includes’.

Glossary

align with each other – з’єднуватися, шикуватися в ряд

Babylonian clay tablets - вавилонські глиняні дощечки
BCE (before the Common Era) - до нашої ери
become rich and varied - стає широким і різноманітним
збірника - збірник
conceive the idea of smth - розуміти ідею чого-небудь
conception of geometry - поняття геометрії
contain gaps - містити недоробки
deduce theorem - виводити теорему
elementary geometry textbook - підручник з елементарної геометрії
Euclid's Elements - «Начала» Евкліда
exercise of reason - використання доказів
fall into disuse - виходити з ужитку
formulation of symmetry - формулювання поняття симетрії
Hellenistic - давньогрецький
Indus Valley - долина річки Інд
Lambert quadrilateral - ламбертов (плоский) чотирикутник
master geometer - провідний геометр
natural background for smth - природний фон для чогось
papyrus - папірус
постулат - постулат, аксіома
precursor to smth - попередник, провісник чогось
Піфагорійська - піфагорієць, послідовник Піфагора
sufficient supply of symmetry - достатня симетрія
supreme example of smth - головний приклад чого-небудь
surveying - межування
Sutra - сутра (в давньоіндійській літературі лаконічне висловлювання)
systematic treatment of smth - систематичний розгляд чого-небудь
treatise - трактат

Exercises

1. What do you think the following terms from the article mean? Check in the article if you need to.

1) length (paragraph 1)
2) angle (paragraph 1)
3) area (paragraph 1)
4) volume (paragraph 1)
5) construction (paragraph 1)
6) astronomy (paragraph 1)
7) ratio (paragraph 3)
8) quadrilateral (paragraph 3)
9) coordinate (paragraph 4)
10) equation (paragraph 4)
11) calculus (paragraph 4)
12) measurement (paragraph 4)
13) point (paragraph 4)

14) line (paragraph 6)
15) axiomatization (paragraph 6)
16) sphere (paragraph 6)

2. Can you remember these phrases and expressions from the article you've just read? They are in the order they appeared.

1) v … crafts
2) axiomatic f …
3) arithmetical o …
4) e … studies
5) a … postulate
6) systematic s …
7) c … consideration
8) mathematical a …
9) Riemann s …
10) geometric t …
11) d … system
12) complex a …
13) c … mechanics
14) explicit a …
15) i … achievement

3. Match the following words from the text to form word partnerships. Refer to the text only if you need to.

1) geometric space
2) geometrical rigor
3) cubic algebra
4) parallel topology
5) algebraic method
6) homogeneous equation
7) axiomatic quantities
8) formal term
9) primitive postulate

4. The following adjectives form strong partnerships with the word geometry. Find 5 more adjectives in the article you have just read.

algebraic
elliptical
geometry

5. All the phrases below were in the article you've read. Complete them using the pairs of the words in the box.

collection + principles	fully + version	look + same
have + development	various + interest	precise + physics
reduce + problems	from + point	meet + need

1) … of empirically discovered …
2) … practical …
3) … geometrical …
4) … a considerable influence on the …
5) … quantitative science of …
6) … point to …
7) … just the …
8) … figures of geometrical …
9) … formalized …

6. Answer the following questions.

1) Where can the earliest beginnings of geometry be traced?
2) What were early geometry principles developed for?
3) What are the earliest known texts on geometry?
4) How was geometry presented in Euclid's Elements?
5) What way did mathematics in medieval Islam contribute to the development of geometry?
6) Why was the creation of analytic geometry in the early 17th century important?
7) What is projective geometry?
8) How did geometry studies change in the 19th century?
9) How was the traditional type of geometry perceived?
10) When did the systematic treatment of geometry by the axiomatic method start?

7. What in the article did you personally find most amusing, interesting, surprising, shocking?

What amused me was …
What interested me was …
What surprised me was …
What shocked me was …

UNIT 12
Text 4. History of set theory

Part I

The history of set theory is rather different from the history of most other areas of mathematics. The idea of infinity had been the subject of deep thought from the time of the Greeks. Zeno of Elea, in around 450 BC, with his problems on the infinite, made an early major contribution. By the Middle Ages discussion of the infinite had led to comparison of infinite sets. For example Albert of Saxony proves that a beam of infinite length has the same volume as 3-space. He proves this by sawing the beam into imaginary pieces which he then assembles into successive concentric shells which fill space. Bolzano was a philosopher and mathematician of great depth of thought. In 1847 he considered sets with the following definition: "an embodiment of the idea or concept which we conceive when we regard the arrangement of its parts as a matter of indifference". Bolzano defended the concept of an infinite set. At this time many believed that infinite sets could not exist. Bolzano gave examples to show that, unlike for finite sets, the elements of an infinite set could be put in 1-1 correspondence with elements of one of its proper subsets. This idea eventually came to be used in the definition of a finite set. It was with Cantor's work however that set theory came to be put on a proper mathematical basis. Cantor's early work was in number theory and he published a number of articles on this topic between 1867 and 1871. These, although of high quality, give no indication that they were written by a man about to change the whole course of mathematics.

An event of major importance occurred in 1872 when Cantor made a trip to Switzerland. There Cantor met Richard Dedekind and a friendship grew up that was to last for many years. Numerous letters between the two in the years 1873-1879 are preserved and although these discuss relatively little mathematics it is clear that Dedekind's deep abstract logical way of thinking was a major influence on Cantor as his ideas developed. Cantor moved from number theory to papers on trigonometric series. These papers contain Cantor's first ideas on set theory and also important results on irrational numbers.

In 1874 Cantor published an article in “Crelle's” Journal, which marks the birth of set theory. A follow-up paper was submitted by Cantor to “Crelle's” Journal in 1878 but already set theory was becoming the centre of controversy. Kronecker, who was on the editorial staff of “Crelle's” Journal, was unhappy about the revolutionary new ideas contained in Cantor's paper. Cantor was tempted to withdraw the paper but Dedekind persuaded Cantor not to withdraw it and Weierstrass supported publication. The paper was published but Cantor never submitted any further work to “Crelle's” Journal.

Glossary

3-space - тривимірний простір
assemble - збирати
beam - промінь, пучок
conceive - осягати, розуміти
concentric shell - концентричний корпус, оболонка
concept - ідея, концепція, поняття, задум
controversy - дискусія, суперечка, полеміка
correspondence - відповідність, співвідношення
embodiment - варіант конструкції, конструктивне виконання
finite set - кінцева безліч
infinite set - нескінченна множина
infinity - нескінченність
proper subset - власна (істинна) підмножина
saw - розпилювати
set theory - теорія множин
tempt - схиляти, переконувати
ultimate - граничний, крайній, останній
volume - місткість, маса, величина

Exercises

1. Match the following words to form word partnerships:

concentric
finite
infinite
irrational
length

number
proper
set
shell
subset
theory

2. Answer the questions:

1) Who made an early contribution to development of set theory?
2) What did discussion of the infinite lead to?
3) Who compared a beam of infinite length with 3-space?
4) How did Albert of Saxony prove that a beam of infinite length has the same volume as 3-space?
5) What person defended the concept of an infinite set?
6) What definition of sets did Bolzano give?
7) What scientist put set theory on a proper mathematical basis?
8) What was Cantor's early work?
9) Who had a major influence on Cantor?
10) What date marks the birth of set theory?
11) Who was in opposition to Cantor's ideas?

UNIT 13

Text 5. History of set theory

Part II

In his 1874 paper Cantor considers at least two different kinds of infinity. Before this orders of infinity did not exist but all infinite collections were considered 'the same size'. However Cantor examines the set of algebraic real numbers, that is the set of all real roots of equations of the form an xn + an-1 xn-1 + an-2 xn-2 + . . . + a1 x + a0 = 0, where a is an integer. Cantor proves that the algebraic real numbers are in one correspondence with the natural numbers in the following way.

For an equation of the above form define its index to be |an| + |an-1| + |an-2| + ... + |a1| + |a0| + n.

There is only one equation of index 2, namely x = 0. There are 3 equations of index 3, namely 2x = 0, x + 1 = 0, x 1 = 0 and x2 = 0.

These give roots 0, 1, -1. For each index there are only finitely many equations and so only finitely many roots. Putting them in 1-1 correspondence with the natural numbers is now clear but ordering them in order of index and increasing magnitude within each index. In the same paper Cantor shows that the real numbers cannot be put into one-one correspondence with the natural numbers using an argument with nested intervals which is more complex than that used today (which is in fact due to Cantor in a later paper of 1891). Cantor now remarks that this proves a theorem due to Liouville, namely that there are infinitely many transcendental (i.e. not algebraic) numbers in each interval.

In his next paper Cantor introduces the idea of equivalence of sets and says two sets are equivalent or have the same power if they can be put in 1-1 correspondence. The word 'power' Cantor took from Steiner. He proves that the rational numbers have the smallest infinite power and also shows that R has the same power as R. He shows further that countably many copies of

R still has the same power as R. At this stage Cantor does not use the word ‘countable’, but he was to introduce the word in a paper of 1883. Cantor published a six part treatise on set theory from the years 1879 to 1884. This work was a brave move by the editor to publish the work despite a growing opposition to Cantor's ideas. The leading figure in the opposition was Kronecker who was an extremely influential figure in the world of mathematics. Kronecker's criticism was built on the fact that he believed only in constructive mathematics. He only accepted mathematical objects that could be constructed finitely from the intuitively given set of natural numbers.

Cantor however continued with his work. His fifth work in the six part treatise was published in 1883 and discusses well-ordered sets. Ordinal numbers are introduced as the order types of well-ordered sets. Multiplication and addition of transfinite numbers are also defined in this work although Cantor was to give a fuller account of transfinite arithmetic in later work. Cantor takes quite a portion of this article justifying his work. Cantor claimed that mathematics is quite free and any concepts may be introduced subject only to the condition that they are free of contradiction and defined in terms of previously accepted concepts. He also cites many previous authors who had given opinions on the concept of infinity including Aristotle, Descartes, Berkeley, Leibniz and Bolzano.

Glossary

continuity - безперервність
controversy - полеміка, дискусія, суперечка
correspondence - відповідність, співвідношення
equation - рівняння
index - індекс, показник, величина
integer - ціле число
irrational number - ірраціональне число
magnitude - величина, значення, абсолютне значення, модуль
natural number - натуральне число
nested interval - вкладений інтервал
number theory - теорія чисел
real number - реальне число
real root - реальний корінь
submit - підкорятися, стверджувати, вказувати
subset - підмножина
transcendental - трансцендентний
тригонометричні - тригонометричний

Exercises

1. Match the following words to form word partnerships.

nested
number
increasing
number
transcendental
magnitude
infinite

number
real
collection
natural
interval

2. Answer the questions.
1) What numbers did Cantor examine in his 1874 paper?
2) What numbers have the smallest infinite power according to Cantor?
3) When was Cantor to introduce the word ‘countable’?
4) When did Cantor publish a six part treatise on set theory?
5) What ideas does Cantor’s fifth work in the six part treatise contain?
6) Why Kronecker was in the opposition to Cantor’s ideas?

UNIT 14
Text 6. History of set theory

Part III

The year 1884 was one of crisis for Cantor. In 1885 Cantor continued to extend his theory of cardinal numbers and of order types. He extended his theory of order types so that now his previously defined ordinal numbers became a special case. In 1895 and 1897 Cantor published his final double treatise on set theory. It contains an introduction that looks like a modern book on set theory, defining set, subset, etc. Cantor proves that if A and B are sets with A equivalent to a subset of B and B equivalent to a subset of A then A and B are equivalent. In 1897 the first published paradox appeared, published by Cesare Burali-Forti. Some of the impact of this paradox was lost since Burali Forti got the definition of a well-ordered set wrong. However, even if the definition was corrected, the paradox remained. It basically revolves round the set of all ordinal numbers. The ordinal number of the set of all ordinals must be an ordinal and this leads to a contradiction. It is believed that Cantor discovered this paradox himself in 1885 and wrote to Hilbert about it in 1886. The year 1897 was important for Cantor because that year the first International Congress of Mathematicians was held in Zurich and at that conference Cantor's work was held in the highest esteem being praised by many including Hurwitz and Hadamard.

Set theory was beginning to have a major impact on other areas of mathematics. Lebesgue defined 'measure' in 1901 and in 1902 defined the Lebesgue integral using set theoretic concepts. Analysis needed set theory of Cantor. Zermelo in 1908 was the first to attempt an axiomatisation of set theory.

Many other mathematicians attempted to axiomatise set theory. Fraenkel, von Neumann, Bernays and Godel are all important figures in this development.

Glossary
analysis - аналіз, дослідження
axiomatisation - аксиоматизация
axiomatise - аксиоматизировать
cardinal number - кардинальне число, потужність множини
concept - ідея, концепція
протиріччя - спростування, протиріччя
defining set - визначає безліч

equivalent - еквівалентний
esteem - пієтет, повагу
integral - інтеграл
measure - міра, критерій
order type - порядковий тип
ordinal number - порядкове числівник
special case - приватний випадок
subset - підмножина
treatise – трактат, наукова праця
well-ordered set - строго впорядкована множина

Exercises

1. Which of these adjectives relate to the word "number"? Choose from the list. defining, infinite, cardinal, ordinal, subset

2. Answer the questions.

1) What year was one of crisis for Cantor?
2) What theory did Cantor continue to extend in 1885?
3) What ideas does Cantor's final double treatise on set theory contain?
4) Why was the year 1897 important for Cantor?
5) What areas of mathematics did set theory have a major impact on?
6) Who was the first to attempt an axiomatization of set theory?

UNIT 15

Text 7. Complex function theory

The development of the theory of functions of a complex variable took a rather winding path, as opposed to the modern theory of today with its extreme elegance, which belongs to the most beautiful and esthetically pleasing theories mathematics has to offer. This theory reaches into all branches of mathematics and physics. The formulation of modern quantum field theory for example is based in essence on the notion of a complex number.

The complex numbers were introduced by the Italian mathematician Bombelli in the middle of the sixteenth century, in order to solve equations of the third order. In his dissertation in 1799, Gauss provided the first (almost) complete proof of the fundamental theorem of algebra. For this proof he required complex numbers as a tool.

Gauss eliminated the mysticism which surrounded complex numbers of the form x+y up until that time, and showed that they may be interpreted as points (x, y) in the complex (Gaussian) plane. There is much evidence that Gauss already knew many properties of the complex-valued functions at the beginning of the eighteenth century, in particular the relation to elliptic integrals. However, he never published any of this.

In his famous Cours d'analyse (course in analysis), Cauchy treated power series in 1821 and showed that series of this kind in the complex realm have a circle of convergence. In a fundamental piece of work in 1825, Cauchy considered contour integrals and discovered their independence from the path of integration.

In this regard, he later developed a calculus of residues for the calculation of apparently complicated integrals. In 1851, Riemann took a decisive step in the construction of a theory of complex-valued functions, when in his dissertation at Gottingen, with the title Grundlagen fur eine allgemeine Theorie der Funktionen einer verdnderlichen komplexen Grofle (Foundations of a theory of functions of a complex variable), he founded the so-called geometric function theory, which uses conformal maps and which is distinguished by its intuitive appeal and the close proximity to physics.

Parallel to Riemann's work, Weierstrass developed rigorous analytic foundations for function theory based on power series. The work of both Riemann and Weierstrass was centered around the search for a deeper understanding of elliptic and more general Abelian integrals for algebraic functions. In this connection, completely new ideas are due to Riemann, out of which modern topology the mathematics of qualitative behavior and form sprouted.

In the last quarter of the nineteenth century Felix Klein and Henri Poincare created the powerful structure of the theory of automorphic functions. This class of functions is a broad generalization of the periodic and doubly period (elliptic) functions and is closely related to Abelian integrals.

In 1907 Koebe and Poincare proved independently the famous uniformization theorem, which represents one of the highlights of classical function theory and which completely clarifies the structure of Riemann surfaces.

The first modern and complete presentation of classical function theory was given by Hermann Weyl in his book Die Idee der Riemannschen Fläche (The idea of Riemann surfaces), which is a pearl of the mathematical literature.

Important new ideas in function theory were introduced in the fifties by the French mathematicians Jean Leray and Henri Cartan, who developed the notion and theory of sheaves.

Glossary

apparently - очевидно
broad generalization - загальна характеристика
calculus of residues - теорія вирахувань
circle of convergence - круг збіжності
close proximity to smth - близькість, схожість з чим-небудь.
complete proof - повний доказ
doubly period function - функція подвійно періодична
highlight - виділяти
in essence - по суті
intuitive appeal - наочна привабливість
notion of complex number - поняття комплексного числа
path of integration - контур (шлях) інтегрування
power series - ступенєвий розряд
powerful structure - потужна структура
qualitative behaviour - якісна поведінка
Riemann surface - риманова поверхня
rigorous analytical foundations - строгі аналітичні основи
sprout - виникати, з'являтися
theory of sheaves - теорія пучків
treat - розглядати, інтерпретувати

Exercises

1. Can you remember these phrases and expressions from the article you've just read? They are in the order they appeared.

1) to take a winding p …
2) to r … into all branches
3) to s … equation
4) to e … the mysticism
5) to take a decisive s …
6) to b … distinguished
7) to be centered a … smth
8) to be closely r … to smth
9) to completely c … the structure

2. Fill in the following chart to form word partnerships. Referring back to the article will help you with some of them.

complex
variable

quantum
field
theory
elliptic
integral
complex-valued function
function

3. Work with a partner. Without referring back to the article, can you remember in what context the following figures were mentioned?

1) Bombelli
2) Gauss
3) Cauchy
4) Riemann
5) Weierstrass
6) Felix Klein
7) Henri Poincare
8) Koebe
9) Hermann Weyl
10) Jean Leray and Henri Cartan

4. Answer the following questions.

1) How can the development of function theory be characterized?
2) When were the complex numbers introduced?
3) Who provided the first complex proof of the fundamental theorem of algebra?
4) What was Cauchy's contribution into integral algebra?
5) How did the theory of complex-valued functions appear?
6) What was Weierstrass's research devoted to?

7) Who created the theory of automorphic functions?

8) When was the famous uniformization theorem proved?

9) Who was the first modern and complete presentation of classical function theory given by?

10) How was the function theory further developed?

UNIT 16

Text 8. Mathematics as science

Carl Friedrich Gauss referred to mathematics as "the Queen of the Sciences". In the original Latin Regina Scientiarum, as well as in German Königin der Wissenschaften, the word corresponding to science means (field of) knowledge.

Indeed, this is also the original meaning in English, and there is no doubt that mathematics is in this sense a science. The specialization restricting the meaning to natural science is of later date. If one considers science to be strictly about the physical world, then mathematics, or at least pure mathematics, is not a science. Albert Einstein stated that "as far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality."

Many philosophers believe that mathematics is not experimentally falsifiable, and thus not a science according to the definition of Karl Popper.

However, in the 1930s important work in mathematical logic showed that mathematics cannot be reduced to logic, and Karl Popper concluded that "most mathematical theories are, like those of physics and biology, hypotheticodeductive: pure mathematics therefore turns out to be much closer to the natural sciences whose hypotheses are conjectures, than it seemed even recently." Other thinkers, notably Imre Lakatos, have applied a version of falsificationism to mathematics itself.

An alternative view is that certain scientific fields (such as theoretical physics) are mathematics with axioms that are intended to correspond to reality. In fact, the theoretical physicist, J. M. Ziman, proposed that science is public knowledge and thus includes mathematics. In any case, mathematics shares much in common with many fields in the physical sciences, notably the exploration of the logical consequences of assumptions. Intuition and experimentation also play a role in the formulation of conjectures in both mathematics and the (other) sciences. Experimental mathematics continues to grow in importance within mathematics, and computation and simulation are playing an increasing role in both the sciences and mathematics, weakening the objection that mathematics does not use the scientific method. In his 2002 book A New Kind of Science, Stephen Wolfram argues that computational mathematics deserves to be explored empirically as a scientific field in its own right.

The opinions of mathematicians on this matter are varied. Many mathematicians feel that to call their area a science is to downplay the importance of its aesthetic side, and its history in the traditional seven liberal arts; others feel that to ignore its connection to the sciences is to turn a blind eye to the fact that the interface between mathematics and its applications in science and engineering has driven much development in mathematics. One way this difference of viewpoint plays out is in the philosophical debate as to whether mathematics is created (as in art) or discovered (as in science). It is common to see universities divided into sections that include a division of Science and Mathematics, indicating that the fields are seen as being allied but that they do not coincide. In practice, mathematicians are typically grouped with scientists at the gross level but separated at finer levels. This is one of many issues considered in the philosophy of mathematics.

Mathematical awards are generally kept separate from their equivalents in science. The most prestigious award in mathematics is the Fields Medal, established in 1936 and now awarded every 4 years. It is often considered the equivalent of science's Nobel Prizes. The Wolf Prize in Mathematics, instituted in 1978, recognizes lifetime achievement, and another major international award, the Abel Prize, was introduced in 2003. These are awarded for a particular body of work, which may be innovation, or resolution of an outstanding problem in an established field. A famous list of 23 such open problems, called "Hilbert's problems", was compiled in 1900 by German mathematician David Hilbert. This list achieved great celebrity among mathematicians, and at least nine of the problems have now been solved. A new list of seven important problems, titled the "Millennium Prize Problems", was published in 2000. Solution of each of these problems carries a $1 million reward, and only one (the Riemann hypothesis) is duplicated in Hilbert's problems.

Glossary

achieve (great) celebrity - ставати популярним, набувати популярність
apply a version of falsification - використовувати фальсифікацію
at finer level - зокрема
at the gross level - загалом
be allied - мати спільні риси
be duplicated - дублюватися, повторюватися
be reduced to smth - зводитися до ч-н.
body of work - конкретний винахід
coincide - збігатися
correspond to reality - відповідати реальності
correspond to smth - відповідати чомусь
downplay the importance of smth - недооцінювати важливість чогось
drive development in smth - сприяти розвитку в чомусь
explore empirically - емпірично вивчати
falsifiable - фальсифікований
formulation of гіпотези - висунення гіпотез
hypothetico-deductive theory - теорія гіпотетичної індукції
institute - засновувати, вводити
keep separate from smth - відділяти, відокремлювати
laws of mathematics - закони математики
lifetime achievement- важливе досягнення
natural science - природознавство
notably - особливо
refer to smth - посилатися на на що-небудь
Riemann hypothesis - гіпотеза Рімана
share much in common with smth - мати багато спільного в чомусь
turn a blind eye to smth - не звертати увагу на щось
weaken the objection - зменшувати заперечення

Exercises

1. Match each of the words in the first column with the word from the second column to make ten word partnerships from the article. There are some alternative partnerships, but there's only one way to match all ten.

1) mathematical	knowledge
2) theoretical	method
3) public	arts
4) logical	field
5) scientific	debate
6) computational	side
7) aesthetic	award
8) liberal	logic
9) philosophical	mathematics
10) prestigious	consequence

2. Find the words in the article which mean the following. The first and the last letters are given.

1) to keep something within strict limits (paragraph 1) r ... t

2) an idea that attempts to explain something but has not yet been tested or proved to be correct (paragraph 2) h ... s

3) the development of a theory or guess based on information that is not complete (paragraph 2) c ... e

4) a statement that is generally believed to be obvious or true (paragraph 3) a ... m

5) something that you consider likely to be true even though no one has told you directly or even though you have no proof (paragraph 3) a ... n

6) the process of calculating a number or amount (paragraph 3) c ... n

7) something that produces the features of a situation in a way that seems real but is not (paragraph 3) s ... n

8) a place where things meet each other, or a thing that connects them (paragraph 4) i ... e

9) the use of a particular method, process, etc (paragraph 4) a ... n

10) the process of separating things into smaller groups or parts (paragraph 4) d … n

11) to show that something is true or exists (paragraph 4) i … e

12) to make something such as a list or book by bringing together information from many different places (paragraph 5) c … e

3. Without referring back to the text, can you expand on the following facts and figures mentioned in the article?

1) 1930s

2) A New Kind of Science

3) Fields Medal

4) 1978

5) Abel Prize

6) "Hilbert's problems"

7) $ 1 million

4. Answer the following questions.

1) Can mathematics be interpreted as a science? Why? Why not?

2) What did Karl Popper’s work reveal?
3) Why do theoretical physicists refer to maths as a science?
4) What plays an important role in the formulation of conjectures in maths?
5) What is the present role of experimental mathematics?
6) What are the opposite opinions of mathematicians?
7) Which important issue is considered in the philosophy of mathematics?
8) When did the most prestigious award in mathematics start its history?
9) What awards were instituted in 1978 and 2003?
10) Does the “Millennium Prize Problems” list have any prototype?

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