BASIC ENGLISH FOR MATHEMATICIANS AND COMPUTER SCIENCE LEARNERS

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Данное учебно-методическое пособие представляет собой практические задания по специализированной лексике для студентов I и II курсов, обучающихся по специальностям «математика», «математика и компьютерные науки» Института механики и математики им. Н.И. Лобачевского. Пособие состоит из трех разделов, двух словарей – словаря математической терминологии и толкового словаря компьютерной лексики.

Цель данного пособия состоит в развитии у студентов математической специализации навыков работы с компьютерно-математической лексикой, текстами на английском языке, включая навыки просмотрового и поискового чтения, навыки монологической и дискуссионной речей по актуальным проблемам специальности на английском языке. Пособие позволяет обучающимся расширить свой словарный запас за счет специализированной лексики, а также развить навыки технического перевода.

Предисловие

Настоящее учебное пособие предназначено для студентов I и II курсов **уровня Pre-Intermediate, Intermediate** Института механики и математики им. Н.И. Лобачевского, обучающихся по специальностям «математика», «математика и информационные технологии».

Целью учебного пособия является обогащение терминологического словарного запаса студентов, развитие навыков работы со специальными текстами среднего уровня трудности, расширение запаса лексики по программированию, а также формирование письменных и устных форм общения по специальности на английском языке. Для достижения поставленных задач в учебник включено достаточное количество примеров и рисунков. В текстах и заданиях имеются перекрёстные ссылки, обеспечивающие возможность получения информации по смежным вопросам.

Пособие состоит из трех разделов, приложения, русско-английского словаря математической терминологии и толкового словаря компьютерной лексики.

Первый раздел включает в себя 5 блоков, каждый из которых содержит лексику специализированной математической тематики, тексты и упражнения. **Второй раздел** состоит из 6 блоков, содержащих лексику специализированной компьютерной тематики, тексты и упражнения. В конце первого и второго разделов содержатся тесты для проверки усвоения пройденного материала.

Работа с каждым из блоков состоит из нескольких этапов. Первый этап – текстовый. На этом этапе происходит знакомство с новой лексикой, осуществляется работа с текстом. Цель данного этапа заключается в формировании навыков и умений чтения профессионально-ориентированных текстов, понимания их смысла и содержания прочитанного. Второй этап – послетекстовый, практический. Он связан с выполнением лексико-грамматических упражнений, нацеленных на закрепление новой специализированной лексики и грамматических конструкций, на развитие навыков монологической и диалогической речи, а также навыков перевода с английского на русский и с русского на английский языки. В основу последовательности расположения предлагаемых упражнений положен принцип усложнения: от более простых упражнений к более сложным. Для более успешного усвоения специальной математической лексики в начале каждого Unit приводится список терминов, которые отрабатываются в данном блоке, что несомненно облегчает работу как студентам, так и преподавателям.

Третий раздел рассчитан на самостоятельную работу студентов и состоит из 15 текстов для дополнительного чтения из аутентичных и отечественных монографий различной математической тематики.

В конце учебного методического пособия представлен **русско-английский словарь** терминов, встречающихся в данном пособии, а также **толковый словарь** компьютерной лексики.

При составлении учебно-методического пособия были использованы следующие **источники**:

1. The New Encyclopedia Britannica. – Chicago, 1994, vol. 3. – 588 p.

The Advanced Learner's Dictionary of Current English. – Ed. By A. S. Hornby. – V. London: Politics & Letters? 1983. – 509 p.

2. The Complete Rhyming Dictoinary. – Ed. By C. Wood. – New York, 1991. – 705 p.

3. The Guinness Encyclopedia of Sings and Symbols. – Ed. By J. Foley. – Guinness Publishing LTD., 1993. – 432 p.

4. The Oxford Illustrated History of English Literature. – Ed. By P Rogers. – Oxford: Univ. Press, 1994. – 526 p.

Webster's New World Dictionary. – New York, 1986. – 880 p.

5. Infotech – English for computer users. – Cambridge: Univ. Press, 1999.

6. Eugene D. Jaffe, M.B.A., Ph.D., Stephen Hilbert, Ph. D. Barron's GMAT (how to prepare for the graduate management admission test) 12 th edition.

7. The NEW MATRICULATION ALGEBRA. Being the Tutorial Algebra, Elementary Course by R. Deakin, M.A. Lond. and Oxon. With a Section on Graphs, 3s. 6d.

8. Леонтьев В.В., Булатов В.В. Английский язык для математиков: Учебное пособие. – Волгоград: Издательство Волгоградского государственного университета, 2001. – 156 с.

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10. http://basicofcomputer.com/what_is_computer.htm

11. http://www.computerhope.com/jargon.htm

12. http://whatis.techtarget.com/

13. http://www.5starsupport.com/inf/glossary.htm

14. http://www.math.utah.edu/~wisnia/glossary.html

15. http://www.ats-group.net/glossary-lexicon-computer.html

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17. http://groups.engin.umd.umich.edu/CIS/course.des/cis400/pascal/pascal.html14

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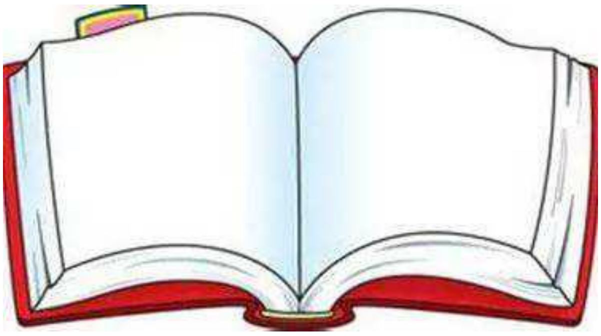
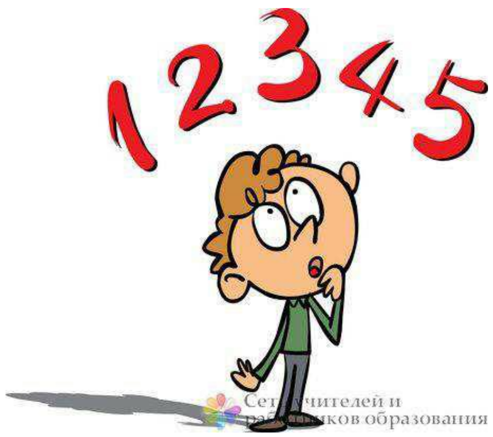


Part 1

Unit 1 *What is mathematics?*



I. Pre-reading task

1. Think about the answers to the following questions:

- Do you face the problem of necessity of counting in your in your everyday life?
- What is mathematics according to your point of view?
- What does mathematics consist of?

2. Read the following statements. Agree or disagree with them. Give the reasons of your choice.

1. It is impossible to give a concise and readily acceptable definition of maths as it is a multifield subject.
2. Maths in the broad sense of the world is a peculiar form of the general process of human knowledge of the real world.
3. Numbers are abstracted ideas or mental notions only, for numbers do not exist in nature.
4. A formal math system bears some analogy to a natural language, for it has its own vocabulary and rules.
5. Nowadays mathematicians frequently liken maths to art or game rather than to science.

6. Maths is the science dealing primarily with what can be obtained by reasoning alone.
7. Math writing is remarkable because it encompasses much information in few words.
8. Contemporary maths is mixture of much that is very old and still important (e.g., counting, the Pythagorean theorem) with new concepts such as sets, axiomatics, structure.
9. We need for careful and rigorous reasoning in proofs is not at once intuitively apparent to a nonmathematician.
10. Modern methods of carrying out arithmetic operations and their applications become sophisticated through modern computers.

II. Reading

1. Read the text and answer the question given in the title. Make a short summary of the text.

What is mathematics?

Mathematics is a Greek word, which means "something that must be learnt or understood". However, let us think what is maths in the modern sense of term, its implications and connotations? Here we deal with the answer, that there is no unified, neat and simple definition.

Maths as a science is a collection of branches. *The largest branch* is called the *real number system*. *A second branch is geometry*. Each branch has the same *logical structure*. It *begins with* certain *concepts*, such as the whole numbers or integers in the maths of number and point, line and triangle in geometry. These *concepts* must *verify* explicitly stated *axioms*. The next step is that *from* the *concepts* and *axioms theorems* are deduced. Hence, from the structural point of view, the concepts, axioms and theorems are the essential components of any compartment of maths.

The basic concepts of the main mathematical branches are abstractions from experience, but on the other hand, there are many more concepts, which are, in essence, creations of the human mind with or without help of any experience. The notion of a *variable,* which represents the quantitative values of some changing physical phenomena, is also at least one mental step beyond the mere observation of change. The *concept of a function* or a relationship between variables is almostly a mental creation.

Axioms constitute the second major component of any mathematical branch. From a set of axioms *the theorems* are deduced. Math theorems must be deductively established and proved. New theorems are proved constantly, even in such old subjects as algebra and geometry and the current developments are as important as the older results.

Growth of maths is possible in still another way. Mathematicians are sure now that sets of axioms, which have no bearing on the physical world, should be explored. Nowadays mathematicians investigate algebras and geometries with no immediate applications. However, there is some disagreement among mathematicians as to the way they answer the question "Do the concepts, axioms, and theorems exist in some objective world and are they merely detected by man or are they entirely human creations?"

In ancient times, the axioms and theorems were regarded as necessary truths about the universe already incorporated in the design of the world. Hence, each new theorem was a discovery, a disclosure of what already existed. The contrary view holds man creates that math, its concepts and theorems. Man distinguishes objects in the physical world and invents numbers and number names to represent one aspect of experience. Axioms are man's generalizations of certain fundamental facts and theorems can logically follow from the axioms. According to this point of view, maths is a human creation. Some mathematicians claim that pure maths is the most original creation of the human mind.

2. Translate and memorize the following words and word combinations.

Science, collection of branches, real number system, to verify, to deduce, to explore, to prove, constantly, explicitly, variable, implication, connotation, neat, general, unique.

3. Complete the following sentences using beginnings 1-7, and endings A-G.

1. Maths a science is …

2. The real number system builds on …

3. From the concepts and axioms …

4. Each branch has the same …

5. The concepts must verify …

6. Pure maths is the most original creation …

7. Math theorems must be deductively …

A. the ordinary whole numbers, fractions, and irrational numbers.

B. explicitly stated axioms.

C. logical structure, which begins with the certain concepts.

D. a collection of branches.

E. established and proved.

F. of the human mind.

G. theorems are deduced.

4. Read and translate the following paragraph.

Pure maths deals with the space forms and quantity relations of the real world – that I, with material which is very real, indeed. The fact that this material appears in an extremely abstract form can only superficially conceal its origin from the external world.

III. Pre-reading task

1. Think about answers to the questions. Try to prove your reasons.

- Have you ever heart about myths in mathematics?

- Describe any myths about maths you know.

- Are you agree with the point of view that women cannot be genuine mathematicians?

- Is it true that mathematicians believe that engineers and natural scientists are only interested in the math formulas and not in the theory of calculus?

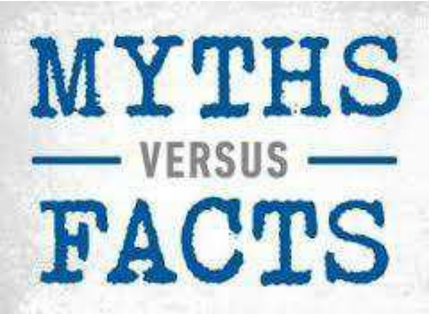
2. Read and remember the following words:

appear *v*	появляться, показываться
attend *v*	посещать, присутствовать
believe *v*	верить, доверять
calculus	исчисление
claim	требование, претензия
discover *v*	делать открытие
discourse	дискурс, высказывание
evaluate *v*	оценивать
evolve *v*	развивать, развертывать
owe *v*	быть должным
visualize *v*	визуализировать, мысленно представлять себе

IV. Reading

2. Read twelve modern myths in mathematics. Discuss with the partner myths in maths you have not mentioned before reading.

Text A



Twelve Maths Myths

1. MEN ARE BETTER IN MATH THAN WOMEN.

Research has failed to show any difference between men and women in mathematical ability. Men are reluctant to admit they have problems so they express difficulty with math by saying, "I could do it if I tried." Women are often too ready to admit inadequacy and say, "I just can't do math."

2. **MATH REQUIRES LOGIC, NOT INTUITION.**

Few people are aware that intuition is the cornerstone of doing math and solving problems. Mathematicians always think intuitively first. Everyone has mathematical intuition; they just have not learned to use or trust it. It is amazing how often the first idea you come up with turns out to be correct.

3. **MATH IS NOT CREATIVE.**

Creativity is as central to mathematics as it is to art, literature, and music. The act of creation involves diametrical opposites-working intensely and relaxing, the frustration of failure and elation of discovery, satisfaction of seeing all the pieces fit together. It requires imagination, intellect, intuition, and aesthetic about the rightness of things.

4. **YOU MUST ALWAYS KNOW HOW YOU GOT THE ANSWER.**

Getting the answer to a problem and knowing how the answer was derived are independent processes. If you are consistently right, then you know how to do the problem. There is no need to explain it.

5. **THERE IS A BEST WAY TO DO MATH PROBLEMS.**

A math problem may be solved by a variety of methods which express individuality and originality-but there is no best way. New and interesting techniques for doing all levels of mathematics, from arithmetic to calculus, have been discovered by students. The way math is done is very individual and personal and the best method is the one, which you feel most comfortable.

6. **IT'S ALWAYS IMPORTANT TO GET THE ANSWER EXACTLY RIGHT.**

The ability to obtain approximate answer is often more important than getting exact answers. Feeling about the importance of the answer often are a reversion to early school years when arithmetic was taught as a feeling that you were "good" when you got the right answer and "bad" when you did not.

7. **IT'S BAD TO COUNT ON YOUR FINGERS.**

There is nothing wrong with counting on fingers as an aid to doing arithmetic. Counting on fingers actually indicates an understanding of arithmetic-more understanding than if everything were memorized.

8. **MATHEMATICIANS DO PROBLEMS QUICKLY, IN THEIR HEADS.**

Solving new problems or learning new material is always difficult and time consuming. The only problems mathematicians do quickly are those they have solved before. Speed is not a measure of ability. It is the result of experience and practice.

9. **MATH REQUIRES A GOOD MEMORY.**

Knowing math means that concepts make sense to you and rules and formulas seem natural. This kind of knowledge cannot be gained through rote memorization.

10. **MATH IS DONE BY WORKING INTENSELY UNTIL THE PROBLEM IS SOLVED.**

Solving problems requires both resting and working intensely. Going away from a problem and later returning to it allows your mind time to assimilate ideas and develop new ones. Often, upon coming back to a problem a new insight is experienced which unlocks the solution.

11. **SOME PEOPLE HAVE A "MATH MIND" AND SOME DON'T.**

Belief in myths about how math is done leads to a complete lack of self-confidence. But it is self-confidence that is one of the most important determining factors in mathematical performance. We have yet to encounter anyone who could not attain his or her goals once the emotional blocks were removed.

12. **THERE IS A MAGIC KEY TO DOING MATH.**

There is no formula, rule, or general guideline, which will suddenly unlock the mysteries of math. If there is a key to doing math, it is in overcoming anxiety about the subject and in using the same skills; you use to do everything else.

1. Read and translate the text.

Text B

Myths in mathematics

There are many myths about maths, e.g., that "mathematics is the queen of the sciences" (K. Gauss); that the Internet is the cyberspace world - a new universe - and that informatics will reign and dominate throughout the 21st century (Microsoft Windows 95 experts claim). Some people believe that only gifted, talented people can learn maths, that it is only for math-minded boys, that only scientists can understand math language, that learning maths is a waste of time and efforts, etc.

Some analysts claimed in 1900 that nations would face a shortage of scientists and mathematicians in particular in 1980-2000years. The myths' practical impact on today's young mathematicians seeking employment is that they should take non-academic jobs in business, government and industry. The full unemployment rate for new math departments graduates was the highest in1992-1994.

A related myth in maths goes like this: "Jobs were tight, but the market improved. It is a cyclic business and the job market will get better soon again". Many scientists no longer have faith in this myth and they believe that math departments in all higher educational institutions ought to reconsider their missions. In particular they should consider downsizing their graduate program and re-examine the math education provided in high schools so that the program more closely should fit the reality of what the graduates will be doing in the future. Many long-term economic, political, academic and teaching issues and problems indicate that the current employment of the new young mathematicians is not likely to be reversed in the next decade. There is sure no single answer to this employment problem. A spectrum of changes and reforms will be needed to improve the situation.

In both education and the industrial high-tech workplace the people not trained as mathematicians are doing math work and research often quite successfully nowadays. This phenomenon is the legacy of a long and profound (very deep) failure of mathematicians to communicate with other groups. For example, mathematicians believe that engineers and natural scientists are only interested in the math formulas and not in the theory of calculus. However, anyone who specializes in physical chemistry or thermodynamics needs to make out (to understand) the chain rule and the implicitfunction theorem at a much deeper level than is taught in standard calculus of several variables in maths. The net result is that physicists and chemists are teaching at present these things more abstractedly and thoroughly than most math university departments. Nowadays the ordinary people no longer rank pure maths research as a top national concern.

The future of maths may depend on whether the emphasis is on the basic concepts, insight, abstract formalization and proof. This does not mean that rigorous, genuine and valid ―proof‖ is dead, just that ―insight‖ is playing a more important role. Successful careers in practical life often require conceptualization and abstraction of some, even engineering, problems. The majority of university graduates must be professionally adroit (skillful, clever) and flexible over a life-long career which includes many uncertain and difficult conditions of excess, insufficient or conflicting theories and data with rarely adequate time for contemplation (thinking or reasoning about).

Another myth in maths is that women cannot be genuine mathematicians. Female applicants must satisfy the same requirements at the entrance competitive examinations as boys should, there are no special tracks for girls. Most female applicants assert to have chosen to study maths because they like it rather than as a career planning. The change of high-school maths into university maths is for many of them a real shock, especially in the amount of information covered and the skills that are being developed. Despite this shock the study of higher maths should be available to a large set of students, both male and female, and not to the selected few.

There is no reason that women cannot be outstanding (famous, prominent) mathematicians and the Ukrainian women mathematicians have proved it. There should be affirmative (positive) action to bring women teachers onto math faculties at colleges and universities. One cannot expect the ratio to be 50/50, but the tendency should continue until male mathematicians no longer consider the presence of female mathematicians to be unusual at math department faculty or at the conferences and congresses.

Some ambitious experts claim that they think of mathematicians as forming a world nation of their own without distinctions of geographical origins, race, and creed (beliefs), sex, age or even time because the mathematicians of the past and "would-be" are all dedicated to the most beautiful of the arts and sciences. As far as math language is concerned, it is in fact too abstract and incomprehensible for average citizens. It is symbolic, too concise and precise, and often confusing to non-specialists. The myth that there is a great deal of confusion about math symbolism, that mathematicians try by means of their peculiar language to conceal the subject matter of maths from people at large is unreasonable and meaningless. The maths language is not only the foremost means of scientists intercourse, finance, trade and business accounts, it is designed and devised to become universal for all the sciences and engineering, e.g., multilingual computer processing and translation.

2. Answer the questions.

1. Who called mathematics the queen of sciences? Are you agree with this statement?

2. Do you believe that only gifted and talented people can learn math?

3. Is it true that only scientists can understand math language?

4. What is the ratio of women and men teachers at maths faculties at colleges and universities in Russia?

3. You have read and discussed various opinions about myths in mathematics. Complete a list of myths you are sure are wrong, and those you are agree to be true.

It's true that…	**It's wrong that…**

Unit 2 *Fundamental arithmetical operations*

Addition	+
Subtraction	−
Multiplication	×
Division	÷

I. Pre-reading task

1. Decide whether the following statements are true or false:

1. In the Hindu-Arabic numeration system we use five digits.

2. The result of multiplication is called the difference.

3. We get the sum as a result of subtraction.

4. Addition and subtraction are inverse operations.

5. As a result of multiplication we find the product.

6. In the expression 2+3=5 two and three are factors.

7. In the equation 12-11= 1 one is the difference.

8. In the mathematical sentence 12:6=2 two is the divisor.

2. Read and remember the following words:

addition	сложение
addends	слагаемые
plus sign	знак плюс
equals sign	знак равенства
sum	сумма
subtraction	вычитание
minuend	уменьшаемое
minus sign	знак минус
subtrahend	вычитаемое

difference	разность
multiplication	умножение
multiplicand	множимое
multiplication sign	знак умножения
multiplier	множитель
product	произведение
factors	сомножители
division	деление
dividend	делимое
division sign	знак деления
divisor	делитель
quotient	частное

II. Reading

1. Read the text below and check your answers to the true and false sentences made in ex. 1.

Four Basic Operations of Arithmetic

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. And here are the corresponding numerals: 0, 1, 2, 3, 4, and so on. In a numeration system numerals are used to represent numbers, and the numerals are grouped in a special way. The numbers used in our numeration system are called digits. In our Hindu-Arabic system 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 in a place-value system 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 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 sumof 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 anequation 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 areaddition, sub-traction, multiplication and division. In arithmetic an operation is a way of thinking 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 thedifference, as you remember from the above. 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 multiplied. 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 (5×2), the 5 and the 2 will be factors. The mul-tiplicand 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 in the dividend. You will get a part of thedividend left over. This part is called the remainder. In our case the remainder will be 1. Since multiplication and division are inverse operations you may check division by using multiplication.

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, $0 \div n$ 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*.

2. Note reading of the following numbers and calculations:

23 is read "twenty three"

578 is read "five hundred (and) seventy eight"

3578 is read "three thousand five hundred (and) seventy eight"

7425629 is read "seven million four hundred twenty five thousand six hundred and twenty nine"

a (one) hundred books hundreds of books

7 + 5 = 12	is read	**seven plus five equals twelve**
	or	**seven plus five is equal to twelve**
	or	**seven plus five is (are) twelve**
	or	**seven added to five makes twelve**
7 – 5 = 2	is read	**seven minus five equals two**
	or	**seven minus five is equal two**
	or	**five from seven leaves two**
	or	**difference between five and seven is two**

5 x 2 = 10	is read or or	**five multiplied by two is equal to ten** **five multiplied by two equals ten** **five times two is ten**
10 : 2 = 5	is read or	**ten divided by two is equal to five** **ten divided by two equals five**

3. Read and write the numbers and symbols in full according to the way they are pronounced:

76, 13, 89, 53, 26, 12, 11, 71, 324, 117, 292, 113, 119; 926, 929, 735, 473, 1002, 1026, 2606, 7354, 7013, 3005, 10117, 13526, 17427, 72568, 634113, 815005, 905027, 65347005, 900000001, 10725514, 13421926, 65409834, 815432789, 76509856, 1000000, 6537.

425 - 25 = 400

730 - 15=715

222 - 22 = 200

1617 + 17 = 1634

1215 + 60 = 1275

512 ÷ 8 = 64

1624 ÷ 4 = 406

456 ÷ 2 = 228

135 × 4 = 540

450 × 3 = 1350

107 × 5 = 535

613 × 13 = 7969

1511 + 30 = 1541

34582 + 25814 = 60396

768903 - 420765 = 348138

1634986 - 1359251 = 275735

1000 ÷ 100 = 10

810 ÷ 5 = 162

4. Translate the definitions of the following mathematical terms.

1. To divide – to separate into equal parts by a divisor;
2. Division – the process of finding how many times (*a number*) is contained in another number (the *divisor*);
3. Divisor – the number or quantity by, which the dividend is divided to produce the quotient;
4. Dividend – thee number or quantity to be divided;
5. To multiply – to find the product by multiplication;
6. Multiplication – the process of finding the number or quantity *(product)* obtained by repeated additions of a specified number or quantity;
7. Multiplier – the number by which another number (the *multiplicand*) is multiplied;
8. Multiplicand – the number that is multiplied by another (the *multiplier*);
9. Remainder – what is left undivided when one number is divided by another that is not one of its factors;
10. Product – the quantity obtained by multiplying two or more quantities together;
11. To check – to test, measure, verify or control by investigation, comparison or examination.

(From Webster's New World Dictionary).

5. Match the terms from the left column and the definitions from the right column:

a)

algebra	a number or quantity be subtracted from another one
to add	to take away or deduct (one number or quantity from another)
addition	the result obtained by adding numbers

	or quantities
addend	the amount by which one quantity differs from another
to subtract	to join or unite (to) so as to increase the quantity, number, size, etc. or change the total effect
subtraction	a number or quantity from which another is to be subtracted
subtrahend	equal in quantity value, force, meaning
minuend	an adding of two or moree numbers to get a number called the sum
equivalent	a mathematical system using symbols, esp. letters, to generalize certain arithmetical operations and relationships

b)

to divide	to test, measure, verify or control by investigation, comparison or examination
division	the process of finding the number or quantity (product) obtained by repeated additions of a specified number or quantity
dividend	the number by which another number is multiplied
divisor	what is left undivided when one number is divided by another that is not one of its factors
to multiply	to separate into equal parts by a divisor
multiplication	the process of finding how many times a number is contained in another number
multiplicand	the number or quantity to be divided
multiplier	the quantity obtained by multiplying two or more quantities

	together
remainder	the number that is multiplied by another
product	the number or quantity by which the dividend is divided to produce the quotient
to check	to find the product by multiplication

6. Read the sentences and think of a word which best fits each space.

1. Subtraction is ... of addition.
2. Addition and subtraction are arithmetical ... .
3. Positive and negative numbers are known as ... numbers.
4. Minuend is a number from which we ... subtrahend.
5. The process of checking subtraction consists of adding subtrahend to ….
6. In arithmetic only ... numbers with no ... in front of them are used.
7. The multiplicand is a number, which must be ... by a multiplier.
8. The number *y* which we divide is ... .
9. Division and multiplication as well as addition and ... are inverse.
10. Division by ... is meaningless.
11. The multiplicand and ... the names for factors.
12. The product is get as the result of multiplying multiplicand and ... .
13. The ... is the part of the dividend left over after the division if the ... isn't contained a whole ... of times in the dividend.

III. Pre-Reading task

1. Complete the following definitions:

a) Pattern: The operation, which is the inverse of addition is subtraction.

1. The operation, which is the inverse of subtraction … .
2. The quantity, which is subtracted … .
3. The result of adding two ОТ more numbers … .
4. The result of subtracting two ОТ more numbers … .
5. To find the sum … .

6. To find the difference … .

7. The quantity number or from which another number (quantity) is subtracted … .

8. The terms of the sum … .

b) Pattern: A number that is divided is a dividend.

1. The process of cumulative addition … .

2. The inverse operation of multiplication … .

3. A number that must be multiplied … .

4. A number by which we multiply … .

5. A number by which we divide … .

6. A part of the dividend left oover after division … .

7. The number which is the result of the operation of multiplication … .

2. Choose the correct term corresponding to the following definitions:

a) The inverse operation of multiplication.

addition	fraction	subtraction
quotient	division	integer

b) A whole number that is not divisible by 2.

integer	prime number	odd number
complex number	even number	negative number

c) A number that divides another number.

dividend	division	divisor
division	sign quotient	remainder

d) The number that is multiplied by another.

multiplication	remainder	multiplicand
multiplier	product	dividend

3. Read and translate the following sentences. Write two special questions to each of them. Then make the sentences negative.

1. Everybody can say that division is an operation inverse of addition.

2. One can say that division and multiplication are inverse operations.

3. The number which must be multiplied is multiplicand.

4. We multiply the multiplicand by the multiplier.

5. We get the product as the resu1t of multiplication.

6. If the divisor is contained a whole number of times in the dividend, we won't get any remainder.

7. The remainder is a part of the dividend left over after the operation is over.

8. The addends are numbers added in addition.

IV. Reading

1. Give the English equivalents of the following Russian words and word combinations:

вычитаемое, величина, уменьшаемое, алгебраическое сложение, эквивалентное выражение, вычитать, разность, сложение, складывать, слагаемое, сумма, числительное, числа со знаками, относительные числа, деление, умножение, делить, остаток, частное, произведение, выражение, обратная операция, делитель, делимое, множитель, множимое, сомножители, сумма, знак умножения, знак деления.

2. Read the text below and find:

What does mathematical language consist of?

How does mathematics use symbolism?

Why does the studying of maths is discouraging to weak minds?

Mathematics is the Language of Science

One of the foremost reasons given for the study of mathematics is, to use a common phrase, that "mathematics is the language of science". This is not meant to imply that mathematics is useful only to those who specialize in science. No, it implies that even a layman must know something about the foundations, the scope and the basic role played by mathematics in our scientific age.

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

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

Mathematical language is precise and concise, so that it is often confusing to people unaccustomed to its forms. The symbolism used in mathematical language is essential to distinguish meanings often confused in common speech. Mathematical style aims at brevity and formal perfection.

Let us suppose we wish to express in general terms the Pythagorean theorem, well-familiar to every student through his high-school studies. We may say: "We have a right triangle. If we construct two squares each having an arm of the triangle as a side and if we construct a square having the hypotenuse of the triangle for its side, then the area of the third square is equal to the sum of the areas of the first two".

But no mathematician expresses himself that way. He prefers: "The sum of the squares on the sides of a right triangle equals the square on the hypotenuse".

In symbols this may be stated as follows: $c^2 = a^2 + b^2$. This economy of words makes for conciseness of presentation, and mathematical writing is remarkable because it encompasses much in few words. In the study of mathematics much time must be devoted 1) to the expressing of verbally stated facts in mathematical language, that is, in the signs and symbols of mathematics; 2) to the translating of mathematical expressions into common language. We use signs and symbols for convenience. In some cases the symbols are abbreviations of words, but often they have no such relation to the thing they stand for. We cannot say why they stand for what they do, they mean what they do by common agreement or by definition.

The student must always remember that the understanding of any subject in mathematics presupposes clear and definite knowledge of what precedes. This is the reason why "there is no royal road" to mathematics and why the study of mathematics is discouraging to weak minds, those who are not able and willing to master the subject.

3. Translate the following sentences. Pay attention to comparative constructions "rather", "rather than", "other than".

1. Maths is the study of relations between certain ideal objects, such as numbers, functions, and geometric figures. These objects are not regarded as real, but rather as abstract models of physical situations.

2. Mathematicians want from math objects not their material or physical existence, but rather the right to use them in proofs.

3. The math concept is a notion or method rather than content.

4. Maths is an active rather than a passive activity.

5. Maths not only aids in the design of musical instruments but sometimes maths rather than the ear is the arbiter of perfect design.

6. In this century the skill of reading is divided into many types among which intensive, extensive and silent are most commonly used. Extensive reading is aimed at ideas rather than grammatical structure and is definitely distinguished from translation.

7. For many physical phenomena no exact concepts exist other than math notions.

8. The concepts of number and space figure do not come from any source other than the world of reality.

4. Read the reasoning of scientific language given by Albert Einstein. Give your own reaction to the definition. Tell your ideas according to the studied topic.

What distinguishes the language of science from language, as we ordinarily understand the word? How is it that scientific language is international? The super national character of scientific concepts and scientific language is due to the fact that they are set up by the best brains of all countries and all times.

A. Einstein

Unit 3 *Numbers*

I. Pre-reading task

1. Read and remember the basic terms of this unit:

9658	**ABSTRUCT NUMBER** **A FOUR FIGURE NUMBER**	отвлеченное число 4-х значное число
9	**thousands**	тысячи
6	**hundreds**	сотни
5	**tens**	десятки
8	**units**	единицы
5 KG.	**CONCRETE NUMBER**	именованное число
2	**CARDINAL NUMBER**	количественное число
2^{nd}	**ORDINAL NUMBER**	порядковое число
+ 5	**P0SITIVE NUMBER**	положительное число
- 5	**NEGATIVE NUMBER**	отрицательное число
a, b, c……	**ALGEBRAIC SYMBOLS**	алгебраические символы
3 1/3	**MIXED NUMBER**	смешанное число
3	**WHOLE NUMBER** **(INTEGER)**	целое число
1/3	**FRACTION**	дробь

2, 4, 6, 8	**EVEN NUMBERS**	четные числа
1,3,5,7	**ODD NUMBERS**	нечетные числа
2, 3, 5, 7	**PRIME NUMBERS**	простые числа
3+2-1	**COMPLEX NUMBER**	комплексное число
3	**REAL PART**	действительное число
2-1	**IMAGINARY PART**	мнимая часть
2/3	**PROPER FRACTION**	правильная дробь
2	**NUMERATOR**	числитель
3	**DENOMINATOR**	знаменатель
3/2	**IMPRORER FRACTION**	неправильная дробь

II. Reading

1. Read and translate the following text using vocabulary from the exercise you've done in the pre-reading task:

Introduction to real-number system

Mathematical analysis studies concepts related in some way to real numbers, so we begin our study of analysis with the real number system. Several methods are used to introduce real numbers. One method starts with the positive integers 1, 2, 3 ….. as undefined concepts and uses them to build a larger system, the positive rational numbers (quotients of positive integers), their negatives, and zero. The rational numbers, in turn, are then used to construct the irrational numbers, real numbers like $\sqrt{2}$ and π which are not rational. The rational and irrational numbers together constitute the real number system.

Although these matters are an important part of the foundations of mathematics, they will not be described in detail here. As a matter of fact, in most phases of analysis it is only the properties of real numbers that concerns us, rather than the methods used to construct them.

For convenience, we use some elementary set notation and terminology. Let S denote a set (a collection of objects). The notation $x \in S$ means that the object x is in the set, and we write $x \notin S$ to indicate that x is not in S.

A set S is said to be a subset of T, and we write $S \subseteq T$, if every object in S is also in T. A set is called nonempty if it contains at least one object.

We assume there exists a nonempty set R of objects, called real numbers, which satisfy ten axioms. The axioms fall in a natural way into three groups which we refer as the field axioms, order axioms, completeness axioms (also called the upper-bound axioms or the axioms of continuity).

2. Translate the definitions of the following mathematical terms:

1. mathematics - the group of sciences (including arithmetic, geometry, algebra, calculus, etc.) dealing with quantities, magnitudes, and forms, and their relationships, attributes, etc., by the use of numbers and symbols;
2. negative - designating a quantity less than zero or one to be subtracted;
3. positive - designating a quantity greater than zero or one to be added;
4. irrational - designating a real number not expressible as an integer or as a quotient of two integers;
5. rational - designating a number or a quantity expressible as a quotient of two integers, one of which may be unity;
6. integer - any positive or negative number or zero: distinguished from fraction;
7. quotient - the result obtained when one number is divided by another number;
8. subset - a mathematical set containing some or all of the elements of a given set;
9. field - a set of numbers or other algebraic elements for which arithmetic operations (except for division by zero) are defined in a consistent manner to yield another element of a set.
10. order - a) an established sequence of numbers, letters, events, units,

b) a whole number describing the degree or stage of complexity of an algebraic expression;

c) the number of elements in a given group.

(From Webster's New World Dictionary).

3. Match the terms from the left column and the definitions from the right column:

negative	designating a number or a quantity expressible as a quotient of two integers, one of which may be unity
positive	a set of numbers or other algebraic elements for which arithmetic operations (except for division by zero) are defined in a consistent manner to yield another element of a set
rational	designating a quantity greater than zero or one to be added
irrational	the number of elements in a given group
order	designating a real number not expressible as an integer or as a quotient of two integers
quotient	a mathematical set containing some or all of the elements of a given set
subset	a quantity less than zero or one to be subtracted
field	any positive or negative number or zero: distinguished from fraction
order	the result obtained when one number is divided by another number

4. Read and decide which of the statements are true and which are false. Change the sentences so they are true.

1. A real number x is called positive if $x > 0$, and it is called negative if $x < 0$.

2. A real number x is called nonnegative if $x=0$.

3. The existence of a relation > satisfies the only axiom: If $x < y$, then for every z we have $x + z < y + z$.

4. The symbol $\geq$ is used similarly as the symbol $\leq$.

5. Translate the following sentences into English.

1. В этой системе используются положительные и отрицательные числа.

2. Положительные и отрицательные числа представлены (to represent)

отношениями целых положительных чисел.

3. Рациональные (rational) числа, в свою очередь, используются для создания иррациональных (irrational) чисел.

4. В совокупности рациональные и иррациональные числа составляют систему действительных чисел.

5. Математический анализ - это раздел математики, изучающий функции и пределы.

6. Множество *X* является подмножеством другого множества *У* в том случае, если все элементы множества *X* одновременно являются элементами множества *У*.

7. Аксиомы, удовлетворяющие множеству действительных чисел, можно условно разделить на три категории.

II. Reading

1. Read the text and give definitions to rational and irrational numbers.

Rational and irrational numbers

Quotients of integers a/b (where b≠0) are called rational numbers. For example, 1/2, -7/5, and 6 are rational numbers. The set of rational numbers, which we denote by Q, contains Z as a subset. The students of mathematics should note that all the field axioms and the order axioms are satisfied by Q.

We assume that every student of mathematical department of universities is familiar with certain elementary properties of rational numbers. For example, if *a* and *b* are rational numbers, their average *(a+b)/2* is also rational and lies between *a* and *b*. Therefore between any two rational numbers there are infinitely many rational numbers, which implies that if we are given a certain rational number we cannot speak of the "next largest" rational number.

Real numbers that are not rational are called irrational. For example, e, π, e^{π} are irrational.

Ordinarily it is not too easy to prove that some particular number is irrational. There is no simple proof, for example, of irrationality of e^{π}. However, the irrationality of certain numbers such as $\sqrt{2}$ is not too difficult to establish and, in fact, we can easily prove the following theorem:

If n is a positive integer which is not a perfect square, *then* $\sqrt{n}$ is *irrational.*

Proof. Suppose first that n contains no square factor > 1. We assume that $\sqrt{n}$ is rational and obtain a contradiction. Let $\sqrt{n} = a/b$, where a and b are integers having no factor in common. Then $nb^2 = a^2$ and, since the left side of this equation is a multiple of n, so too is a^2. However, *if* a^2 is a multiple of n, a itself must be a multiple of n, since n has no square factors > 1. (This is easily seen by examining factorization of a into its prime factors). This means that $a = cn$, where c is some integer. Then the equation $nb^2 = a^2$ becomes $nb^2 = c^2n^2$, *or* $b^2 = nc^2$. The same argument shows that b must be also a multiple of n. Thus a and b are both multiples of n, which contradicts the fact that they have no factors in common. This completes the proof if n has no square factor > 1.

If n has a square factor, we can write $n = m^2k$, where $k > 1$ and k has no square factor > 1. Then $\sqrt{n} = m\sqrt{k}$; and if $\sqrt{n}$ were rational, the number $\sqrt{k}$ would also be rational, contradicting that was just proved.

2. Match the terms from the left column and the definitions from the right column:

perfect square	any of two or more quantities which form a product when multiplied together
factor	the numerical result obtained by dividing the sum of two or more quantities by the number of quantities
multiple	the process of finding the factors
average	a number which is a product of some specified number and another number
factorization	a quantity which is the exact square of another quantity

2. Translate into Russian.

An irrational number is a number that can't be written as an integer or as quotient of two integers. Thee irrational numbers are infinite, non-repeating decimals. There're two types of irrational numbers. Algebraic irrational numbers are irrational numbers that are roots of polynomial equations with rational coefficients. Transcendental numbers are irrational numbers that are not roots of polynomial equations with rational coefficients; π and e are transcendental numbers.

3. Give the English equivalents of the following Russian words and word combinations:

отношения целых, множитель, абсолютный квадрат, аксиома порядка, разложение на множители, уравнение, частное, рациональное число, элементарные свойства, определенное рациональное число, квадратный, противоречие, доказательство, среднее (значение).

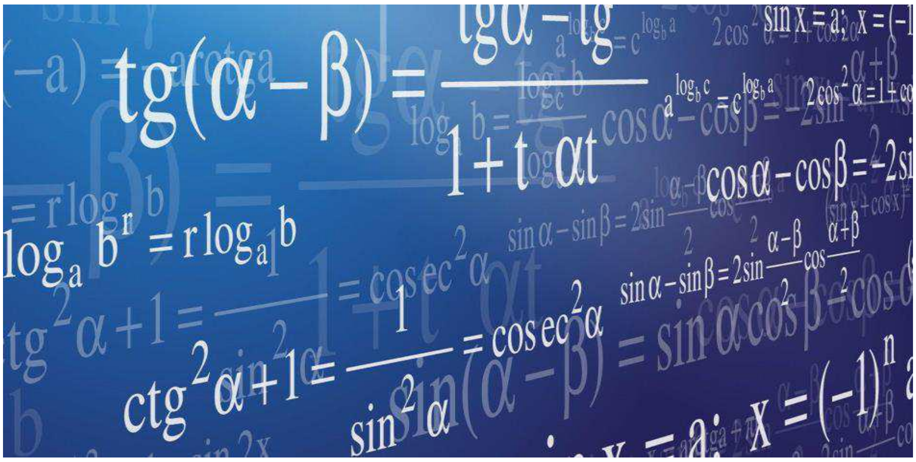
4. Translate the following sentences into English and answer the questions in pairs.

1. Какие числа называются рациональными?
2. Какие аксиомы используются для множества рациональных чисел?
3. Сколько рациональных чисел может находиться между двумя любыми рациональными числами?
4. Действительные числа, не являющиеся рациональными, относятся к категории иррациональных чисел, не так ли?

5. Translate the text from Russian into English.

Обычно нелегко доказать, что определенное число является иррациональным. Не существует, например, простого доказательства иррациональности числа e^{π}. Однако, нетрудно установить иррациональность определенных чисел, таких как $\sqrt{2}$, и, фактически, можно легко доказать следующую теорему: если n является положительным целым числом, которое не относится к абсолютным квадратам, то $\sqrt{n}$ является иррациональным.

Unit 4 *Advanced operations*



I. Pre-reading task

1. Read and remember the basic terminology:

raising to a power	возведение в степень
the base	основание
the exponent (index)	показатель степени
value of the power	значение степени
evolution (extracting a root)	извлечение корня
the index (degree) of the root	показатель корня
the radicand	подкоренное выражение
value of the root	значение корня
radical sign	знак корня
equations	уравнения
simple equation	линейное уравнение
the coefficients	коэффициенты
the unknown quantity	неизвестная величина
identical equation	

conditional equation	тождественное уравнение
	условное уравнение
solution	решение
logarithmic calculations	логарифмические вычисления
logarithm sign	знак логарифма
the characteristic	характеристика
the mantissa	мантисса

2. Read and translate the sentences into Russian paying attention on the construction of the modal compound predicate.

1. Algebraic formulas for finding the volumes of cylinders and spheres may have been used in Ancient Egypt to compute the amount of grain contained in them.

2. Babylonians must have been the first to solve the cubic equations by substitution.

3. The discovery of the theorem of Pythagoras can hardly have been made by Pythagoras himself; but it was certainly made in his school.

4. The Pythagoreans may have been the first to give a rigorous proof to the famous theorem.

5. Regardless of what mystical reasons may have motivated the early Pythagorean investigators, they discovered many curious and fascinating number properties.

6. Before Archimedes there might have been no systematic way of expressing large numbers.

7. Viète's inability to accept negative numbers (not to mention imaginary numbers) must have prevented him from attaining the generality he sought and partly comprehended in giving, for example, relations between the roots and the coefficients of a polynomial equation.

8. Descartes' geometric representation of negative numbers could have been helping mathematician to make negative numbers more acceptable.

9. Newton's earliest manifestations of the higher math talent may well have passed unnoticed.

10. Imaginary numbers must have been looking like higher magic to many eighteenth-century mathematicians.

II. Reading

1. Read the text and find:

a) two kinds of equations

b) what is called the solution

c) when two equations are equivalent

d) what is called transposition

Equations

An equation is **a symbolic statement** that two expressions are equal. Thus $\mathbf{x + 3 = 8}$ is an equation, stating that $\mathbf{x + 3}$ equals **8**.

There are two kinds of equations: **conditional equations,** which are generally called equations and **identical equations** which are generally called **identities.**

An identity is an equality whose two members (sides) are equal for all values of **the unknown quantity** (or quantities) contained in it.

An equation in one unknown is an equality which is true for only one value of the unknown.

To solve an equation in one unknown means to find values of the unknown that make the left member equal to the right member.

Any such value which satisfies the equation is called **the solution** or **the root** of the equation.

Two equations are equivalent if they have the same roots. Thus, $\mathbf{x - 2 = 0}$ and $\mathbf{3x - 6 = 0}$ are **equivalent equations,** since they both have the single root $\mathbf{x = 2}$.

In order to solve an equation it is permissible to:

a) add the same number to both members;

b) subtract the same number from both members;

c) multiply both members by the same number;

d) divide both members by the same number with the single exception of the number zero.

These operations are permissible because they lead to equivalent equations.

Operations **a)** and **b)** are often replaced by an equivalent operation called **transposition.** It consists in changing a term from one member of the equation to the other member and changing its signs.

An equation of the form **ax** + **b = 0** where **a ≠ 0** is an equation of **the first degree in the unknown** x. Equations of the first degree are solved by the permissible operations listed in this text. The solution is incomplete until the value of the unknown so found is substituted in the original equation and it is shown to satisfy this equation.

Example: **Solve:** **x ÷ 3x = 6**

Solution: Divide both members by 3 ÷ x = 2

Check: Substitute **2** for **x** in the original equation: **3(2)** = **6, 6** = **6.**

$\sqrt[3]{8} = 2$	**is read**	**the cube root of eight is two**
2 : 50 = 4 : x	**is read**	**two is to fifty as four is to x**
Log 10 3	**is read**	**logarithm of three to the base of ten**

2. Read and decide which of the statements are true and false. Change the sentences so they are true.

1. An equation is a symbolic statement that two expressions are equal.

2. There is only one kind of equations. It is called an identical equation.

3. An equation in one unknown is an equality, which is true for various values of the unknown.

4. Two or more equations are equivalent if they have the same roots.

5. To solve an equation in one unknown means to find values of the unknown such that make the left member equal to the right member.

6. An equation of the form $ax+b=0$, where $a\neq 0$ is an equation of the first degree in the unknown x.

7. In order to solve an equation it is permissible to add the same number to both members, to subtract the same number from both members, to multiply both members by the same and divide both members be the same number with single exception of the number one.

3. Find equivalents of the following words and word combinations:

equation	уравнение первой степени
statement	подстановка
conditional equation	уравнение с одним неизвестным
identical equation	неизвестная величина
identity	уравнение
unknown quantity	условное уравнение
solution	формулировка (высказывание)
simple equation	решение
permissible operation	эквивалентная операция
transposition	тождество
equation in one unknown	решение
equation of the first degree	линейное уравнение
substitution	корень
equivalent equations	тождественное уравнение

4. Translate the following sentences into English.

1. Математика как наука состоит из таких областей, как арифметика, алгебра, геометрия, математический анализ и т.д.

2. Математическое выражение $x+3=8$ – это уравнение, показывающее, что $x+3$ и 8 равны. Таким образом, считается, что уравнение – это символическое высказывание, показывающее равенство двух или более математических выражений.

3. Уравнение типа $x+3=8$ содержит одно неизвестное.

4. Для того, чтобы решить уравнение, необходимо выполнить определенные математические операции, такие как сложение и вычитание, умножение и деление.

5. Решить уравнение означает найти значения неизвестных, которые удовлетворяют уравнению.

6. Уравнение – это выражение равенства между двумя величинами.

7. Все уравнения 2-й, 3-й и 4-й степени решаются в радикалах.

8. Линейное уравнение может быть записано в форме $3x+2=12$.

III. Pre-reading task

1. Read and translate the sentences.

1. The origin of the title "Algebra" is rather exotic. We owe the word "algebra" to the Arab mathematician al-Khowarismi.

2. Although originally algebra referred only to equations and their solution, the word today has acquired a new connotation.

3. Algebra in its development passed successively through three stages: the rhetorical, the symbolic.

4. Rhetorical algebra is characterized by the complete absence of any symbols and the words were used in their symbolic sense.

5. In syncopated algebra certain words of common and frequent use were gradually abbreviated. Eventually these abbreviations have become symbols. Modern algebra is symbolic.

6. One of the most interesting problems of algebra is that of the algebraic solution of equations.

7. Elementary algebra (from 1700 B.C. until 1700 A.D.) dealt exclusively with the general properties of numbers and the solution of algebraic equations.

8. Nearly all mathematicians of distinguished rank have treated this subject. They arrived at the general expression of the roots of equations of the first four degrees. However, ingenious devices rather than advances in insight and theory achieved these solutions.

9. Early in the 19^{th} century a new view of maths began to emerge. Maths came not to restrict itself to numbers and shapes.

10. Algebra nowadays deals effectively with anything. The mainstream in the development of algebra followed a parallel and concurrent stream in the development of the complex number system.

2. Match the words to the definitions.

fraction	geometry	complex number	mathematical expressions	
algebra	positive number	conditional equation	mantissa	equation
variables	identical equation	characteristic	square root	cube root

1. An equation is a statement that two …….. are equal.

2. A conditional equation is true only for certain values of the …….

3. A whole part of a logarithm is called ……

4. …….. is a number that when multiplied by itself gives a given number.

5. ……..is a statement that two mathematical expressions are equal.

6. A statement that two mathematical expressions are equal for all values of their variables is called…….

7. The branch of mathematics that deals with the general properties of numbers we call ……

8. …….. is a number of type $a+ib$.

IV. Reading

1. Read the text and give more details and your own comments concerning all algebraists mentioned in the text.

Solution of polynomial equations of third and higher degree

The first records of man's interest in cubic equations date from the time of the old Babylonian civilization, about 1800-1600B. C. Among the mathematical materials that survive, arc tables of cubes and cube roots, as well as tables of values of $n^2 + n^3$. Such tables could have been used to solve cubics of special types. For example, to solve the equation $2x^3 + 3x^2 = 540$, the Babylonians might have first multiplied by 4 and made the substitution $y = 2x$, giving $y^3 + 3y^2 = 2{,}160$. Letting $y = 3z$, this becomes $z^3 + z^2 = 80$. From the tables, one solution is $z = 4$, and hence 6 is a root of the original equation.

In the Greek period concern with volumes of geometrical solids led easily to problems that in modern form involve cubic equations. The well-known problem of duplicating the cube is essentially one of solving the equation $x^3 = 2$. This problem, impossible of solution by ruler and compasses alone, was solved in an ingenious manner by Archytas of Tarentum (c. 400 B.C), using the intersections of a cone, a cylinder, and a degenerate torus (obtained by revolving a circle about its tangent).

The well-known Persian poet and mathematician Omar Khayyam (A. D. 1100) advanced the study of the cubic by essentially Greek methods. He found solutions through the use of conics. It is typical of the state of algebra in his day that he distinguished thirteen special types of cubics that have positive roots. For example, he solved equations of the type $x^3 + b^2x = b^2c$ (where b and c are positive numbers) by finding intersections of the parabola $x^2 = by$ and the circle $y^2 = x(c—x)$, where the circle is tangent to the axis of the parabola at its vertex. The positive root of Omar Khayyam's equation is represented by the distance from the axis of the parabola to a point of intersection of the curves.

The next major advance was the algebraic solution of the cubic. This discovery, a product of the Italian Renaissance, is surrounded by an atmosphere of mystery; the story is still not entirely clear. The method appeared in print in 1545 in the"Ars magna" of Girolamo Cardano of Milan, a physician, astrologer, mathematician, prolific writer, and suspected heretic, altogether one of the most colourful figures of his time. The method gained currency as "Cardan's formula"; (Cardan is the English form of his name). According to Cardano himself, however, the credit is due to Scipione del Ferro, a professor of mathematics at the University of Bologna, who in 1515 discovered how to solve cubics of the type $x^3+bx = c$. As was customary among mathematicians of that time, he kept his methods secret in order to use them for personal advantage in mathematical duels and tournaments. When he died in 1526, the only persons familiar with his work were a son-in-law and one of his students, Antonio Maria Fior of Venice.

In 1535 Fior challenged the prominent mathematician Niccolo Tar- taglia of Brescia (then teaching in Venice) to a contest because Fior did not believe Tartaglia's claim of having found a solution for cubics of the type $x^3+bx^2 = c$. A few days before the contest Tartaglia managed to discover also how to solve cubics of the type $x^3+ax = c$, a discovery (so he relates) that came to him in a flash during the night of February 12/13, 1535. Needless to say, since Tartaglia could solve two types of cubics whereas Fior could solve only one type, Tartaglia won the contest. Cardano, hearing of Tartaglia's victory, was eager to learn his method. Tartaglia kept putting him off, however, and it was not until four years later that a meeting was arranged between them. At this meeting Tartaglia divulged his methods, swearing Cardano to secrecy and particularly forbidding him to publish it. This oath must have been galling to Cardano. On a visit to Bologna several years later he met Ferro's son-in-law and learned of Ferro's prior solution. Feeling, perhaps, that this knowledge released him from his oath to Tartaglia, Cardanopublished a version of the method in Ars Magna. This action evoked bitter attack from Tartaglia, who claimed that he had been betrayed.

Although couched in geometrical language the method itself is algebraic and the style syncopated. Cardano gives as an example the equation $x^3 + 6x = 20$ and seeks two unknown quantities, p and q, whose difference is the constant term 20 and whose product is the cube of 1/3 the coefficient of x, 8. A solution is then furnished by the difference of the cube roots of p and q. For this example the solution is

$$\sqrt[3]{\sqrt{108}+10} - \sqrt[3]{\sqrt{108-10}}$$

The procedure easily applies to the general cubic after being transformed to remove the term in x^2. This discovery left unanswered such questions as these: What should be done with negative and imaginary roots, and (a related question) do three roots always exist? What should be done (in the so-called irreducible case) when Cardano's method produced apparently imaginary expression like

$$\sqrt[3]{81+30\sqrt{-3}+\sqrt[3]{81-30\sqrt{-3}}}$$

for the real root, —6, of the cubic x^3—63*—162 = 0? These questions were not fully settled until 1732, when Leonard Euler found a solution.

The general quartic equation yielded to methods of similar character; and its solution, also, appeared in Ars Magna. Cardano's pupil Ludovico Ferrari was responsible for this result. Ferrari, while still in his teens (1540), solved a challenging problem that his teacher could not solve. His solution can be described as follows: First reduce the general quartic to one in which the x^3 term is missing, then rearrange the terms and add a suitable quantity (with undetermined coefficient) to both sides so that the left-hand member is a perfect square. The undetermined coefficients are then determined so that the right-hand member is also a square, by requiring that its determinant be zero. This condition leads to a cubic, which can now be solved — the quartic can then be easily handled.

Later efforts to solve the quantic and other equations were foredoomed to failure, but not until the nineteenth century was this finally recognized. Carl Fridrich Gauss proved in 1799 that every algebraic equation of degree n over the real field has a root (and hence n roots) in the complex field. The problem was to express these roots in terms of the coefficients by radicals. Paolo Ruffini, an Italian teacher of mathematics and medicine at Modena, gave (in 1813) an essentially satisfactory proof of the impossibility of doing this for equations of degree higher than four, but this proof was not well-known at the time and produced practically no effect.

2. Read and decide which of the statements are true and which are false. Change the sentences so they are true.

1. For a positive number *n*, the logarithm of *n* is the power to which some number *b* must be raised to give *n*.

2. Common logarithms are logarithms to the base *e* (2.718…).

3. Common logarithms for computation are used in the form of an integer plus a positive decimal fraction.

4. Logarithms don't obey any laws.

5. An equation has as many roots as its degree.

6. The tree roots of the cubic equation yield to the same treatment as the two roots of the quadratic.

7. No general algebraic solution is possible for the polynomial equation of degree greater than four.

8. Arabic algebra used the rules of false position and of double false position.

3. Suppose that the information in the statement is insufficient. Repeat the statement and add your own reasoning, thus developing the idea further. Use the following phrases:

There is one more point to be noted …..	Bearing in mind ……
Moreover …..	In this connection one more aspect
I might as well add that …..	is interesting to mention …..
More than that …..	

1. The standardization of algebraic notation was being made during the two 9the 16th and 17th) centuries.

2. Who invented a particular symbol is a question requiring detailed research. Often it cannot be determined with certainty.

3. Algebraists of the 17th century made many improvements over Viète's algebraic notation.

4. The theory of symmetric functions of the roots of an equation, first perceived by Viète, was established by Newton.

5. Newton gave a method for finding approximations to the roots of numerical equations.

6. A functional relationship between two variables need not be always expressible as an algebraic equation.

7. One way of classifying is by the number of unknowns which are involved.

8. Equations of the form $ax+b=0$ are referred to as linear equations in one unknown.

9. Every linear equations can be solved.

10. There are several systematic ways in which systems of simultaneous linear equations can be solved.

IV. Reading

1. Read the text. Sum it up expressing the main ideas of the text and share with them in the class.

The theory of equations

History shows the necessity for the invention of new numbers in the orderly progress of civilization and in the evolution of mathematics. We must review briefly the growth of the number system in the light of the theory of equations and see why the complex number system need not be enlarged further. Suppose we decide that we want all polynomial equations to have roots. Now let us imagine that we have no numbers in our possession except the natural numbers. Then a simple linear equation like $2x = 3$ has no root. In order to remedy this condition, we invent fractions. But a .simple linear equation, like $x + 5 = 2$ has no root even among the fractions. Hence we invent negative numbers. A simple quadratic equation like $x^2=2$ has no root among all the (positive and negative) rational numbers, therefore we invent the irrational numbers which together with the rational numbers complete the system of real numbers.

However, a simple quadratic equation like $x^2= —1$ has no root among all the real numbers, hence, we invent the pure imaginary numbers. But a simple quadratic equation like $x^2 + 2x+4 = 0$ has no roots among either the real or pure imaginary numbers; therefore we invent the complex numbers. The story of $(-1)^{1/2}$ the imaginary unit, and of $x + y_i$, the complex number, originated in the logical development of algebraic theory. The word "imaginary" reflects the elusive nature of the concept for distinguished mathematicians who lived centuries ago. Early consideration of the square root of a negative number brought unvarying rejection. It seemd obvious that a negative number is not a square, and hence it was concluded that such square roots had no meaning. This attitude prevailed for a long time.

G. Cardano (1545) is credited with some progress in introducing complex numbers in his solution of the cubic equation, even though he regarded them as “fictitious”. He is credited also with the first use of the square root of a negative number in solving the now-famous problem, “Divide 10 into two parts such that the product ... is 40”, which Cardano first says is “manifestly impossible”; but then he goes on to say, in a properly adventurous spirit, “Nevertheless, we will operate”.

Thus he found 5+√15 and 5—√—15 and showed that they did indeed have the sum of 10 and a product of 40. Cardano concludes by saying that these quantities are “truly sophisticated” and that to continue working with them is “as subtle as it is useless”. Cardano did not use the symbol √—15, his designation was “Rx·m” that is, “radix minus”, for the square root of a negative number. R. Descartes (1637) contributed the terms “real” and “imaginary”. L. Euler (1748) used “i” for √—1 and C. F. Gauss (1832) introduced the term “complex number”. He made significant contributions to the understanding of complex numbers through graphical representation and defined complex numbers as ordered pairs of real numbers for which (a, b) • (c, d) = (ac—bd, ad+bc), and so forth.

Now, we may well expect that there may be some equation of degree 3 or higher which has no roots, even in the entire system of complex numbers. That this is not the case was known to C. F. Gauss, who proved in 1799 the following theorem, the truth of which had long been expected: Every algebraic equation of degree n with coefficients in the complex number system has a root (and hence n roots) among the complex numbers. Later Gauss published three more proofs of the theorem. It was he who called it "**Fundamental** Theorem **of Algebra**". Much of the work on complex number theory is Gauss's. He was one of the first to represent complex number as points in a plain. Actually, Gauss gave four proofs for the theorem, the last when he was seventy; in the first three proofs he assumes the coefficients of the polynomial equation are real, but in the fourth proof the purpose of solving polynomial equations we do not need to extend the number system any further.

2. Give the English equivalents of the following Russian words and word combinations:

тождество, перестановка, корень, решение, неизвестная величина, основа, условное уравнение, степень, показатель степени, высказывание (формулировка), эквивалентная операция, тождественное уравнение, уравнение с одним неизвестным, уравнение первой степени, подстановка, подкоренное выражение, линейное уравнение.

3. Translate the following sentences into English:

1. Математика как наука состоит из таких областей, как арифметика, алгебра, геометрия, математический анализ и т.д.

2. Математическое выражение $x + 3 = 8$ - это уравнение, показывающее что $x + 3$ и 8 равны. Таким образом, считается, что уравнение - это символическое высказывание, показывающее равенство двух или более математических выражений.

3. Уравнение типа $x + 3 = 8$ содержит одно неизвестное.

4. Для того чтобы решить уравнение; необходимо выполнить определенные математические операции, такие как сложение и вычитание, умножение и деление.

5. Решить уравнение означает найти значения неизвестных, которые удовлетворяют уравнению.

6. Уравнение - это выражение равенства между двумя величинами.

7. Все уравнения 2-й, 3-й и 4-й степени решаются в радикалах.

8. Линейное уравнение может быть записано в форме $3x + 2 = 12$.

4. Summarize the major point of the text.

Girolamo Cardano was a famous Italian mathematician, physician and astronomer who lived in the 16 century. He was born in 1501 and died in 1576 at the age of 75. He was noted for the first publication of the solution to the general cubic equation in his book on algebra called "Ars magna" ("The Great Art"). The book also contained the solution of the general biquadrate equation found by Cardano's former assistant Ferrari.

Cardano was also known for his speculations on philosophical and theological matters, and, in mathematics, for his early work in the theory of probability, published posthumously in "A Book on Games of Chance".

4. Read and translate the text.

An equation is a statement that two mathematical expressions are equal. A conditional equation is true only for certain values of the variables. Thus,

$3x + y = 7$ is true only for certain values of x and y. Such equations are distinguished from identities, which are true for all values of the variables. Thus,

$(x + y) = x^2 + 2xy + y^2$ which is true for aall values of x and y, is an identity. Sometimes the symbol ≡ is used to distinguish an identity from a conditional equation.

5. Translate the text into English using the following vocabulary:

выражаться	be expressed
дифференциал	differential
искомая величина	an unknown quantity
независимая переменная	an independent variable
обращаемый	making into
переменная	a variable
порядок	an order
приложение	an application
производная	a variable
свойство	a property, a characteristics
соотношение	a correlation
тождество	an identity
уравнение в частных производных	an equation in quotient variables
функция	a function

В алгебре для нахождения неизвестных величин пользуются уравнениями. На основании условий задачи составляют **соотношение**, связывающее неизвестную величину с данными, составляют уравнение и, затем, решая его, находят **искомую величину**. Аналогично этому в анализе для нахождения неизвестной функции по данным ее **свойствам** составляют уравнение, связывающее неизвестную функцию и величины, задающие ее свойства, и, поскольку эти последние **выражаются** через **производные** (или **дифференциалы**) того или иного **порядка**, приходят к соотношению, связывающему неизвестную функцию и ее производные или дифференциалы. Это уравнение называется дифференциальным уравнением. Решая его, находят искомую функцию. Из всех отделов анализа дифференциальные уравнения являются одним из самых важных по своим **приложениям**; и это не удивительно: решая дифференциальные уравнения, т.е., находя неизвестную функцию, мы устанавливаем закон, по которому происходит то или иное явление.

Не существует каких-либо общих правил для составления дифференциальных уравнений по условиям конкретной задачи. Условия задачи должны быть таковы, чтобы позволяли составить соотношение, связывающее **независимое переменное**, функцию и ее производную (или производные).

Порядком дифференциального уравнения называется наивысший из порядков входящих в него производных. Если в уравнение входят неизвестная функция нескольких переменных и ее производные (**частные производные)**, то уравнение называется **уравнением в частных производных**.

Обыкновенным **дифференциальным уравнением l-го порядка** называется *соотношение, связывающее независимое переменное, неизвестную функцию этого переменного и ее производную 1-го порядка.* Решением дифференциального уравнения мы будем называть всякую **дифференцируемую функцию,** удовлетворяющую этому уравнению, т.е. **обращаемую** его в **тождество** (по крайней мере, в некотором **промежутке** изменения *x).*

6. Match the words and the definitions:

fraction, geometry, complex number, algebra, positive number, conditional equation, mantissa, identical equation, characteristic, square root, cube root, equation

1. a whole part of a logarithm;
2. a number that when multiplied by itself gives a given number;
3. a statement that two mathematical expressions are equal; ,
4. a statement that two mathematical expressions are equal for all values of their variables;
5. the branch of mathematics that deals with the general properties of numbers;
6. a number of the type $a + ib$;

7. Read and decide which of the statements are true and which are false. Change the sentences so they are true.

1. For a positive number *n*, the logarithm of *n* (written *log n*) is the power to which some number *b* must be raised to give *n*.
2. Common logarithms are logarithms to the base *e* (2.718 ...).
3. Common logarithms for computation are used in the form of an integer (the characteristic) plus a positive decimal fraction (the mantissa).
4. Logarithms don't obey any laws.

8. Match the terms from the left column and the definitions from the right column:

logarithm	to put (facts, statistics; etc.) in a table of columns
base	the decimal part of a logarithm to the base 10 as distinguished from the integral part called *the characteristic*
antilogarithm	a logarithm to the base *e*
characteristic	any number raised to a power by an exponent
mantissa	the exponent expressing the power to which a fixed number *(the base)* must be raised in order to produce a

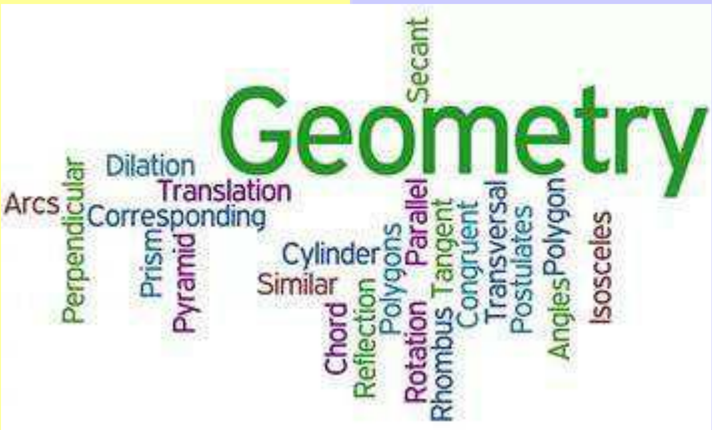
	given number *(an antilogarithm)*
natural logarithm	the resulting number when a base is raised to power by a logarithm
to tabulate	a) the act of computing, calculation, b) a method of computing.
computation	the whole number, or integral part, of a logarithm as distinguished from the *mantissa*

9. Translate the text into English.

Натуральные логарифмы

Число *e* имеет очень важное значение (to be of great importance) в высшей математике, его можно сравнить со значением *P* в геометрии. Число *e* применяется как основание натуральных, или неперовых логарифмов, имеющих широкое применение (application) в математическом анализе. Так, с их помощью многие формулы могут быть представлены в более простом виде, чем при пользовании десятичными логарифмами. Натуральный логарифм имеет символ ln.

Unit 5



I. Pre-reading task

1. Read and remember the basic terminology:

POINT	точка

LINE	линия
ANGLE	угол
POINT OF INTERSECTION	точка пересечения
ANGULAR POINT	угловая точка, вершина
STRAIGHT LINE	прямая (линия)
RAY	луч
PENCIL OF RAYS	пучок лучей
CURVED LINE	кривая линия
RIGHT ANGLE	прямой угол
REFLEX ANGLE	угол в пределах 180° и 360°
ACUTE ANGLE	острый угол
OBTUSE ANGLE	тупой угол
CORRESPONDING ANGLE	соответственный угол
ADJACENT ANGLE	прилежащий угол
SUPPLEMENTARY ANGLE	дополнительный угол [до 180°]
COMPLEMENTARY ANGLE	дополнительный угол [до 90°]
INTERIOR ANGLE	внутренний угол
EXTERIOR ANGLE	внешний угол
PLANE TRIANGLE	плоский треугольник
EQUILATERAL TRIANGLE	равносторонний треугольник
ISOSCELES TRIANGLE	равнобедренный треугольник
ACUTE-ANGLED TRIANGLE	остроугольный треугольник
OBTUSE-ANGLED TRIANGLE	тупоугольный треугольник
RIGHT-ANGLED TRIANGLE	прямоугольный треугольник
QUADRILATERAL	четырехугольник
SQUARE	квадрат
RECTANGLE	прямоугольник
RHOMBUS	ромб
RHOMBOID	ромбоид
TRAPEZIUM	трапеция
DELTOID	дельтоид
IRREGULAR QUADRILATERALS	неправильный четырёхугольник
POLYGON	многоугольник
REGULAR POLYGON	правильный многоугольник
CIRCLE	окружность, круг
CENTER	центр
CIRCUMFERENCE (PERIPHERY)	окружность, периферия
DIAMETER	диаметр
SEMICIRCLE	полукруг, полуокружность

RADIUS	радиус
TANGENT	касательная
POINT OF CONTACT	точка касания
SECANT	секущая
CHORD	хорда
SEGMENT	сегмент
ARC	дуга
SECTOR	сектор
RING (ANNULUS)	кольцо
CONCENTRIC CIRCLES	концентрические окружности
AXIS OF COORDINATES	координатная ось
AXIS OF ABSCISSAE	ось абсциссы
AXIS OF ORDINATE	ось ординаты
VALUES OF ABSCISSAE AND ORDINATES	значения абсциссы ординат
CONIC SECTION	коническое сечение
PARABOLA	парабола
BRANCHES OF PARABOLA	ветви параболы
VERTEX OF PARABOLA	вёршина параболы
ELLIPSE	эллипс
(sing. FOCUS) FOCI OF THE ELLIPSE	фокусы эллипса
TRANSVERSE AXIS (MAJOR AXIS)	пересекающая ось (главная ось)
CONJUGATE AXIS (MINOR AXIS)	сопряженная ось (малая ось)
HYPERBOLA	гипербола
ASYMPTOTE	асимптота
SOLIDS	твердые тела
CUBE	куб
PLANE SURFACE (A PLANE)	плоская поверхность (плоскость)
EDGE	грань
PARALLELEPIPED	параллелепипед
TRIANGULAR PRISM	трехгранная призма
CYLINDER	цилиндр
CIRCULAR PLANE	плоскость круга
SPHERE	сфера
CONE	конус

II. Reading

1. Read the text and give your own definitions to geometric terms "ellipse", "hyperbola", "parabola".

History of the terms "ellipse", "hyperbola", and "parabola"

The evolution of our present-day meanings of the terms "ellipse" "hyperbola", and "parabola" may be understood by studying the discoveries of history's great mathematicians. As with many other words now in use, the original application was very different from the modern.

Pythagoras (c. 540 B. C), or members of his society, first used these terms in connection with a method called the "application of areas". In the course of the solution (often a geometric solution of whatequivalent to a quadraticequation) one of three things happens: the base of the constructed figure either falls short of, exceeds, or fits the length of a given segment. (Actually, additional restrictions were imposed on certain of the geometric figures involved.) These three conditions were designated as ellipsis ("defect"), hyperbola ("excess") and parabola ("a placing beside"). It should be noted that the Pythagoreans were not using these terms in reference to the conic sections.

In the history of the conic sections Menaechmus (350 B.C.), a pupil of Eudoxus, is credited with the first treatment of the conic sections. Menaechmus was led to the discovery of the curves of the conic sections by a consideration of sections of geometrical solids. Proclus in his "Summary" reported that the three curves were discovered by Menaechmus; consequently they were called the "Menaechmian triads". It is thought that Menaechmus discovered the curves now known as the ellipse, parabola and hyperbola by cutting cones with planes perpendicular to an element and with the vertex angle of the cone being acute, right, obtuse, respectively.

The fame of Apollonius (c. 225 B. C.) rests mainly on his extraordinary "Conic Sections". This work was written in eight books, seven of which are preserved. The work of Apollonius on the conic sections differed from that of his predecessors in that he obtained all of the conic sections from one right double cone by varying the angle at which the intersecting plane cuts the element.

All of Apollonius' work was presented in regular geometric form, without the aid of the algebraic notation of the present-day Analytic Geometry. However, his work can be described more easily by using modern terminology and symbolism. If the conic is referred to a rectangular coordinate system in the usual manner with point A as the origin and with (x, y) as coordinates of any point P on the conic, the standard equation of the parabola $y^2=px$ (where p is the length of the latus rectum, i.e., the length of the chord that passes through a focus of the conic perpendicular to the principal axis) is immediately verified. Similarly, if the ellipse or hyperbola is referred to a coordinate system with vertex at the origin, it can be shown that $y^2 < px$ or $y^2 > px$, respectively. The three adjectives “hyperbolic”, “parabolic”, and “elliptic” are encountered in many places in mathematics, including projective geometry and non-Euclidean geometries. Often they are associated with the existence of exactly two, one, or none of something of particular relevance. The relationship arises from the fact that the number of points in common with the so- called line at infinity in the plane for the hyperbola, parabola and ellipse is two, one and zero, respectively.

2. Read and translate the following statements with the group.

1. Geometry is a very old subject. 2. It probably began in Babylonia and Egypt. 3. Men needed practical ways for measuring their land, for building pyramids, and for defining volumes. 4. The Egyptians were mostly concerned with applying geometry to their everyday problems. 5. Yet, as the knowledge of Egyptians spread to Greece the Greeks found the ideas about geometry very intriguing and mysterious. 6. The Greeks began to ask "Why? Why is that true?" 7. In 300 B. C. all the known facts about Greek geometry were put into a logical sequence by Euclid. 8. His book, called Elements, is one of the most famous books of mathematics. 9. In recent years men have improved on Euclid's work. 10. Today geometry includes not only the study of the shape and size of the earth and all things on it, but also the study of relations between geometric objects. 11. The most fundamental idea in the study of geometry is the idea of a point. 12. We will not try to define what *a* point is, but instead discuss some of its properties. 13. Think of a point as an exact location in space. 14. You cannot see a point, feel a point, or move a point, because it has no dimensions. 15. There, are points (locations) on the earth, in the earth, in the sky, on the sun, and everywhere in space. 16. When writing about points, you represent the points by dots. 17. Remember the dot is only a picture of a point and not the point itself. 18.

Points are commonly referred to by using capital letters. 19. The dots below mark points and are referred to as point *A*, point *B,* and point *C.*

.*B*

.*A*

.*C*

20. If you mark two points on your paper and, by using a ruler, draw a straight line between them, you will get a figure. 21. The figure below is a picture of a line segment.

22. Points *D* and *E* are referred to as endpoints of the line segment. 23. The line segment includes point *D,* point *E,* and all the points between them.

24. Imagine extending the segment indefinitely. 25. It is impossible to draw the complete picture of such an extension but it can be represented as follows.

26. Let us agree on using the word line to mean a straight line. 27. The figure above is a picture of line *DE* or line *ED.*

3. Read and decide which of the statements are true and which are false. Change the sentences so they are true.

1. A curve can be considered as the path of a moving point.
2. There're two types of curves: algebraic curves and transcendental curves.
3. Open curves have no end points and closed curves have a lot of end points.
4. A curve that does not lie in a plane is a skew or twisted curve.
5. A curvature is the rate of change of direction of a curve at a particular point on that curve.
6. The angle $\delta\psi$ through which the tangent to a curve moves as the point of contact moves along an arc PQ is the total curvature of this arc.
7. We define the mean curvature of any arc taking into account both the total curvature and the arc length.
8. At any point on a surface the curvature doesn't vary with direction.

4. Match the terms from the left column and definitions from the right column:

curvature	a) any straight line extending from the center to the periphery of a circle or sphere, b) the length of such a line
graph	the rate of deviation of a curve or curved surface from a straight line or plane surface tangent to it
arc	a curve or surface showing the values of a function
radius	any part of a curve, esp. of a circle

III. Pre-reading task

1. Read the sentences and think of a word, which best fits, each space.

a) 1. The Egyptians were mostly concerned with applying … to their everyday problems.

2. In 300 B.C. all the known facts about Greek geometry were put into a logical sequence by … .

3. Today geometry includes not only the study of the … and … of the earth and all things on it, but also the study of relations between geometric … .

4. The most fundamental idea in the study of geometry is the idea of a … .

5. You cannot see a … , feel a … , or move a … , because it has no dimensions.

For ideas: shape, point (4), size, geometry, Euclid, object.

b) 1. ... are generally studied as graphs of equations using a coordinate systems.

2. Only ... curves (or arcs) have end points.

3. A curve that does entirely in a plane is a ... curve.

4. A curve that does not lie in ... is a skew or twisted curve.

5. The rate of change of direction of a curve at a particular point on that curve is called a ...

6. The angle δψ through which the tangent to a curve moves as the point of contact moves along any arc is the ... of this arc.

7. The ... of any arc is defined as the total curvature divided by the arc length.

8. The circle of curvature at any point on a curve is the circle that is ... to the curve at that point.

9. There are two ... in which the radius of curvature has an absolute maximum and absolute minimum.

10. The principal curvatures at the point are the curvatures in two ... directions.

IV. Reading

1. Read the text.

Analytic geometry

The rectangular coordinate system provides a one-to-one correspondence between number pairs and points; that is, corresponding to a number pair (X_1, Y_1) there is always one and only one point P_1; and corresponding to a point P_2 there is one and only one number pair (X_2, Y_2). This one-to-one correspondence is the starting point of the plane Analytic Geometry.

The notion of a correspondence between a point in the plane and a pair of numbers can be extended to a more general kind of correspondence, namely, between a geometric locus and an equation. The graph of an equation is the locus of the points whose coordinates satisfy the equation. Conversely, the equation of a given curve is an equation satisfied by the coordinates of every point on the curve and by the coordinates of no other points.

This correspondence between equations and geometric loci, will indeed, form the central subject of our study. That is to say, our main investigation will take the form of one or the other of the problems:

1. Given an equation, to obtain the corresponding geometric locus (the graph of the equation) along with its properties.

2. Given a geometric locus whose points possess some common property (shared by no other points), to find the corresponding equation.

In the latter case the equation, in turn, will help us in studying other properties of the locus.

Thus, we define a curve as composed of points whose coordinates satisfy a certain equation. We may think of a curve as a locus or a path traced by a moving point according to certain specified conditions. From these conditions, it is possible to derive the equation of its curve and then discuss the curve in detail from the equation. The locus of an equation in X and Y is defined as the totality of points whose coordinates satisfy the equation. There exists no definite rule for finding the equation of the locus. As a matter of fact, the problem is to translate the geometric definition of the locus into an algebraic form with a suitable choice of a coordinate system.

We shall proceed to the discussion of particular species of loci — namely, the straight line, a circle, a parabola, an ellipse, and a hyperbola.

The problem of finding the equation of the straight line is the simplest case of the general problem of finding the equation of a curve. The equation of a straight line is determined by two points $P(X_1, Y_1)$ and $P_2(X_2, Y_2)$. This equation will be obtained from the fact that the point P(X, Y) is on the straight line, if and only if, the slopes of the segments P_1P and $P_1P_2$are equal. This condition is $(Y—Y_1)/(X — X_1) = (Y_2—Y_1)/(X_2 — X_1)$, $X_1 \neq X_2$. We shall refer to this as the two-point form of theequation of the straight line. Thus any straight line may be represented by an equation of the first degree in X and Y. Conversely, every equation of first degree $Ax+By+ C = 0$ represents a straight line.

The following loci lead to particular type of second degree equations, in two variables.

The Circle is the locus of a point, which moves so that its distance from a fixed point, called a centre, is constant. The distances from its centre to the locus are radii of the circle. Thus, $x^2 + y^2 = r^2$ is the equation of the circle with the centre at the origin and a radius r.

The Parabola is the locus of points which are equidistant from a fixed point and a fixed straight line.

The fixed point is the focus, the fixed line is the direotrix. The line perpendicular to the directrix and passing through the focus is the axis of the parabola. The axis of the parabola is, obviously, a line of symmetry. The point on the axis halfway between the focus and the directrix on the parabola is the vertex of the parabola. The parabola is fixed when the focus and the directrix are fixed.

The equation of the parabola, however, depends on the choice of the coordinate system. If the vertex of the parabola is at the origin and the focus is at the point (O, P) its equation is $X^2 = 2PY$ or $Y^2 = 2PX$.

The Ellipse — is the locus of a point which moves so that, the sum of its distances from two fixed points called the foci is constant. This constant will be denoted by 2a, which is necessarily greater than the distance between the foci (the focal distance). The line through the foci is the principal axis of the ellipse; the points in which the ellipse cuts the principal axis are called the vertices of the ellipse. If the centre of the ellipse is at the origin but the foci are on the y-axis its

$$\frac{y}{a2} + \frac{X2}{b2} = 1$$

where a and b represent the lengths of its semimajor and semiminor axes.

The Hyperbola is the locus of a point which moves so that the difference of its distances from two fixed points is a constant 2a. Its equation is

$$x^2/a^2 - y^2/b^2=1$$

This equation shows that the hyperbola is symmetric with respect to both coordinate axes and also the origin. It intersects the X-axis but does not cut the У-axis. Hence, the curve is not contained in a bounded portion of a plane. The curve consists of two branches. The line segment joining the vertices is called the transverse axis of the hyperbola; its lenght is 2a. The point midway between the ver An **angle is a configuration** of two lines (the sides or arms) meeting at a point (the **vertex).** Often an angle is regarded as the measure of **rotation** involved in moving from one **initial axis** to coincide with another final axis (termed a directions angle). If the amount and sense of the rotation are specified the angle is a rotation angle, and is positive if measured in an **anticlockwise** sense and negative if in a **clockwise** sense.

Angles are classified according to their measure:

-**Null** (or zero) **angle** - zero rotation (0°).

- **Right angle** - a quarter of a complete turn (90°)
- **Flat (or straight) angle** - half a complete turn (180°).
- **Round angle** (or perigon) - one complete turn (360°),
- **Acute angle** - between 0° and 90°.
- **Obtuse angle** - between 90° and 180°.
- **Reflex angle** - between 180°and 360°.

The angle of **elevation** of a point *A* from another point *B* is the angle between the line *AB* and the horizontal plane through *B*, with *A* lying above the plane. The angle of **depression** is similarly defined with A lying below the plane. The angle at point *B* made by lines *AB* and *CB* is denoted by $\angle ABC$.

2. Answer the questions.

1.What is an angle?

2.Can one say that an angle is regarded as the measure of rotation involved in moving from one initial axis to coincide with another final axis?

3.What are characteristics of a null angle?

4.An acute angle is an angle between 0° and 90°, isn't it?

5.What are characteristics of an obtuse angle?

6.What are characteristics of a reflex angle?

7.Is there any difference between the angle of depression and the angle of elevation?

3. Read and decide which of the statements are true and which are false. Change the sentences so they are true.

1. An angle is often regarded as the measure of rotation involved in moving from one initial axis to coincide with another final axis.
2. There’re eleven types of angles in their classification according to their measure.
3. 90° - it is the measure of an acute angle.
4. An angle is positive if it is measured in a clockwise sense.
5. The measure of a reflex angle is between 180°and360°.
6. The main difference of an angle of elevation of a points and its angle of depression is the following one: in the case of the angle of elevation the point *A* lies above the plane and in the case of the angle of depression - below the plane.

4. Match the terms from the left column and definitions from the right column:

an angle	formed by, or with reference to, a straight line or plane perpendicular to a base
null	of less than 90 degrees
right	designating an angle greater than a straight angle (180 degrees)
obtuse	height above a surface, as of the earth
flat	the shape made by two straight lines meeting at a common point, the vertex, or by two planes, meeting along an edge
acute	a decrease in force, activity, amount, etc. - a decrease in force, activity, amount, etc.
reflex	greater than 90 degrees and less than 180 degrees greater than 90 degrees and less than 180 degrees
elevation	designating of, or being zero, as: a) having all zero elements *(null* matrix), b) having a limit of zero *(null* sequence), c) having no members whatsoever *(null* set)
depression	absolute, positive

5. Give the Russian equivalents of the following words and word combinations:

1. side (arm)

2. acute angle

3. angle of depression

4. direction angle

5. sense of rotation

6. clockwise sense

7. vertex

8. obtuse angle

9. rotation

10. reflex angle

11. rotation angle

12. angle of elevation

13. right angle

14. flat (straight) angle

15. round angle (perigon)

16. null (zero) angle

6. Give the English equivalents of the following words and word combinations:

тупой угол, развёрнутый угол, нулевой угол, угол возвышения, угол понижения, прямой угол, полный угол, сторона, направление вращения, вершина, угол в пределах от 180° 360, вращение (поворот), острый угол, по часовой стрелке, против часовой стрелки, угол вращения, направляющий угол.

7. Translate the sentences into English.

1. Если две стороны и угол между ними одного треугольника равны соответственно двум сторонам и углу между ними другого треугольника, то такие треугольники равны.

2. Две прямые называются перпендикулярными, если они пересекаются под прямым углом.

3. Какой угол называется прилежащим?

4. Докажите, что вертикальные углы равны.

5. Сумма трех этих углов равна 270°.

8. Read the sentences and think of a word, which best fits, each space.

1. An angle is a ... of two lines (the sides or …) meeting at a point called the vertex.

2. Flat (or ...) angle means half a ... turn.

3. An obtuse angle is greater than an ... angle.

4. The measure of a ... angle is between 180°and 360°.

5. Angles are classified according to their....

6. Clockwise means the ... in which the hands of a clock rotate.

7. The largest angle is the ... angle being 360 degrees.

Check your skills

CHECKING VOCABULARY IN ADVANCED OPERATIONS & HIGHER MATHEMATICS

1. Choose the appropriate answer.

1. A variable whose limit is zero:

(A) infinitesimal	(D) unknown quantity
(B) derivative	(E) constant
(C) absolute value	(F) limit

2. A positive and negative change in a variable:

(A) increment	(D) derivative
(B) argument	(E) infinity
(C) function	(F) series

3. The interval which doesn't contain the end points:

(A) segment	(D) partly open interval
(B) closed interval	(E) straight line
(C) open interval	(F) curve

4. An equation which is true for aall values of the variable:

(A) conditional equation	(D)simple linear equation
(B) identical equation	(E) differential equation
(C) integral equation	(F) quadratic equation

5. The indicated sum of the terms of a sequence:

(A) finite sequence (D) general term

(B) series (E) summation

(C) infinite sequence (F) I don't know

2. Give the English equivalents of the following words and word combinations:

бесконечно малая величина, извлечение корня, значение степени, подкоренное выражение, возведение в степень, тело, криволинейные фигуры, касательная, бесконечность, сходящаяся последовательность.

3. Translate the text without using a dictionary.

INTEGRAL EQUATIONS

It is an equation that involves an integral of an unknown function. A general integral equation of the third kind has the form

$$u(x)g(x) = f(x) + \lambda \int_a^b K(x,y)g(y)dy$$

where the functions $u(x)$, $f(x)$ and $K(x, y)$ are known and g is the unknown function. The function K is the **kernel (1)** of the integral equation and is the parameter.

The limits of integration may be constants or may be functions of x. If $u(x)$ is zero, the equation becomes an integral equation of the first kind - i.e. it can be put in the form:

$$f(x) = \lambda \int_a^b K(x,y)g(y)\,dy$$

If $u(x)=1$, the equation becomes an integral equation of the second kind:

$$g(x) = f(x) + \lambda \int_a^b K(x, y)g(y)dy$$

An equation of the second kind is said to be **homogeneous (2)** if $f(x)$ is zero.

If the limits of integration, a and b, are constants then the integral equation is a Fredholm integral equation. If a is a constant and b is the variable x, the equation is a

Volterra integral equation.

CHECKING VOCABULARY IN GEOMETRY

1. Choose the correct variant of the answer.

1. An angle equal to one-half of a complete turn:

(A) flat angle (D) obtuse angle

(B) right angle (E) reflex angle

(C) round angle (F) acute angle

2. A type of conic that has an eccentricity greater than 1:

(A) parabola (D) focus

(B) hyperbola (E) transverse axis

(C) ellipse (F) circle

3. A plane figure formed by four intersecting lines:

(A) angle (D) quadrilateral

(B) cube (E) star polygon

(C) triangle (F) square

4. A surface composed of plane polygonal surface:

(A) polyhedron (D) quadrilateral

(B) polygon (E) circle

(C) isosceles (F) dodecahedron

5. A line either straight or continuously bending without angles:

(A) curvature (D) curve

(B) straight line (E) height

(C) ray (F) circle

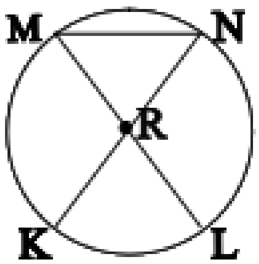
2. Give the English equivalents of the following words and word combinations:

соответственный угол, тупоугольный треугольник, касательная дуга, хорда, кольцо, окружность, пространство, уравнение прямой в отрезках, вектор положения точки, пространственная кривая, прямолинейная координата, по часовой стрелке, против часовой стрелки, угол вращения, выпуклый многоугольник, равноугольный многоугольник.

3. Give the Russian equivalents of the following words and word combinations:

1. edge;
2. origin of coordinates;
3. reference line;
4. mirror image;
5. translation of axes;
6. generating angle;
7. semi-regular polyhedron;
8. truncated cube;
9. oblique cone;
10. slant height.

4. Use the figure for completing the following statements.



1. *RM* is called a………………. of the circle.
2. *KN is* twice as long as...............................
3. *LM* is called a………………………….of a circle.
4. *RL* has the same length as ……………………….
5. ▲ *MRN* is an............................... triangle.
6. Point *R* is called the ....of the circle and the ... .of ∟*KRL*.

7. *MN* is called .... of a circle.

8. *MN* is called an ....

9. ∟*MRN* is an..angle.

10. ∟*MRK* is a... angle.

11. No matter how short an arc is, it is.................... at least slightly.

12. The term circumference means...................................

13. A diameter is a chord which.................................. .

14. A circle is a set of points in a plane each of which.......................... .

15. We cannot find the circumference of a circle by adding.....................

5. Translate the following sentences.

1. Сумма углов треугольника равна 180◦.
2. В треугольнике может быть только один тупой угол и два острых.
3. В равностороннем треугольнике все углы равны.
4. Углы при основании в равнобедренном треугольнике равны.
5. В прямоугольном треугольнике сумма квадрата катетов равна квадрату гипотенузе.
6. В прямоугольнике противоположные стороны равны и параллельны.
7. Параллельные линии не пересекаются.
8. При помощи циркуля можно начертить окружность.
9. Площадь круга равна πR^2.
10. Любая точка лежащая на окружности равноудалена от центра.
11. Мы всегда можем вычислить площадь криволинейной трапеции.
12. Синусоиду можно растянуть вдоль оси координат.

Part 2

Unit 6 *Computer applications*

I. Pre-reading task

1. Think about the answers to the following questions:

- Do you use computer in your everyday life?
- What kind of computer do you have?
- What do you use your computer for?

2. Computers have many applications in a great variety of fields. Read and match these captions with the texts:

a Using an automatic cash dispenser

b In education, computers can make all the difference

c Organizing the Tour de France demands the use of computer technology

d Controlling air traffic

1. Computers can help students perform mathematical operations and solve difficult questions. They can be used to teach courses such as computer-aided design, language learning, programming, mathematics, etc.

PCs (personal computers) are also used for administrative purposes: for example, schools use databases and word processors to keep records for students, teachers and materials.

2. Race organizers and journalists rely on computers to provide them with the current positions of riders and teams in both the particular stages of the race and in the overall competition.

Workstations in the race buses provide the timing system and give up-to-the-minute timing information to TV stations. In the press room several PCs give real-time information on the state of the race. Computer databases are also used in the drug-detecting tests for competitors.

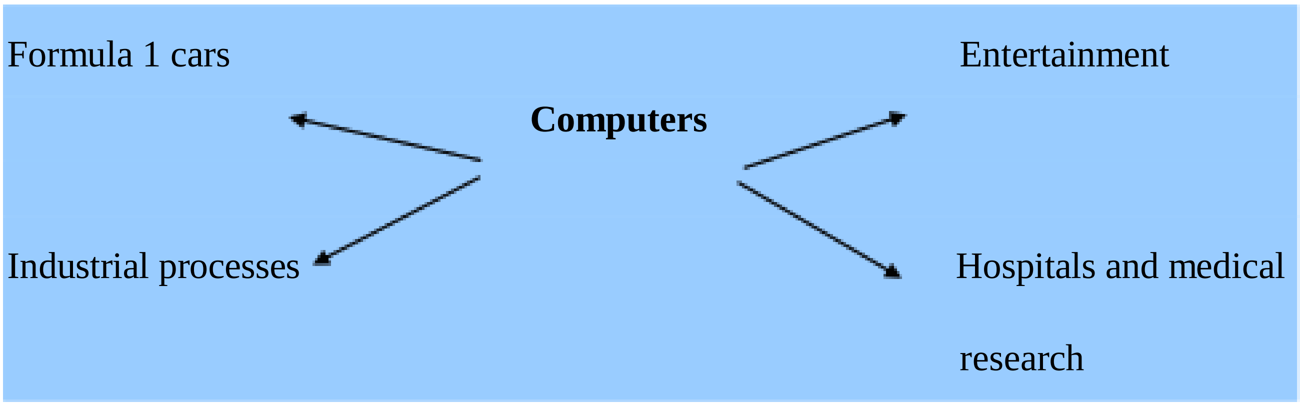
3. Computers store information about the amount of money held by each client and enable staff to access large databases and to carry out financial transactions at high speed. They also control the automatic cash dispensers which, by the use of a personal coded card, dispense money to clients.

4. Airline pilots use computers to help them control the plane. For example, monitors display data about fuel consumption and weather conditions.

In airport control towers, computers are used to manage radar systems and regulate air traffic.

On the ground, airlines are connected to travel agencies by computer. Travel agents use computers to find out about the availability of flights, prices, times, stopovers and many other details.

3. In small groups, choose one of the areas in the diagram below and discuss what computers can do in this area.



Useful words

Formula 1: racing car, car body, design, mechanical parts, electronic components, engine speed

Entertainment: game, music, animated image, multimedia, encyclopedia

Factories: machinery, robot, production line, computer-aided manufacturing software

Hospitals: patients, medical personnel, database program, records, scanner, diagnose, disease, robot, surgery

Useful constructions

Computers are used to ... A PC can also be used for ...

Computers can help ... make ... control ... store ... keep ... provide ... manage … give ... perform ... measure ... test... provide access to ...

4. *Read and remember the following words:*

capable of	['keipəbl]	способный
communicate *v*	[kə'mju:nikeit]	общаться, связываться, передавать
databases	['deitə'beises]	база данных
entertainment	[ˌentə'teinment]	развлечение
enumeration	[iˌnju:mə'reiʃ(ə)n]	перечисление, перечень
government	['gʌvnmənt]	правительство
irreplaceable	[ˌiri'pleisəbl]	незаменимый
receive *v*	[ri'si:v]	получать, принимать
science	['saiəns]	наука
store *v*	['stɔ:]	сохранять, хранить
throughout	[θru:'aut]	во всех отношениях, повсюду
transfer *v*	[træns'fə:]	передавать, переносить
	[tri'mendəs]	

tremendous	['ju:zidʒ]	огромный
usage		употребление, применение

II. Reading

1. Read the following information:

www.image.yandex.ru

Text A

The age of modern computer technologies

Computers have become a part of our everyday life because the modern world is the age of high technologies. Different types, sizes, names of computers find uses throughout our society. They are used for computing in many ways, for example, computer helps us to do different mathematical and logical operations, to receive, store and transfer any kind of information, to work on the internet, to communicate with people all over the world... It's really very hard to finish the enumeration of all usages of the computer.

We daily deal with different computer systems, as calculators, car electronics, mobile phones, timer in the microwave or the washing machine, the programmer inside the TV set and so on. The impact of the computer on our society is felt in every area – government, business, science, medicine, sport, industry, agriculture, entertainment and at home.

But let's try to answer the question: “What makes the computer such an irreplaceable device? The answer is very simple – computers make us capable of doing everything you need. It is a high speed calculating machine which speeds up your financial calculations. It is an electronic notebook which manages to collect tremendous quantity of data, such as databases any school or university, which keeps records of students and teachers, studying programs, personal information etc. It is an unique typewriter that allows every user to type and to print any kind of written document, pictures or even photos. It is the greatest electronic entertainment system, so you can relax listening to your favourite music or watching you favourite film, or playing computer games. And finally, computer is a personal communicator that enables to communicate with other people all over the world without living your house .

2. Discuss with the partner computer applications you haven't mentioned before reading the text.

3. Using the information from the next text complete the table with the most relevant information. Then compare your notes with the class.

Text B

● I write music mainly for videos and plays. I work on a keyboard connected to a computer. I use the computer in two ways really, first of all, to record what I play on the keyboard, in other words to store what I play on the key board. Secondly, the computer controls the sounds I can make with the different synthesizers. The computer is the link between the keyboard which I play and the synthesizers which produce the sounds.

● I use my computer to do the usual office things like write memos, letters, faxes and so on, but the thing which I find really useful is electronic mail. We are an international company and we have offices all over the world. We are linked up to all of them by e-mail. With e-mail I can communicate with offices around the world very efficiently. It has really changed my life.

● Well, I use computers for almost every aspect of my job. I use them to design electrical installations and lighting systems: for example the program will tell you how much lighting you need for a particular room, or how much cable you need, and it will show where the cable should go. I also use the computer to make drawings and to keep records. We have to test our installations every five years and the information is stored on computer.

● I use computers to find information for people. Readers come in with a lot of queries and I use either our own database or the national database that we are connected to to find what we want. They might want to know the name and address of a particular society or last year's accounts of a company and we can find it for them. On the other hand, they might want to find a particular newspaper article but they do not know the exact date it was published so we can find it for them by checking on our online database for anything they can remember: a name or the general topic. Moreover, we use computers to catalogue the books into the library and to record the books that readers borrow.

ikt.ucoz.ru›load/0-0-0-3-20

	Job	*What do they use computers for*
a		
b		
c		
d		

4. Fill in the gaps in this paragraph with the words from the box.

help	play	internet	calculations	schedule
type	look after	transfers	computer	connect

Each member of the Browns family can't imagine a day without _____. Their son Michael uses the personal computer to _____ with the homework and to _____ the computer games. Their daughter Katherine studies languages and the computer gives her an opportunity to _____ with other language-learners all over the world. On the _____ she easily finds the books or the articles she wants to read as quickly as possible. The computer enables their father to _____ his customers' money, to do any _____ and money _____ all over the world. As you understand, Mr. Brown is a serious person, he is a bank manager. And what about Mrs. Brown? She is a doctor and her computer allows her to connect with the hospital's main computer, to _____ in orders, for example, for blood tests and to _____ operations.

5. Translate and memorize the following words and word combinations:

Addition, division, multiplication, subtraction, numerical measurement, sequence of numbers, reasonable operations, total, to select, to compare, to perform, to sort, to match, to rise to a power, to take a square root, particular memory location

6. Find the equivalents.

1 physical variables	**a** особая ячейка памяти
2 binary system	**b** извлекать квадратный корень
3 particular memory cell	**c** последовательность разумных операций
4 numerical measurement	**d** возводить в степень
5 to take a square root	**e** физические переменные
6 sequence of reasonable operations	**f** числовые величины
7 to rise to a power	**g** числовое измерение
8 numerical quantities	**h** двоичная система

7. Translate the sentences into English.

a Произведите умножение, а затем вычитание следующих чисел: 167×4-215.

b Выдайте, пожалуйста, итог и, затем, возведите полученное число в третью степень.

c Извлеките квадратный корень из числа 64.

d Разумные операции, совершаемые компьютерной системой бывают математическими и логическими.

e Современный компьютер может выполнять более миллиона различных разумных операций в секунду, например таких как, сложение, вычитание, умножение, деление, сортировка, согласование, сравнение или выбор.

f Любая информация для компьютера должна быть представлена в двоичной системе.

g Адрес любой информации — это название определенной ячейки памяти, в которой она сохранена.

Unit 7 *Basic elements of a computer system*

I. Pre-reading task

1. Discuss the following questions with your partner:

- Can you remember any elements of a computer system? Please, name them.
- Which element do you think is the "brain" of the computer?
- What operations the computer is used for?

2. Read and translate the song:

I've got a lovely computer

I've got a lovely computer,
But it's got only two K!
I'd better add some more memory
Before it crashes today!
I've got a lovely computer,
And now it's up to one meg.
But if it don't run faster!
I'll have to buy keg!
I've got a lovely computer,
And now it's up to four gigs.

It runs so fast and so smooth now,

I'll go and dance a jig!

http://basicofcomputer.com/what_is_computer.htm

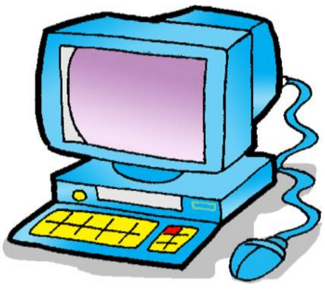
3. Read and remember the following words:

carry *v* out	выполнять
data	данные, факты
device	прибор, устройство
exceed	превышать, превосходить
external	внешний, наружный
hardware	аппаратное обеспечение компьютера
peripherals	периферическое оборудование
permanent	постоянный, неизменный
process *v*	обрабатывать
RAM	ОЗУ, оперативное запоминающее устройство
ROM	ПЗУ, постоянное запоминающее устройство
software	программное обеспечение
transmit *v*	передавать

unit	единица, устройство

II. Reading

1. Read the text and study the picture above the text.



What is a computer?

Computer is an electronic device which can receive and store data, processes a set of reasonable operations with the data and carries out or transmits the results of the processing.

There are two types of computer units – electronic and mechanical. www.image.yanedex.ru

The characteristics of these are as following:

- Modern computer use electronic devices in this way their performance is superior to mechanical machines.

- Speed of operation of computers is very fast since computer system operates at electronic speed i.e., at the speed of light. while mechanical devices can never perform at speed of light therefore they are slow.

- Operation of the computer is automatic under the control of stored programs as opposed to mechanical calculating device in which operator's intervention is required at every step of the sequence.

- Due to use of electronic circuits in place of mechanical gears and wheels, the problems of maintenance are totally eliminated. Electronic computers are therefore very reliable and highly accurate.

- While mechanical calculating devices can perform only limited arithmetic, computers are more versatile and can perform logic operation and complex arithmetic operations by writing relevant programs.

There are three main steps the computer's processing.

First, data is taken in and stored into computer's internal memory. Then, the computer produces a set of instructions, which are called computer programs, and finally, computer gives out the results in a specified format as information on the display or in the printed form, or transmits the exceeded results to the external storage unit.

A computer system consists of two parts: the **software**, which are instructions and programs of the computer and the **hardware**, which consists of all electronic and mechanical parts of the computer. The basic structure of a computer system contains three main hardware sections: the central processing unit or CPU, the main memory or the internal memory and the peripherals.

The **central processing unit** is the brain of the computer. Its function is to carry out program instructions of the software and to operate the processing of the other computer units. For better video and sound performances or networking the user can add a specialized expansion cards to the CPU of his computer. The **main memory** stores all the instructions and data which were currently processed by the CPU. It usually consists of two sections: RAM (random access memory) and ROM (read only memory). RAM is the memory used for creating, loading and running computer programs. ROM is computer memory which holds the programmed instructions in the system. The **peripherals** are the physical devices attached to the computer, which include **input/output units** (mouse, keyboard, monitor, keyboard, scanner, printer, fax machines, head-phones etc.) and **internal storage devices** (floppy, hard or optical disks, blue-ray disks, external hard disk drive, flash disk drive etc.) Input units, such as the mouse and the keyboard, give us an opportunity to transfer data into computer's memory. Output units, for example, the monitor or the printer, enable us to give out the final result of the processing from the computer system. Internal storage devices are used to store both data and programs permanently.

Now make a list of the words you don't understand. Can you guess their meaning? Compare your ideas with other students and with the teacher.

3. Using information from the text, answer the questions.

a What does the term “computer”mean?

b Which operations does the computer perform?

c What are the main components of a computer system?

d What is the difference between the software and the hardware of the computer?

e What is the difference between the terms “data” and “information”?

f What are the peripheral devices of the computer?

g Which electronic units help to store information permanently?

e What is the difference between electronic and mechanical devices of the computer?

4. Match the terms from the left column with the definition from the right column.

a Software	**1** physical devices which build up the whole computer system
b Monitor	**2** small electronic device used to store and transmit information
c Output	**3** any physical unit attached to the computer
d Peripherals	**4** programs and instructions used on a particular computer
e Hardware	**5** computer unit used to produce final result of computing
f Input	**6** output unit of the computer which shows virtual display of the information
g Flash drive	**7** the most common examples of this unit are the mouse and the keyboard

5. Decide whether the following statements are true or false:

a The purpose of the main memory is to store computer instructions and data.

b Data and information are synonymous computer terms.

c A standard computer system consists of four parts: the CPU, the main memory, the peripherals and printer.

d The type of memory used for loading and running programs is called random access memory.

e For better video and sound performances or networking the user can add a specialized expansion cards to the hardware of the computer.

f The main memory is the brain of the computer.

g The CPU reads and interprets software and prints the result on paper.

6. ***Translate the following sentences:***

1 Компьютер — это электронное устройство, которое сначала принимает данные, затем проводит ряд разумных операций и затем выдает полученные результаты.

2 Программное обеспечение включает в себя данные и программы компьютера.

3 Все электронные и механические детали компьютера называются аппаратным обеспечением компьютера.

4 Каждая компьютерная система состоит из трех основных элементов: центрального блока , главной памяти и периферических устройств.

5 К периферическим устройствам относятся устройства ввода и вывода информации, а также все виды запоминающих устройств.

6 Главная память хранит все команды и данные, которые в текущий момент обрабатываются центральным блоком компьютера.

7 Съемные запоминающие устройства используются для хранения, передачи, просмотра, прослушивания, распечатывания любого рода информации, произведенной компьютером.

Unit 8 *Hardware*

www.image.yanedex.ru

I. Pre-reading task

1. Look at the picture and enumerate the hardware units of a modern personal computer:

Monitor

Motherboard

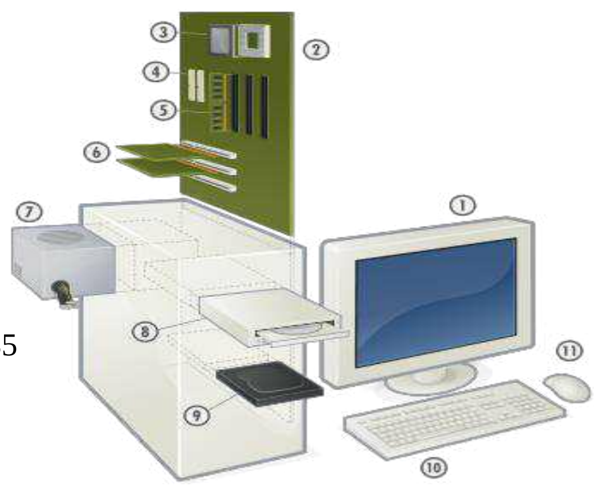
CPU

RAM

Expansion cards

Power supply

Optical disc drive



Hard disk drive

Keyboard

Mouse

www.image.yandex.ru

2. *Try to answer the questions.*

– What is the main function of hardware of the computer?

– Can you name groups of the computer hardware?

3. *Read and remember the following words:*

acceptable	приемлемый
access	доступ
auxiliary	вспомогательный, дополнительный
capacity	способность; ёмкость
compare *v*	сравнивать
computation	вычисление
digit	цифра, число; разряд; символ
equipment	оборудование; снаряжение; снабжение
execute *v*	выполнять, осуществлять
obtain *v*	получать, достигать
produce *v*	производить; порождать; синтезировать
proper	надлежащий; правильный; собственный; свойственный

vary *v*	менять(ся)

II. Ρεαδινγ

1. Read the text below and check your answers to the questions (ex. 1).

As you know from the previous text **hardware** consists of devices composing a computer system: the central processing unit, the main memory and the input and output units.

The part of the computer that takes in information is called the **input unit**. It collects and converts data in the form suitable for computer processing. To be accepted by the machine, information has to be in the form of digits 0, 1, 2, 3, 4,... 9 or signs A, B, C, D, … . So, the input unit makes possible communication from the other data-handling equipment and human to the computer. The most common input device is a **keyboard**, which looks like an electric typewriter. The **mouse** is a hand-held device connected with the computer by means of a small cable or bluetooth. Another type of the input unit is optic-electronic scanner. **Video camera** and **microphone** can be also used to take in information into the computer.

The part of the computer that puts out information produced by the computer system is called the **output unit**. The computer can easily put out information in the form acceptable to people – hardcopy or softcopy forms. **Hardcopy** output can be held in your hands, such as paper with the text or pictures printed on it. **Softcopy** is displayed on a monitor. The output unit is varying according to the capacity of the auxiliary equipment receiving information. But all peripherals are slow as compared with the computer. In this case buffers are used. A buffer is a storage device which is able to accept information at a very high speed from the computer and release the information at the proper speed for the peripheral equipment.

The central processing unit (CPU) is the nerve centre of any computer system.

It coordinates and controls the activities of all other computer units, reads, interprets software instructions and performs all arithmetic and logic processes applied to data. The CPU has three separate sections: an internal or main memory, an arithmetic and logic unit, and a control unit.

The main memory is the component of the computer which stores information. It stores the numbers to be operated on, intermediate and final results, as well as the instruction themselves. There are two important features of the memory unit: an **access time** and a **capacity**. The more memory has your computer, the more operations you can perform. There are two basic types of the main memory: **RAM** and **ROM**. RAM accepts new instructions and information from the peripherals. ROM is used to store data or instruction inside of computer permanently.

The control unit obtains instructions from the memory, interprets them and on the basis of its interpretation tells the arithmetic and logic unit what to do next. The next function of the CPU, which is performed by **the arithmetic and logic unit**, is the producing of the actual computations.

A power supply unit (PSU) converts alternating current electric power to low-voltage DC power for the internal components of the computer. Some power supplies have a switch to change between 230 V and 115 V. Other models have automatic sensors that switch input voltage automatically, or are able to accept any voltage between those limits. Power supply units used in computers are nearly always switch mode power supply. The SMPS provides regulated direct current power at the several voltages required by the motherboard and accessories such as disk drives and cooling fans.

For the computer programmer understand the work of every part of the central processing unit is quite necessary.

2. Find the equivalents.

a access time	**1** числа, которые будут обрабатываться
b during processing	**2** оборудование по управлению данными
c data-handling equipment	**3** важные особенности

d important features — **4** для того, чтобы быть принятой машиной

e information has to be in the form of digits — **5** во время обработки

f to be accepted by the machine — **6** время доступа

g auxiliary equipment — **7** дополнительное оборудование

h the numbers to be operated on — **8** информация должна быть представлена в форме чисел

i the control unit — **9** блок управления

3. Using information from the text complete the following sentences:

1 The central processing unit is … of any computer system.

2 Hardcopy output can be held in your hands, such as …

3 One of the functions of the CPU, which is performed by the arithmetic and logic unit, is … .

4 Softcopy is displayed on … .

5 The peripherals are slow as compared with … .

6 The main memory is the component of the computer which … information.

7 There are two important features of the memory unit: … .

8 The most common input device is … , which looks like an electric typewriter.

4. Memorize the following definitions:

a Hardware is all mechanical parts of the computer, which consists of the central processing unit, the main memory and the peripherals.

b Input unit is a part of the computer which accepts information inside of the computer.

c Output is equipment which puts out information from the computer.

d Central processing unit is the brain of any computer system.

e Memory unit is a part of a computer which stores data.

f The control unit the part of the CPU which receives instructions from the memory and interprets them and tells the other unit what to do next.

g The arithmetic/logic unit is the part of CPU in which the actual computations take place.

5. Answer the questions below.

1 What is the general purpose of the internal memory?

2 What kind of information does the computer machine accept?

3 What memories are used in computers?

4 What is the general purpose of the input unit?

5 What does the peripheral equipment consist of?

6 How many parts is the CPU composed of?

7 What is the main purpose of the CPU?

8 What unit obtains instructions from the main memory, interprets them and tells the other unit what to do next?

6. Translate from Russian into English.

a Центральный процессор состоит из трех элементов: внутренней памяти, блока управления и арифметически/логического устройства.

b Аппаратное обеспечение компьютера состоит из центрального процессора главной памяти и вводного и выходного устройств.

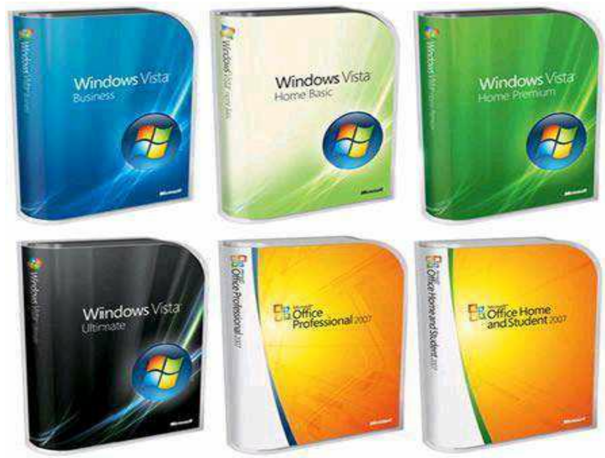
c Основными чертами внутренней памяти являются время доступа к памяти и её ёмкость.

d Внутренняя память хранит числа, которые будут обрабатываться компьютером, промежуточные и окончательные результаты, а также сами команды.

e Буфер — это устройство хранения, которое принимает информацию на высокой скорости от компьютера и передает ее на надлежащей скорости периферическому оборудованию.

f Чем больше внутренняя память вашего компьютера, тем больше действий ты можешь на нем выполнять.

Unit 9 *Software*



I. Pre-reading task

1. The extract below tells about the difference of two main computer parts: Hardware and Software. Read the text and complete the information about each of them.

Computer hardware is … .

a any single part of a larger machine **b** a binary code **c** the "body" of any computer

Computer software translates our human input into a language that the computer … can use to actually perform a function.

a monitor, board, chip **b** hardware **c** printer

… acts as the brain of the computer, telling the hardware what to do and when and how to do it.

a software **b** memory storage **c** CPU

When you think of a computer imagine a machine made of two parts. The first part is the computer hardware, the physical parts of the computer that you can actually touch. Some examples of hardware are disks, monitors, boards, chips, etc. Hardware does all of the physical work of the computer, from memory storage to display.

The second part, what we call “computer software”, acts as the brain of the computer, telling the hardware what to do and when and how to do it.

Think of a computer as a living being — in this example, the hardware would be the body, the eyes, the limbs, the lungs, etc. Computer software would be the mind, interpreting sounds we hear with our ears into recognizable symbols. The “software” in our brain would tell our other body parts how to behave. Both parts are crucial for the survival of the body.

Computer hardware, any single part of a larger machine, is only ever on or off. There are no other states of being for the hardware, and computer hardware operates on a system called “binary”. Computer software uses this binary code to tell the computer hardware what to do. Computer software translates our human input (clicking a mouse or loading a disk into a drive) into a language that the computer hardware can use to actually perform a function. As such, computer software depends on hardware to survive just as much as hardware depends on software.

http://www.askdeb.com/blog/technology/

2. Read and remember the following words:

addition	сложение
capacity	способность, емкость
comparing	сравнение
conduct *v*	проводить
division	деление
install *v*	устанавливать
matching	согласование
multiplication	умножение
regardless	невзирая на
require *v*	требовать
sequence	последовательность, ряд

sorting	сортировка
subtraction	вычитание

3. Read and memorize the following word combinations:

to produce logical and arithmetical operations – производить логические и арифметические операции

to rise into a power – возводить в степень

to take a square root – извлекать квадратный корень

a general-purpose machine – многоцелевая машина (механизм)

II. Reading

1. ***Read the texts below and find the rights answers to the questions.***

– What is the main function of the computer's software?

– What are the types of computer's software?

Text A

The ***final component*** of any computer system is its ***Software***, which includes programs for directing all computer operations and electronic data. These computer programs give the hardware exact sequence of instructions to conduct the processing. The computer is merely a general-purpose machine which requires a specific software to execute a given instruction.

Computers accept information, carry out different calculations – addition, subtraction, multiplication, division, raising into a power, taking a square root, produce logical operations, such as comparing, sorting, matching, selecting, etc. and then output data as information. It is exactly that unit of the computer which determines the order of operations to be performed.

Programs of the software are usually divided into ***two categories*** – system software and application software. ***System software*** sits directly on top of your computer's hardware components (also referred to as its bare metal). It includes the range of software you would install to your system that enables it to function. This include the operating system, drivers for your hardware devices, linkers and debuggers.

Systems software can also be used for managing computer resources. Systems software is designed to be used by the computer system itself, not human users.

System software controls all standard computer activities: when a computer is first turned on, one of the system programs is loaded into its memory, these programs contain information about capacity of the computer's main memory, the processor's model, the disk drivers to be used and so on. System programs are designed for the specific pieces of hardware. These programs are called drivers. For example, if the user wants to activate his peripheral device, such as printer or scanner, he needs to load a specific driver. By installing the driver you start the application of newly attached auxiliary.

After the system software is loaded, the ***applications software*** is acceptable to work. Applications software satisfies user's specific need. The developers of application software rely mostly on marketing research strategies trying to do their best to attract more users to their software. As the productivity of the hardware has increased greatly in recent years, the programmers nowadays tend to include all kinds of gimmicks in one program to make software interface look more attractive to the user.

Today we find new terms created frequently to classify types of applications software. You have classifications based on usage – for example games or financial software, office applications, and other categories where the category is derived based on the main use of the software. Unfortunately, we also have a newer group of software related terms that have a negative association. While the applications software itself may be useful, it may also carry hidden programs or utilities that may cause undesirable effects.

Text B

Malware

We have a whole selection of software that may come bundled under the name of malware. Short for malicious software, malware is any software that has been designed (programmed) specifically to damage or disrupt a computer system. The most common forms of malware are computer viruses, worms, and Trojan horses.

Adware and Spyware

Other common types of software are adware and spyware. Adware is considered a legitimate alternative offered to consumers who don't wish to pay for software. Today we have a growing number of software developers who offer their goods as "sponsored" freeware until you pay to register. Generally most or all features of the software are enabled but you will be viewing sponsored advertisements while the software is being used. If you're using legitimate adware, when you stop running the software, the ads should disappear, and you always have the option of disabling the ads by purchasing a registration key.

Unfortunately some applications that contain adware track your Internet surfing habits in order to serve ads related to you. When the adware becomes intrusive like this, then we move it into the spyware category and it then becomes something you should avoid for privacy and security reasons.

Spyware works like adware, but is usually a separate program that is installed unknowingly when you install another application. Once installed, the spyware monitors user activity on the Internet and transmits that information in the background to someone else. Spyware can also gather information about e-mail addresses and even passwords and credit card numbers.

Unlike adware, spyware is considered a malicious program.

2. Find synonyms (a) and antonyms (b) and translate them.

a to calculate, auxiliary device, information, number, instruction, to switch on, speed, to perform, command, to carry out, data, to turn on, to compute, the peripheral, rate, digit.

b outside**,** multiplication, software, big, simple, to forget, to integrate, subtraction, to put out, addition, complex, division, to receive, hardware, inside, small, to store, to differentiate.

3. Complete the sentences and translate them.

1 Software is a computer unit which includes programs for … .

2 Software programs give the hardware exact sequence of … .

3 Programs of the software are usually divided into … .

4 System software controls … .

5 When the system software is installed … is acceptable to work.

6 Applications software satisfies … .

7 … rely mostly on marketing research strategies trying to do their best ... to their software.

8 … is any software that has been designed specifically to damage or disrupt a computer system.

9 There are classifications based on software usage usage – games or financial software, … , and other categories where the category is derived based on the main use of the software.

4. Answer the questions.

1 What is the software of the computer?

2 What operations do the software programs perform?

3 What kind of calculations does the computer execute?

4 Which logical operations does the modern computer produce?

5 How do the software programs are usually divided?

6 What is system software of the computer?

7 What is application system of any computer system?

8 Which new created types of application software do you know?

9 What is the function of the computer's malware?

5. Translate from Russian into English.

a Компьютер выполняет различные виды вычислений, такие как сложение и вычитание, умножение и деление, возведение в степень, извлечение квадратного корня и т. д.

b Программное обеспечение содержит все программы и команды компьютера.

c Компьютерные программы, содержащиеся в программном обеспечении дают точные команды для выполнения аппаратному обеспечению.

d Программное обеспечение компьютера, это как раз то устройство, которое устанавливает порядок выполнения команд.

e Программы компьютера разделяются на системное программное обеспечение и программное обеспечение по применению .

f Системное программное обеспечение контролирует все стандартные действия компьютера, такие как включение и выключение машины, загрузка программ, информирование об объеме памяти и т.д.

g Программное обеспечение по применению становится приемлемым для функционирования только после установки системного обеспечения.

e На сегодняшний день большое количество компьютерных пользователей не хотят платно устанавливать программное обеспечение. Для этих целей разработана бесплатная версия, получившая название Адвеа.

f Вся совокупность программ, хранящихся на всех устройствах долговременной памяти компьютера, составляет его программное обеспечение.

Unit 10 *The basic principles of programming*

I. Pre-reading task

1. ***Try to think of an answer for the following question:***

- What is programming?
- How can you define this notion?

2. Now complete the following definitions with the highlighted words and phrases. Look at the definition of "programming". Is it similar to yours?

coding ***the complete list of instructions*** ***code***

program ***sequence of steps*** ***various parts of the code***

1 …(1) a short list of instructions that directs the computer to execute the logical steps of operating.

2 The word … (4) denotes an exact set of instructions which a computer carries out.

3 The process which refers to ... (2) produced for the computer to make it perform a specific task is called programming.

4 A procedure is the …(5) used to solve the given problem.

5 The representation of data or instruction in the symbolic form is known as …(3) .

6 A flow chart is a diagram which represents relations between …(6) .

2. Read and remember the following words:

debugging	наладка (программы)
define *v*	определять, формулировать (задачу)
eliminate *v*	заменять, исключать, устранять
error	ошибка, погрешность
flow chart	блок-схема, схема потока информации
retain *v*	сохранять, удерживать
subroutine	подпрограмма
tabulate *v*	табулировать, сводить в таблицы
	разнообразие,

variety (of)	множество, ряд (чего-то)
visualize *v*	визуализировать, мысленно представлять себе

4. *Memorize the following word combinations:*

octal numbers – восьмеричные числа

the actual coding – действительное кодирование

debugging the code – отладка кода

memory space – объем памяти

permanent numbers – постоянные числа

temporary numbers – временные числа

crossing lines – линии пересечения

II. Reading

1. Read the text below and find:

1 the function of the flow chart.

2 difference between "Coding" and "Programming".

3 the technique of detecting and correcting a program mistakes.

The terms "***Coding***" and "***Programming***" are often used as synonyms. But if we'll examine this computer processes a bit deeper we'll face that coding is more specifically short process of writing instructions which handles the computer to accomplish only a part of operations, whereas programming consists of the complete number of instructions produced to the computer to make it perform a specific task.

There are five steps of programming. The first step requires a clear and exact determination of all future calculations and which then are diagrammed by a so-called flow chart. The flow chart is a diagram or a picture of a code which is always useful for visualizing the relations between different parts of the code. This diagram is usually made before putting in the particular instruction. There are tree types of symbols used in a flow chart: the first represents calculation functions, the second shows various alternatives of decisions, the third one eliminates a spare lines and indicates which line to follow if the diagram has to continue on the next page.

The second step is the process of actual coding, during which all digits are assigned to the symbols to prepare the final code. Here is necessary to mention about a symbolic coding aids. Symbolic coding writes a code not in the form of numerical addresses, but in the form of symbolism. This means that when the computer receives the specific address, symbolic coding aids assign them into the symbols or names to produce the actual code.

Then comes the third step when the final code is resided into computer's memory. The use of the subroutine (subcode) may be faced many times during the program's computation but stored only once in the whole code.

The fourth step consists of debugging the code. This is the technique of detecting, diagnosing and correcting the errors which may appear in the programs. And finally comes the last fifth step which makes running the code and tabulating the results.

One of the most important details of the process of coding is that the actual bits in the instruction are given not in a binary code. The instruction is represented in the octal equivalent. This means, that two octal numbers represent the instruction and every address will be represented by three octal numbers.

2. Find the Russian equivalents of the following English word combinations:

1 memory location temporaries	**a** средства символического кодирования
2 the final code	**b** независимые переменные
3 symbolic coding aids	**c** правильный адрес

4 to eliminate the spare lines	**d** конечный код
5 independent variables	**e** исходные условия
6 the proper address	**f** восьмеричная стенография
7 initial conditions	**g** рабочие ячейки памяти
8 octal shorthand	**h** устранять лишние линии

3. Answer the questions.

1 What is the difference between coding and programming?

2 How many steps of programming do you know? Describe them.

3 What is the flow chart?

4 When is the flow chart made?

5 How many types of symbols are used in a flow chart?

6 When does a symbolic coding take place?

7 How many times can the subcode be stored in the final code?

8 In which form does the instruction is represented to the computer?

4. Complete the definitions and give Russian equivalents.

a A program is a set of instructions required for … .

b A code is the representation of … in the form of symbols.

c A flow chart is a … which represents a sequence of logical actions of all parts of any program.

d … writes a code in the form of symbolism

e … is the technique of detecting, diagnosing and correcting the errors.

f The last stage of programming makes … and tabulating the results.

g Coding is written in the ... .

1 diagram	**2** a symbolic coding
3 debugging	**4** solving definite computer tasks
5 octal equivalent	**6** running the code

7	instruction or data.

5. Check your knowledge translating this extra text.

Что такое программирование?

Робот, производственный станок или бытовой прибор управляется человеком. При этом человек не стоит у прибора и не отдает ему команды одна за другой, а определенным образом записывает их последовательность в память машины. Последовательность команд, определяющая деятельность вычислительной машины в заданных условиях, представляет собой программу. Составление подобных программ – это программирование – широко распространенный на сегодняшний день вид человеческой деятельности.

Программа – это план деятельности исполнителя, например, компьютера, по решению определенного типа задач. Чтобы составить план, важны логическое и иные формы мышления, знание условий выполнения программы и возможностей исполнителя, предугадывание возможных ошибок, а также умение писать программы на понятном исполнителю языке – конкретном языке программирования. Это и есть основные знания, умения и навыки программиста.

Unit 11 *Programming Languages*

I. Pre-reading task

1. Look at the illustration of this unit. Do you guess what do they mean?

2. Make a list of computer languages you know.

3. Study this information about Pascal and answer the questions below.

The Pascal programming language was originally developed by **Niklaus Emil Wirth** (born February 15, 1934), a member of the International Federation of Information Processing Working Group. Professor Niklaus Wirth developed Pascal to provide features that were lacking in other languages of the time. His principle objectives for Pascal were for the language to be efficient to implement and run, allow for the development of well structured and well organized programs, and to serve as a vehicle for the teaching of the important concepts of computer programming. Pascal, which was named after the mathematician Blaise Pascal, is a direct descendent from ALGOL 60, which Wirth helped to develop. Pascal also draws programming components from ALGOL 68 and ALGOL-W. The original published definition for the Pascal language appeared in 1971 with latter revisons published in 1973. It was designed to teach programming techniques and topics to college students and was the language of choice to do so from the late 1960's to the late 1980's.

From "The Pascal Language Page":

1 Who invented Pascal?

2 What is Pascal?

3 When was Pascal invented?

4 What for was Pascal designed?

II. Reading

1. *Remember the following words:*

adopt *v*	принимать, перенимать
allow *v*	позволять, давать
alphanumeric	буквенно-цифровой
artificial	искусственный
convenient	удобный, подходящий
distinguish *v*	различать

generate *v*	производить
immediately	немедленно
mnemonic	мнемонический
set	набор, комплект
whereas	тогда как

2. *Memorize the word combinations.*

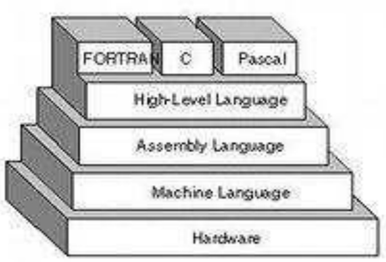
alphanumeric names – буквенно-цифровые имена

low / high level languages – языки низкого / высокого уровня

relative addresses – относительные адреса

assembly language – язык ассемблера

source program – исходная программа



3. *Study the text about Programming Languages.*

A programming language is an artificial language invented to communicate instructions or commands to a computer. In order to distinguish the the spectrum of programming languages we divide them according to the convenience of the machine computing or the work of a programmer. Machine language, mnemonic machine language and assembly language are best for machines, whereas such languages as FORTRAN, ALGOL, BASIC, PASCAL etc. are best for programmers.

Sometimes a **machine language** is called as a basic programming language or autocode which refers to a computer instructions written in a machine code. This machine code can be immediately obeyed by a computer without translation. The machine code is the coding system adopted in the design of a computer to represent the set of its instructions. The actual machine language is generated by the software, but not by the programmer.

A **mnemonic language** deals with symbolic names for each instruction's part. That is easier for the programmer to remember than the numeric code for the machine. These alphnumeric names usually begin with the letter than with a number and refer to fields, files and subroutines in a program.

An **assembly language** is mnemonic, its addresses are symbolic and introduction of data to a program, as well as reading of the program is much easier. All these three types of programming languages are so-called low level languages because they have a single corresponding machine equivalent.

High level programming languages on the contrary use the instruction corresponding to several machine code instructions. Such languages as **FORTRAN**, **ALGOL**, **BASIC**, **PASCAL** etc. are oriented to the problem, while low level languages are oriented to the computer's machine code.

The programming languages are also divided into three basic categories according to their similarity to English: **machine languages**, **symbolic languages** and **automatic coding languages**. Comparing the convenience of the languages for the computer and the programmer usages we can say that the machine languages are used by the computer directly, while symbolic and automatic coding languages are more similar to English, so they are more convenient for the use of the programmer.

Instructions in a machine language are almost always represented by particular combinations of numbers and letters acceptable for a computer. Symbolic languages use symbolic addresses in the operands and for the instruction's addresses. This fact differs symbolic languages from the machine languages which use absolute addresses. The absolute address determines a physical location of data in the memory. An indirect address is an absolute or symbolic address of the operand needed by the instruction. This kind of addresses is very useful for the programmer because it allows greater flexibility in programming by changing the contents of indirect addresses, and moreover, even to change the program.

5. These statements are all false. Using information from the text point out the mistakes and correct them.

1 The machine language is a kind of human language which can be immediately be obeyed by a computer.

2 The machine code is the system of a machine languages.

3 A mnemonic is a numerical name used for every part of instruction given in the mnemonic machine language.

4 The actual machine language is generated by the hardware, but not by the programmer.

5 The programming languages are also divided into two basic categories according to their similarity to English.

6 The absolute address determines a philosophical location of data in a human memory.

7 Medium level programming languages use the instruction corresponding to single or several machine code instructions.

6. Choose the best answer.

a A machine language:

1 was a language which any computer could understand and obey immediately.

2 is a programming language which loads the basic computer instructions.

3 is a basic programming language which refers to instructions expressed in a machine code.

b A mnemonic machine language uses:

1 mnemonic signs.

2 symbols, such as letters and numbers.

3 symbolic addresses.

c An assembly language has the following advantages for the programmer's use:

1 it has absolute addresses and requires the use of the assembler.

2 it has simple reading and introduction of data.

3 it has easy configuration.

d According to the article:

1 High level programming languages use the instruction corresponding to several machine code instructions.

2 Such high level programming languages as FORTRAN, ALGOL, BASIC, PASCAL etc. are oriented to the computer's machine code.

3 For data description in the symbolic languages the programmer uses special symbolic signs.

e Symbolic and automatic coding languages are more similar to

1 a human language.

2 English.

3 Russian.

7. Complete the following sentences with one word that is opposite in meaning to the word in brackets.

1 An indirect address allows great ______ (invariety) in programming.

2 Symbolic and automatic coding languages are more similar to English, so they are more ______ (uncomfortable) for the use of the programmer.

3 ALGOL was developed as a international language which gained ______ (uncertainty) in Europe more than in the United States.

4 The _______ (shortcomings) of using GLOBOL are that it is simple in learning, programs can be quickly written and tested.

5 The idea of an automatic computer that would not only add, multiply, subtract, and divide but perform the sequence of reasonable operations _______ (manually) was given by the English scientist Charles Babbage.

6 PASCAL is noted for its _______ (complexity) and structured programming design.

7 ADA is a PASCAL-based language, but much more ________ (narrow) than PASCAL, being designed for both commercial and scientific problems.

Check your skills

A ***Choose the right answer.***

1 A machine which performs a sequence of reasonable operations is called **…** .

a hardware **b** internet **c** computer **d** buffer

2 A computer system which includes programs for directing all computer operations and electronic data is computer's **…** .

a operative system **b** software **c** hardware **d** main memory

3 The basic structure of **…** contains three hardware units: the central processing unit , the main memory and the peripheral devices.

a monitor **b** software **c** input unit **d** hardware

4 **…** coordinates and controls the activities of all other computer units, reads, interprets software instructions and performs all activities applied to data.

a bluetooth **b** CPU **c** hardcopy **d** keyboard

5 The **…** stores all the instructions and data currently being processed by the CPU.

a main memory **b** internal memory **c** external memory **d** secondary memory

6 The producing of the actual computations takes place in **…** .

a CPU **b** control unit **c** arithmetic and logic unit **d** calculator

7 The brain of the computer is its **…** .

a mouse **b** printer **c** CPU **d** flash drive

8 **…** give us an opportunity to transfer data into computer's memory.

a input unit **b** main memory **c** storage device **d** CD disk

9 The final result of the processing from the computer system is given out by **…** .

a printer **b** keyboard **c** output unit **d** control unit

10 The computer virtual display device is called **…** .

a internet **b** processor **c** peripheral device **d** monitor

B ***Choose the right answer.***

1 Coding is a … which handles the computer to accomplish only a part of operations.

a short process of writing instructions **b** clear and exact determination of codes **c** long process of debugging the code

2 Programming consists of … produced to the computer to make it perform a specific task.

a a diagram or a picture of a code **b** the complete number of instructions **c** the specific address

3 The machine code or autocode can be … by a computer without translation.

a recently carried out **b** immediately obeyed **c** sequentially retained

4 A mnemonic language deals with symbolic for each instruction's part.

a addresses **b** names **c** letters and numbers

5 The Internet is a combination of a number of concepts that have ultimately been merged together to provide the.

a personal computer **b** communication **c** service

6 The flow chart is a … of a code which is always useful for visualizing the relations between different parts of the code.

a diagram or a picture **b** letters or numbers **c** 1's and 0's

7 … is a recent technological term that refers to a device that has a purpose and a specific function, practical and useful in everyday life.

a smartphone **b** computer **c** gadget

8 The first commercial network was called … .

a ARPANET **b** Ethernet **c** Telnet

9 The first use of network email occurred in … by … .

a 1972, Ray Tomlinson **b** 1976, Larry Roberts

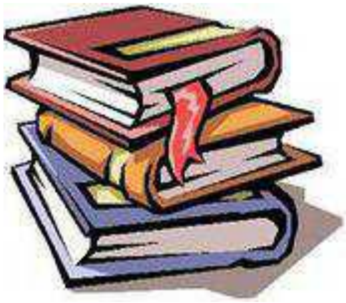
c 1983, The Massachusets Institute of Technology

10 High level programming languages use the instruction corresponding to … machine code instructions.

a sophisticated **b** acceptable **c** several

Part 2

ADDITIONAL READING



I. MATRICULATION ALGEBRA DEFINITIONS

1. ALGEBRA is the science which deals with quantities. These quantities may be represented either by figures or by letters. Arithmetic also deals with quantities, but in Arithmetic the quantities are always represented by figures. Arithmetic therefore may be considered as a branch of Algebra.

2. In Algebra it is allowable to assign any values to the letters used; in Arithmetic the figures must have definite values. We are therefore able to state and prove theorems in Algebra as being true, universally, for all values; whereas in Arithmetic only each particular sum is or is not correct. Instances of this will frequently occur to the student of Algebra, as he advances in the subject.

3. This connection of Arithmetic and Algebra the student should recognize from the first. He may expect to find the rules of Arithmetic included in the rules of Algebra. Whenever he is in a difficulty in an algebraical question, he will find it useful to take a similar question in Arithmetic with simple figures, and the solution of this simple sum in Arithmetic will often help him to solve correctly his algebraical question.

4. All the signs of operation used in Arithmetic are used in Algebra with the same significations, and all the rules for arithmetical operations are found among the rules for elementary Algebra. Elementary Algebra, how ever, enables the student to

solve readily and quickly many problems which would be either difficult or impossible in Arithmetic.

5. **Signs and abbreviations.** — The following signs and abbreviations are used in Algebra :—

+ **plus**, the sign of addition.

− **minus**, the sign of subtraction.

× **into**, or **multiplied by**, the sign of multiplication.

÷ **by**, or **divided by**, the sign of division.

~ **the sign of difference** ; thus, a~6 means the difference between *a* and *b*, whichever is the larger.

= **is**, or **are**, **equal to**.

∴ **therefore**.

6. The sign of multiplication is often expressed by a **dot** placed between the two quantities which are to be multiplied together.

Thus, 2.3 means 2×3; and *a*. *b* means a × *b*.

This dot should be placed low down, in order to distinguish it from the decimal point in numbers. Thus 3.4 means 3×4; but 3·4 means 3 *decimal point* 4, that is 3 + ·4.

More often between letters, or between a number and a letter, no sign of multiplication is placed.

Thus 3*a* means 3 × *a;* and *bcd* means *b* × *c* × *d*.

1. The operation of division is often expressed by writing the dividend over the divisor, and separating them by a line.

Thus $\frac{a}{b}$ means *a* ÷ *b*. For convenience in printing this line is sometimes written in a slanting direction between the terms ; thus *a/b* = $\frac{a}{b}$.

The words *sum, difference, multiplier, multiplicand, product, divisor, dividend,* and *quotient* are used in Algebra with the same meanings as in Arithmetic.

8. **Expressions and terms**. — Quantities in Algebra are represented by figures and by letters. The letters may have any values attached to them, provided the same letter always has the same value in the same question.

The letters at the beginning of the alphabet are generally used to denote *known* quantities, and the letters at the end of the alphabet are used to denote quantities whose values are *unknown.* For example, in the expression $ax + by — c$, it is generally considered that a, b, and c denote known values, but x and y denote unknown values.

An **algebraical expression** is a collection of one or more signs, figures, and letters, which are used to denote **one** quantity.

Terms are parts of an expression which are connected by the signs + or —.

A **simple expression** consists of only one term.

A **compound expression** consists of two or more terms.

Thus a, bc, and $3d$ are simple expressions; and $x + 3yz — 2xy$ is a compound expression denoting one quantity ; and x, $3yz$, and $2xy$ are terms of the expression.

A **binomial** expression is a compound expression consisting of only **two** terms; *e.g.,* $a+b$ is a binomial expression.

A **trinomial** expression is a compound expression consisting of only **three** terms; *e.g.,* $a — b + c$ is a trinomial expression.

A **multinomial expressi**on is a compound expression consisting of more than three terms.

Positive terms are terms which are preceded by the sign +.

Negative terms are terms which are preceded by the sign −.

When a term is preceded by no sign, the sign + is to be understood. The first term in an expression is generally positive, and therefore has no sign written before it.

Thus, in $a + 2b — 3c$, a and $2b$ are positive terms, and $3c$ is a negative term.

Like terms are those which consist of the same letter or the same combination of letters. Thus, *a, 3a,* and 5*a* are like terms; *bc,* 2*bc,* and 6*bc* are like terms ; but *ab* and *ac* are unlike terms.

9. The way in which the signs of multiplication and division are abbreviated or even omitted in Algebra will serve to remind the student of the important rule in

Arithmetic that the operations of multiplication and division are to be performed before operations of addition and subtraction.

For example — $2 \times 3 + 4 \div 2 — 5 = 6 + 2 — 5 = 3$.

A similar sum in Algebra would be

ab + — *e.*

From the way in which this is written, the student would expect that he must multiply *a* by *b,* and divide *c* by *d,* before performing the operations of addition and subtraction.

10. **Index, Power, Exponent.**—When several like terms have to be multiplied together, it is usual to write the term only once, and to indicate the number of terms that have to be multiplied together by a small figure or letter placed at the right-hand top corner of the term.

Thus:—

a^2 means $a.a$, or $a \times a$.

a^3 means $a.a.\ a$, or $a \times a \times a$.

a^4 means $a.a.a.a$, or $a \times a \times a \times a$.

a^2 is read ***a* square;** a^3 is read ***a* cube ;** a^4 is read ***a* to the fourth power,** or, more briefly, ***a* to the fourth;** a^7 is read ***a* to the seventh power, or *a* to the seventh;** and so on.

Similarly, $(3a)^4 = 3a \times 3a \times 3a \times 3a = 81a^4$; and a^b means that *b* *a*'s are to be

multiplied together.

11. Instead of having several like terms to multiply together, we may have a number of like expressions to multiply together. Thus, $(b + c)^3$ means

when the use of brackets has been *c*, and the product multiplied again by $b+c$; *i.e.*, $(b + c)^3 = (b + c) \times (b + c) \times$ explained.

12. The small figure or letter placed at the right-hand top corner of a quantity to indicate how many of the quantities are to be multiplied together is called an **index,** or **exponent.** This index or exponent, instead of being a number or letter, may also be a compound expression, or, in fact, any quantity; but we, at first, restricts ourselves to positive integral indices. We say, therefore, that an **index** or **exponent** is an integral quantity, usually expressed in small characters, and placed at the right-hand top corner of another quantity, to express how many of this latter quantity are to be multiplied together. A **power** is a product obtained by multiplying some quantity by itself a certain number of times.

13. Notice carefully that an index or an exponent expresses how many of a given quantity are to be multiplied together. For example, a^5 means that five *a*'s are to be multiplied together. In other words, the index expresses how many factors are to be used. The index, if a whole number, is always greater by one than the number of times that the given quantity has to be multiplied by itself. For example, the 5 in a^5 expresses the fact that five factors, each equal to *a*, are to be multiplied together; or, in other words, that *a* is to be multiplied by itself **four** times. Thus, $a^5 = a \times a \times a \times a \times a$. This fact is often overlooked by beginners.

14. **Factor, Coefficient, Co-Factor.** — A term or expression may consist of a number of symbols, either numbers or letters, which are multiplied together. For example, the term $15a^2bc$ consists of the numbers 3 and 5 and the letters *a, a, b, c* all multiplied together.

A factor (Lat. **facere,** to make) of an expression is a quantity which, when multiplied by another quantity, makes, or produces, the given expression. In the above example 3, 5, *a, b, c,* and also 15, *ab, ac, &c.*, are all factors of $15a^2bc$. For we may consider that

$15a^2bc = 3 \times 5\, a \times a \times b \times c$;

or that $15a^2bc = 15 \times ab \times ac$;

or that $15a^2bc = 15 \times a^2 bc$;

or that $15a^2 bc = ab \times 15ac$; *&c.*

15. It is evident that the term $15a^2 bc$ may be broken up into factors in several ways. Sometimes the factors of a quantity may be broken up again into simpler factors. Thus the factors 15 and $a^2 bc$ may be broken up again into 5 and 3 and into *ab* and *ac*; and *ab* and *ac* may be broken up again into *a* and *b*, and into *a* and *c*. When a quantity has been broken up into its simplest factors, these factors are called the **simple** or **prime** factors of the quantity. In whatever way we begin to break up a given integral quantity into factors, if we continue to break each factor into simpler factors as long as this is possible, we shall always arrive at the same set of simple factors from the same integral quantity. There is therefore only one set of simple or prime factors for the same integral quantity. In the above example the simple factors of $15a^2bc$ are 3, 5, *a, a, b, c*.

16. When a quantity is broker up into only two factors, either of these factors may be called the **Coefficient or Co-Factor** of the other factor. For example, in $15a^2bc$ we may call 15 the coefficient of a^2bc, or $15a^2$the coefficient of *bc*, or *3ab* the coefficient of 5*ac*, *&c*. It is convenient, however, to use the word coefficient in the sense of numerical coefficient, and to speak of 15 as the coefficient of $a^2 bc$ in $15a^2bc$. In this sense the *coefficient* of a quantity is the numerical factor of the quantity.

17. In Arithmetic the factors of a whole number or integer are always taken to be whole **numbers** or **integers.** The factors of a fraction may be either integers or fractions. For example, the factors of 6/5 may be either 3 and 2/5, or 2 and 3/5, or 6 and 1/5; or, again, the factors of *3/4* may be taken as ½ and 2/3, or as 3 and 1/4. In the case of fractions, a fraction can be broken up into different sets of simple factors in an infinite number of ways.

18.The coefficient of a quantity may be either integral or fractional. Thus in $5/6a^2b$ the coefficient is 5/6. When no coefficient is expressed, the coefficient **one** is to be understood. Thus *ab* means **once** *ab*, just as in Arithmetic 23 means **once** 23.

19. **Roots.** — We have seen that $a \times a = a^2$. Here we multiply the quantity *a* by itself and so get a^2. Suppose we reverse this process; that is, we have a quantity given us, and we try to find some quantity which, when multiplied by itself, will produce the given quantity. For example, what quantity multiplied by itself will give a^2? Evidently, *a* is the required answer. Again, what number multiplied by itself will produce 16? Here 4 is the answer. In these cases we are said to find a root of a^2, and of 16.

A **root** of a given quantity is a quantity which, when multiplied by itself a certain number of times, will produce the given quantity.

20. The **square root** of a given quantity is that quantity which, when two of them are multiplied together, produces the given quantity. Thus, the square root of a^2 is *a*; because two *a*'s multiplied together produce a^2. Again, the square root of 16 is 4, because two fours multiplied together produce 16.

The square root of a quantity is indicated by the sign √, which was originally the first letter in the word **radix**, the Latin for **root**. Thus, $\sqrt{16} = 4$; $\sqrt{a^2} = a$.

21.The **cube root** of a given quantity is that quantity which, when three of the latter are multiplied together, produces the given quantity. The cube root of a quantity is indicated by the sign $\sqrt[3]{}$. Thus, $\sqrt[3]{64} = 4$, because $4 \times 4 \times 4 = 64$. Similarly, $\sqrt[3]{a^3} = a$, because $a \times a \times a = a^3$.

22.In like manner $\sqrt[4]{}$, $\sqrt[5]{}$, $\sqrt[6]{}$ &c., are used to indicate the fourth, fifth, sixth, &c.,

roots of a quantity. Thus, $\sqrt{64} = 2$, because $2 \times 2 \times 2 \times 2 \times 2 \times 2 = 64$. Similarly, $\sqrt[5]{a^5} = a$; $\sqrt[7]{a^7} = a$; $\sqrt[3]{x^3} = x$; $\sqrt[3]{y^3} = y$.

23. With regard to Square and Cube Boot, the student may notice that in Mensuration, if the area of a square is given, the length of each side of the square is expressed by the square root of the quantity expressing the area. For example, a

square whose area is 16 square feet has each side 4 feet long. Similarly, a cube whose content is 27 cubic feet has each edge 3 feet long.

24. **Brackets**. — In Arithmetic each number, as, for example, 13, is thought of as one number. It is true that 13 is equal to the sum of certain other numbers; e.g., 6 + 4 + 3 = 13; but we do not necessarily consider 13 as made up of these numbers, 6, 4, and 3. So also in Algebra each expression must be considered as expressing one quantity, e.g., $a + b — c$ represents the one quantity which is obtained by adding 5 to *a* and then subtracting *c* from the sum of *a* and *b*.

So also each of the expressions in Exercises I ***a*** and I ***b*** represents one quantity. The answer to each of these examples is the numerical value of the example when the letters *a*, *b*, *c*, *d*, *e*, and *f* have the numerical values mentioned.

25. When an expression is made up of terms containing the signs +, —, ×, and ÷, either expressed or understood, we know from Arithmetic that the operations of multiplication and division are considered as indicating a closer relation than the operations of addition and subtraction. The operations of multiplication and division must be performed first, before the operations of addition and subtraction. For example,

$3 + 8 \div 2 — 2\times3 = 3 + 4 — 6 = 1.$

Exactly the same rule applies in Algebra. For example, consider the expression $a + bc — d\div e + f$. Here we must first multiply *b* by *c*, and divide *d* by *e*. Then we add the product to *a*, then subtract the quotient, and finally add *f* to get the result.

26. Frequently, however, it is necessary to break this rule about the order of operations, and we may wish some part of an expression to be considered as forming but one term. This is indicated by placing in brackets that part which is to be considered as one term.

For example, in Arithmetic, $(3 + 7) \times 2 = 10 \times 2 = 20$. Here we treat 3 + 7 as one term, and therefore we place it in brackets. If we leave out the brackets,

$3 + 7\times2 = 3 + 14 = 17$. Exactly the same thing is done in Algebra. For example, $(a + b) \times c$ means that the sum of *a* and *b* is to be multiplied by *c*; whereas

$a+b\times c$ means that first of all b is to be multiplied by c, and then the product is to be added to a.

27. **Negative quantities.** — In Arithmetic, in questions involving subtraction, we are always asked to take a smaller quantity from a larger quantity. For example, if we have to find the difference between 5 and 7, we say 7—5 = 2. But suppose we are asked to subtract 7 from 5. Arithmetically this is impossible. In Algebra such a question is allowable. We say that 5 — 7 = 5—5—2 = —2, and we arrive at a negative answer, namely —2. In Algebra, therefore, we may either subtract 5 from 7, or 7 from 5; and we consider it correct to write a — 5, whether a is larger or smaller than b.

28. Instead of considering abstract numbers like 5 and 7, let us suppose that we have to deal with concrete quantities such as £5 and £7. Suppose a tradesman made a profit of £5 one day, and then lost £7 the next day. How should we express his total profit? We should say £5 —£7 = —£2; his profits on the two days amounted to —£2; or, in other words, he lost +£2. It appears then that the negative result of —£2 profit can be expressed as a positive result of + £2 loss.

29. Again, suppose a ship sails 5 miles towards a harbour, and then is carried back by wind and tide 7 miles away from the harbour. We might say that the ship has advanced (5 — 7) miles, or —2 miles towards the harbour; or that the ship has retired + 2 miles from the harbour.

30. In both these examples a negative answer can be expressed as a positive answer by altering the form of the answer. This can always be done with concrete quantities, and, in Arithmetic, whenever we arrive at a negative result, we transpose the form of the answer and express the result as a positive answer. In Algebra, however, it is convenient to leave a negative result and even to speak of a negative quantity without expressing any positive quantity. Thus we speak of —a, or of —3b, &c., as well as of +a or of +3b, &c.

31. The signs, therefore, + and — are used to distinguish quantities of opposite kinds. Every term in an algebraical expression and also every factor in

every term must be thought of as being preceded by either + or —. If no sign is expressed, the sign + is understood. This use of the signs + and — is so constant and so important that + and — are often spoken of as *the* signs in an expression, and to change the signs in an expression means to change all + signs to —, and all — signs to +. For example, $a + b—c$ is the same expression as $-a—b+c$ with the signs changed.

This use of + and — before each term must not be confused with the use of the same signs to mark operations of addition and subtraction.

ADDITION AND SUBTRACTION

32. We know, from Arithmetic, that the operations of addition and subtraction are mutually opposed. If we add to and subtract from the same number some other number, we shall not alter the number with which we started. For example, suppose we start with 7. Add and subtract 3, thus: 7 + 3—3 = 7; adding and subtracting 3 has not altered the 7. This is true in Algebra.

In Arithmetic we can add together two or more abstract numbers and express them more shortly as a single number, thus : 2 + 3 + 5 = 10; but in Algebra we can only add together and express more shortly terms which are alike, thus: $2a + 3a + 5a = 10a$. Terms which are unlike cannot be added together; thus a + b + c cannot be expressed in a shorter form.

33. The rules for addition are as follows: —

(1) *Only like terms can be added.*

(2) *Add together all the like terms that are positive and all the like terms that are negative; subtract the smaller of these sums from the larger, and prefix the sign of the larger sum.*

Remember that when no numerical coefficient is expressed the coefficient 1 is understood.

34. **Subtraction.** — If we add together —7 and 20, we get 13. If we subtract + 7 from 20, we get 13. Therefore to subtract + 7 from 20 gives the same result as adding -7 to 20.

Conversely, since +7 added to 20 gives 27, we might infer that —7 subtracted from 20 would give 27, and this would be correct. Hence we can also infer a general rule for subtraction, viz.: — *Change the signs of all the terms in the express-ion which has to lie subtracted, and then proceed as in addition.* For

example: — Subtract $3a—4b$ from $8a + 2b$.

Set down as in addition, and change the signs in the lower line, thus:

$8a +2b$

$\underline{-3a+4b}$

$5a+6b$

By adding, we get 5a + 6i as the difference required.

In working subtraction sums, the signs in the lower lines should be changed mentally. The above sum would then appear thus:

$8a +2b$

$\underline{3a - 4b}$

$5a+6b.$

The actual process of working this sum after setting it down would be as follows: — Begin with the *a*'s, minus 3 and plus 8; the plus is the larger by 5; therefore set down $5a$, omitting the plus sign because $5a$ is the first term. Again, plus 4 and plus 2 give plus 6; therefore set down plus $6b$.

35. As in addition, like terms must be arranged under like terms. Take another example. From $5a^3 + 5a^2 — 7a + 3a^4—5$ take $5a^2 — 6a + 7 — 2a^4 + 2a^3$. Arrange in order thus:

$3a^4 + 5a^3 + 5a^2 - 7a – 5$

$\underline{-2a^4 + 2a^3 +5a^2 - 6a+ 7}$

$5a^4 + 3a^3 — a — 12.$

The working of this question was as follows: — Begin with a^4 plus 2 and plus 3 give plus $5a^4$. Then, for a^3, minus 2 and plus 5, the plus is the larger by 3; therefore set down + $3a^3$. Then a^2minus 5 and plus 5 give 0; therefore set nothing down. Then *a* plus 6 and minus 7, the minus is the larger by 1; therefore set down —*a*, the 1 being understood before the *a*. Lastly, minus 7 and minus 5 give —12.

36. Notice that in Algebra we do not consider which expression is the larger in a subtraction sum. The answer may be either a positive or a negative quantity; and so in Algebra we may subtract either a larger quantity from a smaller, or a smaller quantity from a larger. Also the letters used in an algebraical expression may have **any** value, so that we cannot always tell which, is the larger of two expressions. We usually, therefore, pay no attention in Algebra to the magnitudes of the quantities we use.

37. Since subtraction and addition are inverse operations, we can prove the accuracy of our work in an addition sum by subtracting one or more of the expressions added together from the sum; and we can prove the accuracy of a subtraction sum by adding the expression subtracted to the remainder. To take an example from Arithmetic: 7+5+3=15; to prove that this is correct, we subtract 3 from 15, thus: 15— 3 = 12; then subtract 5 from 12, thus: 12 — 5 = 7; we have now come back to 7, which is the number we started with; so we infer that our addition was correct. In subtraction, 14—5 = 9 and 5 + 9 = 14. This will be evident to the student from his knowledge of Arithmetic.

MULTIPLICATION

38. In Arithmetic we say 2×3 = 6. No notice is taken of signs; but, if this be expressed fully and correctly, we should say + 2× +3 = +6. Therefore, when two terms with **plus** signs are multiplied together the product is **plus**.

Suppose +2 × -3 or -2 × +3. Evidently the product will not be the same in either of these cases as in +2 × +3. Therefore we assume that +2 × -3 = -6 and -2 × +3= -6.

Therefore, when one term has a plus sign and the other term has a minus sign the product is minus.

Again, suppose -2 × -3. This is different from the last two cases, and we assume that -2 × -3 = +6. Therefore, when two terms with **minus** signs are multiplied together the product is **plus**.

From these results we can infer the rule of signs.

Rule of signs. — *Like signs produce plus; unlike produce minus.*

39. The application of the rule of signs is very important when we come to deal with indices or powers, and roots of quantities. For example:

$(+a)^2 = +a \times +a = +a^2 = a^2$.

$(-a)^2 = -a \times -a = +a^2 = a^2$.

$(+a)^3 = +a \times +a \times +a = +a^3 = a^3$.

$(-a)^3 = -a \times -a \times -a = -a^3$.

We see that a **plus quantity raised to any power produces a plus result; a minus quantity raised to an even power produces a plus result,** e.g., $(-a)^6 = a^6$; but **a minus quantity raised to an odd power produces a minus result**,

e.g., $(-a)^7 = -a^7$.

Again, with roots $\sqrt{(a^2)}$ = either $+a$ or $-a$, since $+a \times +a = a^2$, and $-a \times -a = a^2$ also.

So that the square root of a positive or plus quantity is either plus or minus; that is, every positive quantity which is an exact square has two roots, these roots being of opposite sign — the one plus and the other minus.

Since like signs produce plus, we cannot find the square root of any negative or minus quantity, e.g., $\sqrt{(-a^2)}$ is impossible quantity, for $-a \times -a = +a^2$, and

$a \times a = +a^2$.

Again, $\sqrt[3]{(+a^3)} = +a^3$, since $+a \times +a \times +a = +a^3$; and $\sqrt[3]{(-a^3)} = -a^3$, since $-a \times -a \times -a = -a^3$.

We see, therefore, that apparently there is only one real or possible cube root of a given quantity, but this given quantity may be either plus or minus.

Similarly, for higher powers; if we are asked to find the 4th, 6th, 8th, or any even root of a, given quantity, we can only do so when the given quantity is plus, and then we can find two real roots, one of each sign. But, if we are asked to find the 5th, 7th, 9th, or any odd root of a given quantity, we may be able to do so whatever the sign of the quantity is, but we can only find **one real** root, and the sign of this root will be the same as the sign of the given quantity.

40. These conclusions must be understood to be true only in a limited sense. It is only in a few cases that any root can be obtained exactly; as, for example, the square roots of 4, 9, 16, &c., of a^2, a^4, a^6, &g. ; the cube roots of 8, 27, &o., and of a^3, a^6, a^9, &c. But we can calculate roots of numbers to some required degree of accuracy, or we can express the roots algebraically without actually calculating them, e.g., $\sqrt[5]{(a^4)}$, $\sqrt[7]{(a^2)}$, $\sqrt[8]{(a^3)}$, &g. The student also will learn afterwards to consider that every quantity has just as many roots as the power of the root, e.g., there are 5 fifth roots of any quantity, 6 sixth roots, 7 seventh roots, and so on. One or more of these roots will be real, and the rest only imaginary.

41. We have already seen that when any term is multiplied by itself the product may be expressed in a simple form by the use of an index or power. Thus

$a \times a = a^2$; $b \times b \times b = b^3$; $c \times c \times c \times c = c^4$; and so on. By reversing the process, $b^4 = b \times b \times b \times b$ and $b \times b = b^2$.

Therefore $b^4 \times b^2 = b \times b \times b \times b \times b \times b = b^6$.

Hence we infer that different powers of the same form may be multiplied by writing the quantity with an index equal to the sum of the indices of the multipliers. In the above example, 4 + 2 = 6; therefore $b^4 \times b^2 = b^6$.

Similarly, $b^3 \times b^5 = b^8$.

Also, since $a = a^1$, $a^2 \times a = a^3$, $a^4 \times a = a^5$; and so on.

Also we have seen that when two different terms are multiplied together the product may be expressed by writing the two terms side by side. Thus: $a \times b = ab$; $c^2 \times d^4 = c^2 d^4$.

42. In Arithmetic the student knows that, if several numbers have to be multiplied together, the numbers may be taken in any order. For example:

2 ×3 ×4 = 2 ×4 ×3 = 3 ×4 ×2 = 4 ×3 ×2, &c., for each product is equal to 24. So also in Algebra the terms in any product may be taken in any order. So that

$abc = acb = bca = bac = cab = cba.$

If, therefore, in Algebra we have to multiply together two or more simple factors, we may place the numerical factors all together, and we may gather together any factors which are powers of the same quantity, and apply the rule for the multiplication of indices. For example:

$$3a^2 b^3c^4 \times 2a b^2 c^3=3\times2 \times a^2\times a\times b^3\times b^2\times c^4\times c^3 =6\times a^3\times b^5 \times c^7=6a^3b^5c^7.$$

43. In the multiplication of simple expressions like the above, the student will find it advisable to take the numbers first, then the letters in alphabetical order, and, lastly, to apply the rule of signs.

44. **Dimension and degree**. — If we take a simple expression and write down separately all the letters used as factors of the expression, and if we then count the letters, we obtain the number of the dimensions, or the degree of the term. Thus $3a^2 b^3 = 3\times a\times a\times b\times b\times b$, is of five dimensions, or of the fifth degree; or $3a^2 b^3$ is of two dimensions in a, and of three dimensions in b. In multiplication, the dimensions of the product must be equal to the sum of the dimensions of the factors. With integral indices, the dimension or degree of any term is equal to the sum of all the indices; thus $3abc^2$ is of the fourth degree, the indices being 1, 1, 2.

45. The following considerations will enable the student to test the correctness of his work. Notice that —

(1) *There are as many lines as there are terms in the multiplier*.

(2) *There are as -many terms in each line as there are terms in the multiplicand*

(3) With regard to signs, *a plus sign in the multiplier will leave all the signs the same as in the multiplicand*. Conversely, *a minus sign in the multiplier will change all the signs of the multiplicand in the corresponding line of the product.*

(4) It is advisable *to arrange both multiplicand and multiplier in descending powers of some letter*, because by so doing we shall find that the products produced in the working will be easier to arrange in columns.

46. **A compound expression in which all the terms are of the same dimension is said to be homogeneous.**

Since the dimension of every term in a product is equal to the sum of the dimensions of its factors, it follows that, if we multiply together two homogeneous expressions, we shall obtain a homogeneous product.

47. The following rules will therefore enable us to read off the product when two binomial expressions, such as $x + 7$ and $x — 8$, are multiplied together.

(1) *The first and last terms in the product are obtained by multiplying together the two first terms, and then the two last terms.*

(2) *The coefficient of the middle term in the product is obtained by adding together, algebraically, the two last terms;* e.g.,

$(a + 6)(a + 4) = a^2 + 10a+24.$

Similar rules will hold if, instead of a number, we use any other kind of term for the second term in each multiplier; e.g., $(a + 2b)(a + 3b) = a^2 +5ab+6b^2$.

II. BASE TWO NUMERALS

During the latter part of the seventeenth century a great German philosopher and mathematician Gottfried Wilhelm von Leibnitz (1646—1716), was doing research on the simplest numeration system. He developed a numeration system using only the symbols 1 and 0. This system is called a base two or binary numeration system.

Leibnitz actually built a mechanical calculating machine which until recently was standing useless in a museum in Germany. Actually he made his calculating machine some 3 centuries before they were made by modern machine makers.

The binary numeration system introduced by Leibnitz is used only in some of the most complicated electronic computers. The numeral 0 corresponds to *off* and the numeral 1 corresponds to *on* for the electrical circuit of the computer.

Base two numerals indicate groups of ones, twos, fours, eights, and so on. The place value of each digit in 1101_{two} is shown by the above words *(on* or *off)* and also by powers of 2 in base ten notation as shown below.

The numeral 1101_{two} means $(1x2^3)^4 + (1x2^2) + (0x2) + (1x1) = (1x8) + (1x4) + (0x2) + (1x1) = 8 + 4 + + 0 + 1 = 13$. Therefore $1101_{two} = 13$

...2^{3} Eights	2^{24} Fours	**2** Twos	1 Ones
1	1	0	1

A base ten numeral can be changed to a base two numeral by dividing by powers of two.

From the above you know that the binary system of numeration is used extensively in high-speed electronic computers. The correspondence between the two digits used in the binary system and the two positions (on and off) of a mechanical switch used in an electric circuit accounts for this extensive use.

The binary system is the simplest[5] place-value, power-position system of numeration. In every such numeration system there must be symbols for the numbers zero and one. We are using 0 and 1 because we are well familiar with them.

The binary numeration system has the advantage of having only two digit symbols but it also has a disadvantage of using many more digits to name the same numeral in base two than in base ten. See for example:

476 = 111011100 two

It is interesting to note that any base two numeral looks like a numeral in any other base. The sum of 10110 and 1001 appears the same in any numeration system, but the meaning is quite different. Compare these numerals:

10110 two	10110ten	10110seven
+ 1001 two	+ 1001ten	+ 1001 seven

III. CLOSURE PROPERTY

In this lesson we shall be concerned with the closure property.

If we add two natural numbers, the sum will also be a natural number. For example, 5 is a natural number and 3 is a natural number. The sum of these two numbers, 8, is also a natural number. Following are other examples in which two natural numbers are being added and the sum is another natural number. 19+4 = 23 and only 23; 6+6=12 and only 12; 1429+357=1786 and only 1786. In fact, if you add any two natural numbers, the sum is again a natural number. Because this is true, we say that the set of natural numbers is closed under addition.

Notice that in each of the above equations we were able to name the sum. That is, the sum of 5 and 3 exists, or there is a number which is the sum of 19 and 4. In fact, the sum of any two numbers exists. This is called the existence property.

Notice also that if you are to add 5 and 3, you will get 8 and only 8 and not some other number. Since there is one and only one sum for 19+4, we say that the sum is unique. This is called the uniqueness property.

Both uniqueness and existence are implied in the definition of closure.

Now, let us state the closure property of addition.

If a and b are numbers of a given set, then $a+ b$ is also a number of that same set. For example, if a and b are any two natural numbers, then $a + b$ exists, it is unique, and it is again a natural number.

If we use the operation of subtraction instead of the operation of addition, we shall not be able to make the statement we made above. If we are to subtract natural numbers, the result is sometimes a natural number, and sometimes not. 11—6 = 5 and 5 is a natural number, while 9—9 = 0 and 0 is not a natural number.

Consider the equation $4—7 = n$. We shall not be able to solve it if we must have a natural number as an answer. Therefore, the set of natural numbers is not closed under subtraction.

What about the operation of multiplication? Find the product of several pairs of natural numbers. Given two natural numbers, is there always a natural number which is the product of the two numbers?

Every pair of natural numbers has a unique product which is again a natural number. Thus the set of natural numbers is closed under multiplication.

In general, the closure property may be defined as follows: if x and y are any elements, not necessarily the same, of set A (A capital) and * (asterisk) denotes an operation *, then set A is closed under the operation asterisk if $(x*y)$ is an element of set A.

To summarize, we shall say that there are two operations, addition and multiplication, for which the set of natural numbers is closed. Given any two natural numbers x and y, $x + y$ and x x y are again natural numbers. This implies that the sum and the product of two natural numbers exists. It so happens that with the set of natural numbers (but not with every mathematical system) the results of the operations of addition and multiplication are unique.

It should be pointed out that it is practically impossible to find the sum or the product of *every* possible pair of natural numbers. Hence, we have to accept the closure property without proof, that is, as an axiom.

IV. SOMETHING ABOUT MATHEMATICAL SENTENCES

In all branches of mathematics you need to write many sentences about numbers. For example, you may be asked to write an arithmetic sentence that includes two numerals which may name the same number or even different numbers. Suppose that for your sentence you choose the numerals 8 and 11—3 which name the same number. You can denote this by writing the following arithmetic sentence, which is true: 8= 11—3.

Suppose that you choose the numerals 9+6 and 13 for your sentence. If you use the equal sign (=) between the numerals you will get the following sentence 9+6=13. But do 9+6 and 13 both name the same number? Is 9+6= 13 a true sentence? Why or why not?

You will remember that the symbol of equality (=) in an arithmetic sentence is used to mean *is equal to.* Another symbol that is the symbol of non-equality (≠) is used to mean *is not equal to.* When an equal sign (=) is replaced by a non-equal sign

($\neq$), the opposite meaning is implied. Thus the following sentence ($9+6\neq13$) is read: nine plus six is not equal to thirteen. Is it a true sentence? Why or why not?

An important feature about a sentence involving numerals is that it is either true or false, but not both.

A mathematical sentence that is either true or false, but not both is called a closed sentence. To decide whether a closed sentence containing an equal sign (=) is true or false, we check to see that both elements, or expressions, of the sentence name the same number. To decide whether a closed sentence containing a non-equal sign ($\neq$) is true or false, we check to see that both elements do not name the same number.

As a matter of fact, there is nothing incorrect or wrong, about writing a false sentence; in fact, in some mathematical proofs it is essential that you write false sentences. The important thing is that you must be able to determine whether arithmetic sentences are true or false.

The following properties of equality will help you to do so.

Reflexive: $a = a$

Symmetric: If $a = b$, then b — a.

Transitive: If $a = b$ and $b = c$, then $a = c$.

The relation of equality between two numbers satisfies these basic axioms for the numbers a, b, and c.

Using mathematical symbols, we are constantly building a new language. In many respects it is more concise and direct than our everyday language. But if we are going to use this mathematical language correctly we must have a very good understanding of the meaning of each symbol used.

You already know that drawing a short line across the = sign (equality sign) we change it to $\neq$ sign (non-equality sign). The non-equality symbol ($\neq$) implies either of the two things, namely: is greater then or is less than. In other words, the sign of non-equality ($\neq$) in $3+4\neq6$ merely tells us that the numerals 3+4 and 6 name different numbers; it does not tell us which numeral names the greater or the lesser of the two numbers.

If we are interested to know which of the two numerals is greater we use the conventional symbols meaning less than (<) or greater than (>). These are inequality symbols or ordering symbols because they indicate order of numbers. If you want to say that six is less than seven, you will write it in the following way: 6<7. If you want to show that twenty is greater than five, you will write 20>5.

The signs which express equality or inequality (=, ≠, >, <) are called relation symbols because they indicate how two expressions are related.

V. RATIONAL NUMBERS

In this chapter you will deal with rational numbers. Let us begin like this.

John has read twice as many books as Bill. John has read 7 books. How many books has Bill read?

This problem is easily translated into the equation $2n = 7$, where n represents the number of books that Bill has read. If we are allowed to use only integers, the equation $2n=7$ has no solution. This is an indication that the set of integers does not meet all of our needs.

If we attempt to solve the equation $2n = 7$, our work might appear as follows.

$2n=7$, $\frac{2n}{2} = \frac{7}{2}$, $\frac{2}{2} \times n = \frac{7}{2}$, $1 \times n = \frac{7}{2}$, $n = \frac{7}{2}$.

The symbol, or fraction, 7/2 means 7 divided by 2. This is not the name of an integer but involves a pair of integers. It is the name for a rational number. *A rational number* is the quotient of two integers (divisor and zero). The rational numbers can be named by fractions. The following fractions name rational numbers:

$\frac{1}{2}$, $\frac{8}{3}$, $\frac{0}{5}$, $\frac{3}{1}$, $\frac{9}{4}$.

We might define a rational number as any number named by $\frac{a}{n}$ where a and n name integers and $n \neq 0$.

Let us dwell on fractions in some greater detail.

Every fraction has a numerator and a denominator. The denominator tells you the number of parts of equal size into which some quantity is to be divided. The numerator tells you how many of these parts are to be taken.

Fractions representing values less than 1, like $\frac{2}{3}$ (two thirds) for example, are called proper fractions. Fractions which name a number equal to or greater than 1, like $\frac{2}{2}$ or $\frac{3}{2}$, are called improper fractions.

There are numerals like $1\frac{1}{2}$ (one and one second), which name a whole number and a fractional number. Such numerals are called mixed fractions.

Fractions which represent the same fractional number like $\frac{1}{2}$, $\frac{2}{4}$, $\frac{3}{6}$, $\frac{4}{8}$, and so on, are called equivalent fractions.

We have already seen that if we multiply a whole number by I we shall leave the number unchanged. The same is true of fractions since when we multiply both integers named in a fraction by the same number we simply produce another name for the fractional number.

For example, $1 \times \frac{1}{2} = \frac{1}{2}$ We can also use the idea that I can be as expressed a fraction in various ways: $\frac{2}{2}$, $\frac{3}{3}$, $\frac{4}{4}$, and so on.

Now see what happens when you multiply $\frac{1}{2}$ by $\frac{2}{2}$. You will have

$\frac{1}{2} = 1\,\frac{1}{2} = \frac{2}{2} \times \frac{1}{2} = \frac{2x1}{2x2} = \frac{2}{4}$. As a matter of fact in the above operation you have changed the fraction to its higher terms.

Now look at this: $\frac{6}{8} : 1 = \frac{6}{8} : \frac{2}{2} = \frac{6:2}{8:2} = \frac{3}{4}$.

In both of the above operations the number you have chosen for 1 is $\frac{2}{2}$. In the second example you have used division to change $\frac{6}{8}$ to lower terms, that is to $\frac{3}{4}$. The numerator and the denominator in this fraction are relatively prime and accordingly we call such a fraction the simplest fraction for the given rational number.

You may conclude that dividing both of the numbers named by the numerator and the denominator by the same number, not 0 or 1 leaves the fractional number unchanged. The process of bringing a fractional number to lower terms is called reducing a fraction.

To reduce a fraction to lowest terms, you are to determine the greatest common factor. The greatest common factor is the largest possible integer by which both numbers named in the fraction are divisible.

From the above you can draw the following conclusion[6]: mathematical concepts and principles are just as valid in the case of rational numbers (fractions) as in the case of integers (whole numbers).

VI. DECIMAL NUMERALS

In our numeration system we use ten numerals called digits. These digits are used over and over again in various combinations. .Suppose, you have been given numerals 1, 2, 3 and have been asked to write all possible combinations of these digits. You may write 123, 132, 213 and so on. The position in which each digit is written affects its value. How many digits are in the numeral 7086? How many place value positions does it have? The diagram below may prove helpful. A comma separates each group or period. To read 529, 248, 650, 396, you must say: five hundred twenty-nine billion, two hundred forty-eight million, six hundred fifty thousand, three hundred ninety-six.

Billions period			Millions period			Thousands period			Ones period		
Hundred billions	Ten-billions	One-billion	Hundred millions	Ten-millions	One-million	Hundred-thousands	Ten-thousands	One-thousand	Hundreds	Tens	Ones
5	2	9,	2	4	8,	6	5	0,	3	9	6

But suppose you have been given a numeral 587.9 where 9 has been separated from 587 by a point, but not by a comma. The numeral 587 names a whole number. The sign (.) is called a decimal point.

All digits to the left of the decimal point represent whole numbers. All digits to the right of the decimal point represent fractional parts of 1.

The place-value position at the right of the ones place is called tenths. You obtain a tenth by dividing 1 by 10. Such numerals like 687.9 are called decimals.

You read .2 as two tenths. To read .0054 you skip two zeroes and say fifty four ten thousandths.

Decimals like .666..., or .242424..., are called repeating decimals. In a repeating decimal the same numeral or the same set of numerals is repeated over and over again indefinitely.

We can express rational numbers as decimal numerals. See how it may be done.

$$\frac{31}{100} = 0.31. \quad \frac{4}{25} = \frac{4 \times 4}{4 \times 25} = \frac{16}{100} = 0.16$$

The digits to the right of the decimal point name the numerator of the fraction, and the number of such digits indicates the power of 10 which is the denominator. For example, .217 denotes numerator 217 and a denominator of 10^3 (ten cubed) or 1000.

In our development of rational numbers we have named them by fractional numerals. We know that rational numerals can just as well be named by decimal numerals. As you might expect, calculations with decimal numerals give the same results as calculations with the corresponding fractional numerals.

Before performing addition with fractional numerals, the fractions must have a common denominator. This is also true of decimal numerals.

When multiplying with fractions, we find the product of the numerators and the product of denominators. The same procedure is used in multiplication with decimals.

Division of numbers in decimal form is more difficult to learn because there is no such simple pattern as has been observed for muliplication.

Yet, we can introduce a procedure that reduces all decimal-division situations to one standard situation, namely the situation where the divisor is an integer. If we do so we shall see that there exists a simple algorithm that will take care of all possible division cases.

In operating with decimal numbers you will see that the arithmetic of numbers in decimal form is in full agreement with the arithmetic of numbers in fractional form.

You only have to use your knowledge of fractional numbers.

Take addition, for example. Each step of addition in fractional form has a corresponding step in decimal form.

Suppose you are to find the sum of, say, .26 and 2.18. You can change the decimal numerals, if necessary, so that they denote a common denominator. We may write .26 = .260 or 2.18 = 2.180. Then we add the numbers just as we have added integers and denote the common denominator in the sum by proper placement of the decimal point.

We only have to write the decimals so that all the decimal points lie on the same vertical line. This keeps each digit in its proper place-value position.

Since zero is the identity element of addition it is unnecessary to write .26 as .260, or 2.18 as 2.180 if you are careful to align the decimal points, as appropriate.

VII. THE DIFFERENTIAL CALCULUS

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 form 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 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 contour**.** If we know a 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 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, dy/dx is the gradient of the railway. If the height increases by 1 foot while the distance x increases by 172 feet, the average value of dy/dx is 1/172. We say that the gradient is 1 to 172. If x is the time measured in hours and fractions of an hour, and y the number of miles gone, then dy/dx is the speed in miles per hour. Of course, the rate of change may be zero, as on level road, and negative when the height is diminishing as the distance x increases. To take two more examples, if x the temperature, and y the length of a metal bar, *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 commodity, and y the amount bought per day, then -*dyldx* 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. This notion of elasticity is very important in the academic economics taught in our universities. Professors say that Marxism is out of date 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 kiad and "elasticity of demand" is out 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 dy/dx if y has some mathematical relations 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 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. 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 there is close enough to the truth for many purposes.

The differential calculus goes a lot further. 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 dy/dx is increasing. The rate of change of dy/dx with regard to y is written 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 distance, d^{2y}/dx^2 is the rate of change of speed with time, or acceleration. This is a quantity which 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 for accurate theory of their action.

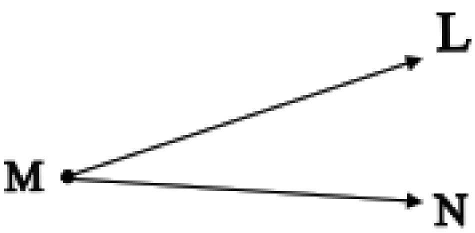
Finally, the calculus is a fascinating study for its own sake. In February 1917 I was one of a row wounded officers lying on stretchers on a steamer going down the river Tigris in Mesopotamia. I was reading a mathematical book on vectors, the man next to me was reading one on the calculus. As antidotes 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 was invented as a tool to help men to calculate the movement of stars and cannon balls. It has the beauty of really efficient machine.

VIII. RAYS, ANGLES, SIMPLE CLOSED FIGURES

1. You certainly remember that by extending a line segment in one direction we obtain a ray. 2. Below is a picture of such an extension.

3. The arrow indicated that you start at point *M*, go through point *N*, and on without end. 4. This results in what is called ray *MN*, which is denoted by the symbol *MN*. 5. Point *M* is the endpoint in this case. 6. Notice that the letter naming the endpoint of a ray is given when first naming the ray.

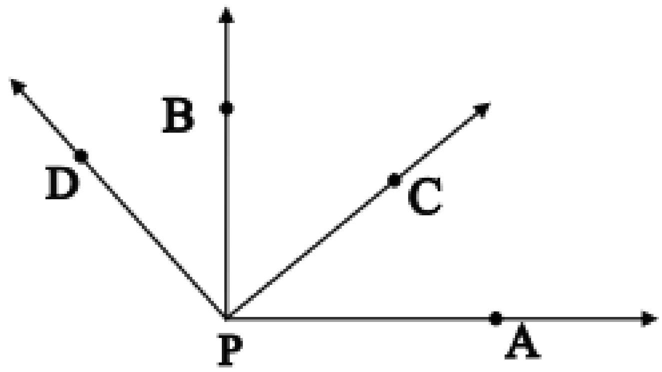
7. From what you already know you may deduce that drawing two rays originating from the same endpoint forms an angle. 8. The common point of the two rays is the vertex of the angle.



9. Angles, though open figures, separate the plane into three distinct sets of points: the interior, the exterior, and the angle. 10. The following symbol $\angle$ is frequently used in place of the word angle.

11.The angle pictured above could be named in either of the following ways: a) angle *LMN* (or ∠*LMN);* b) angle *NML* (or ∟*NML).*

12.The letter naming the vertex of an angle occurs as the middle letter in naming each angle. 13. Look at the drawing below.



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13.Ray *PA (PA)* and ray *PB (PB)* form a right angle, which means

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that the angle has a measure of 90° (degrees). 15. Since *PC* (except for point *P)* lies in the *interior* of ∠*APB,* we speak of ∠ *CPA* being less than a right angle and call it an acute angle with a degree

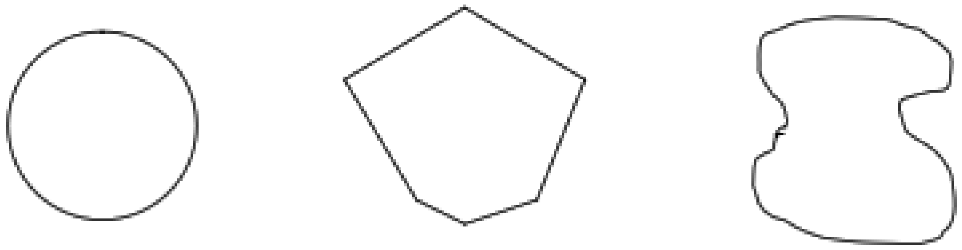
→

measure less than 90°. 16. Since *PD* (except for point *P)* lies in the *exterior* of ∠APB, we say that ∠APD is greater than a right angle and call it an obtuse angle with a degree measure greater than 90°.

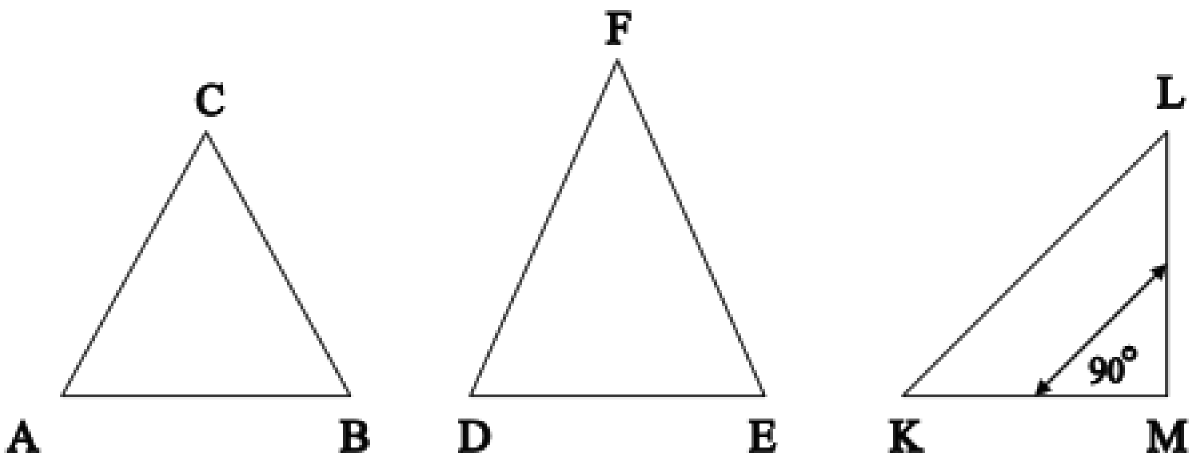
Simple Closed Figures

17 A simple closed figure is any figure drawn in a plane in such a way that its boundary never crosses or intersects itself and encloses part of the plane. 18. The following are examples of simple closed figures. 19. Every simple closed figure separates the plane into three distinct sets of points. 20. The interior of the figure is the set of all points in the part of the plane enclosed by the figure. 21.

The exterior of the figure is the set of points in the plane which are outside the figure. 22. And finally, the simple closed figure itself is still another set of points.



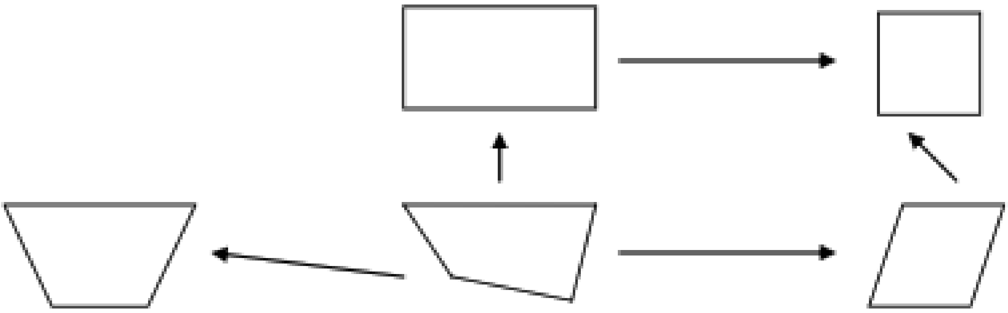
23. A simple closed figure formed by line segments is called a polygon. 24. Each of the line segments is called a side of the polygon. 25. Polygons may be classified according to the measures of the



angles or the measure of the sides. 26. This is true of triangles — geometric figures having three sides — as-well as of quadrilaterals, having four sides.

27. In the picture above you can see three triangles. ΔABC is referred to as an equilateral triangle. 29. The sides of such a triangle all have the same linear measure. 30. ΔDEF is called an isosceles triangle which means that its two sides have the same measure. 31. You can see it in the drawing above. 32. $\Delta ALMK$ being referred to as a right triangle means that it contains one right angle. 33. In ΔMKL, $\angle M$ is the right angle, sides *MK* and *ML* are called the legs, and side *KL* is called the hypotenuse. 34.

The hypotenuse refers only to the side opposite to the right angle of a right triangle. Below you can see quadrilaterals.



35. A parallelogram is a quadrilateral whose opposite sides are parallel. 36. Then the set of all parallelograms is a subset of all quadrilaterals. Why? 37. A rectangle is a parallelogram in which all angles are right angles. 38. Therefore we can speak of the set of rectangles being a subset of the set of parallelograms. 39. A square is a rectangle having four congruent sides as well as four right angles. 40. Is every square a rectangle? Is every rectangle a square? Why or why not? 41. A rhombus is a parallelogram in which the four sides are congruent. 42. Thus, it is evident that opposite sides of a rhombus are parallel and congruent. 43. Is defining a square as a special type of rhombus possible? 44. A trapezoidal has only two parallel sides. 45. They are called the bases of a trapezoidal.

IX. SOMETHING ABOUT EUCLIDEAN AND NON-EUCLIDEAN GEOMETRIES

1. It is interesting to note that the existence of the special quadrilaterals discussed above is based upon the so-called parallel postulate of Euclidean geometry. 2. This postulate is now usually stated as follows: Through a point not on line *L*, there is no more than one line parallel to *L*. 3. Without assuming (не допуская) that there exists at least one parallel to a given line through a point not on the given line, we could not state the definition of the special quadrilaterals which have given pairs of parallel sides. 4. Without the as sumption that there exists no more than one parallel

to a given line through a point not on the given line, we could not deduce the conclusion we have stated (сформулировали) for the special quadrilaterals. 5. An important aspect of geometry (or any other area of mathematics) as a deductive system is that the conclusions which may be drawn are consequences (следствие) of the assumptions which have been made. 6. The assumptions made for the geometry we have been considering so far are essentially those made by Euclid in Elements. 7. In the nineteenth century, the famous mathematicians Lobachevsky, Bolyai and Riemann developed non-Euclidean geometries. 8. As already stated, Euclid assumed that through a given point not on a given line there is no more than one parallel to the given line. 9. We know of Lobachevsky and Bolyai having assumed independently of (не зависимо от) one another that through a given point not on a given line there is more than one line parallel to the given line. 10. Riemann assumed that through a given point not on a given line there is no line parallel to the given line. 11. These variations of the parallel postulate have led (привели) to the creation (создание) of non-Euclidean geometries which are as internally consistent (непротиворечивы) as Euclidean geometry. 12. However, the conclusions drawn in non-Euclidean geometries are often completely inconsistent with Euclidean conclusions. 13. For example, according to Euclidean geometry parallelograms and rectangles (in the sense (смысл) of a parallelogram with four 90-degree angles) exist; according to the geometries of Lobachevsky and Bolyai parallelograms exist but rectangles do not; according to the geometry of Riemann neither parallelograms nor rectangles exist. 14. It should be borne in mind that the conclusions of non-Euclidean geometry are just as valid as those of Euclidean geometry, even though the conclusions of non-Euclidean geometry contradict (противоречат) those of Euclidean geometry. 15. This paradoxical situation becomes intuitively clear when one realizes that any deductive system begins with undefined terms. 16. Although the mathematician forms intuitive images (образы) of the concepts to which the undefined terms refer, these images are not logical necessities (необходимость). 17. That is, the reason for forming these intuitive images is only to help our reasoning (рассуждение) within a certain deductive system. 18. They are not logically a part of the deductive system. 19. Thus, the intuitive images corresponding to the undefined terms straight line and plane are not the same for Euclidean and non-Euclidean geometries. 20. For example, the plane of Euclid is a flat surface; the plane of Lobachevsky is a saddle-shaped (седлообразный) or pseudo-spherical surface; the plane of Riemann is an ellipsoidal or spherical surface.

X. CIRCLES

1. If you hold the sharp end of a compass fixed on a sheet of paper and then turn the compass completely around you will draw a curved line enclosing parts of a plane. 2. It is a circle. 3. A circle is a set of points in a plane each of which is equidistant, that is the same distance from some given point in the plane called the center. 4. A line segment joining any point of the circle with the center is called a radius. 5. In the figure above *R* is the center and *RC* is the radius. 6. What other radii are shown? 7. A chord bf a circle is a line segment whose endpoints are points on the circle. 8. A diameter is a chord which passes through the center of the circle. 9. In the figure above *AB* and *BC* are chords and *AB* is a diameter. 10. Any part of a circle containing more than one point forms an arc of the circle. 11. In the above figure, the points *C* and *A* and all the points in the interior of ∠*ARC* that are also points of the circle are called arc

AC which is symbolized as $\overset{\frown}{AC}$. 12. $\overset{\frown}{ABC}$ is the arc containing points *A* and *C* and all the points of the circle which are in the exterior of ∠*ABC*. 13. Instead of speaking of the perimeter of a circle, we usually use the term circumference to mean the distance around the circle. 14. We cannot find the circumference of a circle by adding the measure of the segments, because a circle does not contain any segments. 15. No matter how short an arc is, it is curved at least slightly. 16. Fortunately mathematicians have discovered that the ratio of the circumference (*C*) to a diameter *(d)* is the same for all

C

circles. This ratio is expressed *d* 17. Since $d = 2r$ (the length of a diameter is equal to twice the length of a radius of the same circle), the following denote the same ratio.

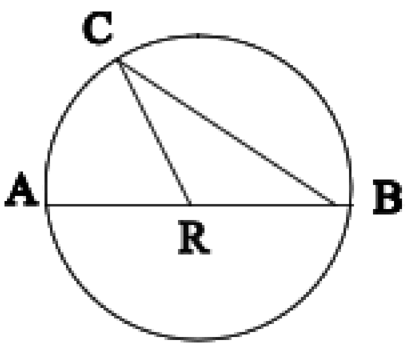
$$\frac{C}{d} = \frac{C}{2r} \quad \text{since } d=2r$$

18. The number $\frac{C}{d}$ or $\frac{C}{2r}$ which is the same for all circles, is designated by π 19. This allows us to state the following:

$$\frac{C}{d} = \pi \quad \text{or} \quad \frac{C}{2r} = \pi$$

20. By using the multiplication property of equation, we obtain the following:

$C = \pi d$ or $C = 2\pi r$.



XI. THE SOLIDS

A solid is a three-dimensional figure, e.g. a prism or a cone.

A prism is a solid figure formed from two congruent polygons with their corresponding sides parallel (the bases) and the parallelogram (lateral faces) formed by joining the corresponding vertices of the polygons. The lines joining the vertices of the polygons are lateral edges. Prisms are named according to the base - for example, a triangular prism has two triangular bases (and three lateral faces); a quadrangular prism has bases that are quadrilaterals. Pentagonal, hexagonal, etc. prism have bases that are pentagons, hexagons, etc.

A right prism is one in which the lateral edges are at right angles to the bases (i.e. the lateral faces are rectangles) - otherwise the prism is an oblique prism (i.e. one base is displaced with respect to the other, but remains parallel to it). If the bases are regular polygons and the prism is also a right prism, then it is a regular prism.

A cone is a solid figure formed by a closed plane curve on a plane (the base) and all the lines joining points of the base to a fixed point (the vertex) not in the plane of the base. The closed curve is the directrix of the cone and the lines to the vertex are its **generators** (or **elements).** The curved area of the cone forms its lateral **surface.** Cones are named according to the base, e.g. a **circular** cone or an **elliptical** cone. If the base has a center of symmetry, a line from the vertex to the center is the axis of the cone. A cone that has its axis perpendicular to its base is a right cone; otherwise the cone is a oblique cone. The **altitude** of a cone (h) is the perpendicular distance from the plane of the base to the vertex. The **volume** of any cone is **l/3hA,** where A is the area of the base. A right circular cone (circular base with perpendicular axis) has **a slant height** (s), equal to the distance from the edge of the base to the vertex (the length of a generator). The term "cone" is often used loosely for "conical surface".

A **pyramid** is a solid figure (a polyhedron) formed by a polygon (the base) and a number of triangles (lateral faces) with a common vertex that is not **coplanar** with the base. Line segments from the common vertex to the vertices of the base are lateral edges of the pyramid. Pyramids are named according to the base: a triangular pyramid (which is a tetrahedron), a square pyramid, a pentagonal pyramid, etc.

If the base has a center, a line from the center to the vertex is the axis of the pyramid. A pyramid that has its axis perpendicular to its base is a right pyramid; otherwise, it is an oblique pyramid, then it is also a regular pyramid.

The altitude (h) of a pyramid is the perpendicular distance from the base to the vertex. The volume of any pyramid is **l/3Ah,** where A is the area of the base. In a regular pyramid all the lateral edges have the same length. The slant height (s) of the pyramid is the altitude of a face; the **total surface area** of the lateral faces is **l/2sp,** where **p** is the perimeter of the base polygon.

XII. POLYHEDRON

A polyhedron is a surface composed of plane polygonal surfaces **(faces).** The sides of the **polygons,** joining two faces, are its **edges.** The corners, where three or more faces meet, are its vertices. Generally, the term "polyhedron" is used for **closed solid** figure. A convex polyhedron is one for which a plane containing any face does not cut other faces; otherwise the polyhedron is concave.

A **regular** polyhedron is one that has **identical (congruent)** regular polygons forming its faces and has all its **polyhedral** angles congruent. There are only five possible convex regular polyhedra:

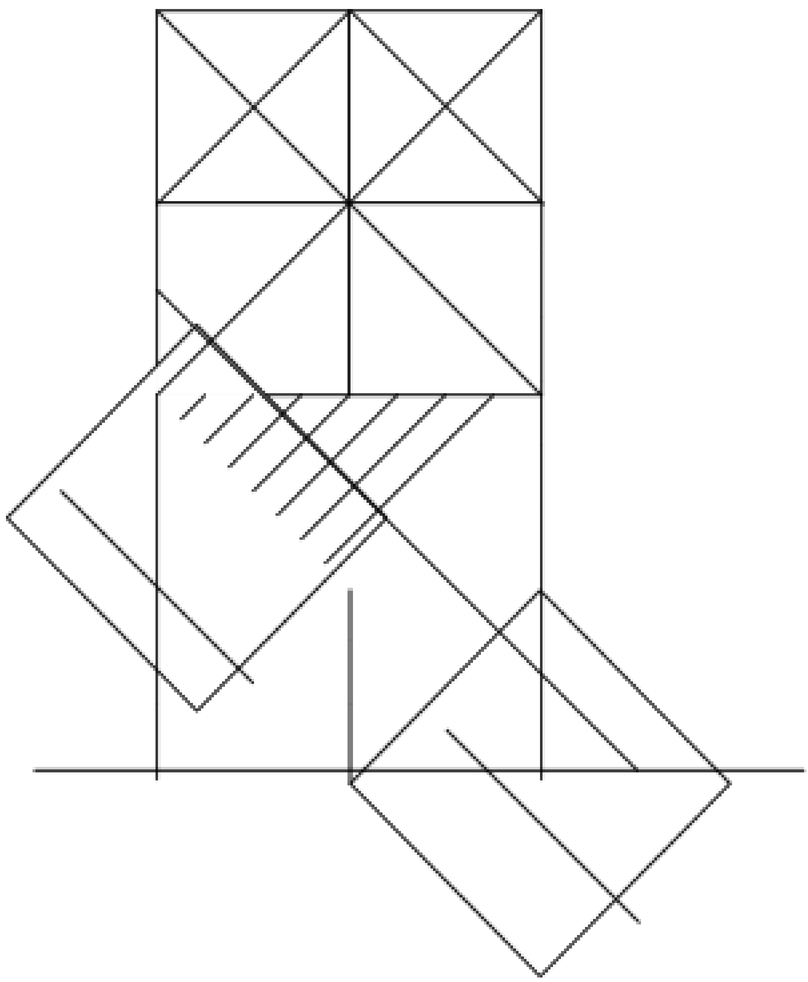
1) **tetrahedron** - four triangular faces,
2) **cube** - six square faces,
3) **octahedron** - eight triangular faces,
4) **dodecahedron** - twelve pentagonal faces,
5) **icosahedron** - twenty triangular faces.

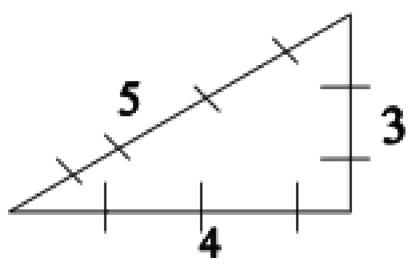
The five regular solids played a significant part in Greek geometry. They were known to Plato and are often called **Platonic** solids. Kepler used them in his complicated model of the solar system.

A **uniform** polyhedron is a polyhedron that has identical polyhedral angles at all its vertices, and has all its faces formed by regular polygons (not necessarily of the same type). The five regular polyhedra are also uniform polyhedra. Right **prisms** and antiprisms that have regular polygons as bases are also uniform. In addition, there are thriteen **semiregular** polyhedra, the so-called **Archimedian** solids. For example, the **icosidodecahedron** has 32 faces - 20 triangles and 12 pentagons. It has 60 edges and 30 vertices, each vertex beeing the meeting point of two triangles and two **pentagons.** Another example is the **truncated** cube, obtained by cutting the corners off a cube. If the corners are cut so that the new vertices lie at the centers of the edges of the original cube, a **cuboctahedron** results. **Truncating** the cuboctahedron and "distorting" the rectangular faces into squares yields another Archimedian solid. Other uniform polyhedra can be generated by truncating the four other regular polyhedra or the icosidodecahedron.

XIII. THE PYTHAGOREAN PROPERTY

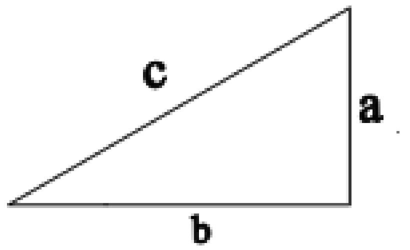
The ancient Egyptians discovered that in stretching ropes of lengths 3 units, 4 units and 5 units as shown below, the angle formed by the shorter ropes is a right angle. 2. The Greeks succeeded in finding other sets of three numbers which gave right triangles and were able to tell without drawing the triangles which ones should be right triangles, their method being as follows. 3. If you look at the illustration you will see a triangle with a dashed interior. 4. Each side of it is used as the side of a square. 5. Count the number of small triangular regions in the interior of each square. 6. How does the number of small triangular regions in the two smaller squares compare with the number of triangular regions in the largest square? 7. The Greek philosopher and mathematician Pythagoras noticed the relationship and is credited with the proof of this property known as the Pythagorean Theorem or the Pythagorean Property. 8. Each side of a right triangle being used as a side of a square, the sum of the areas of the two smaller squares is the same as the area of the largest square.

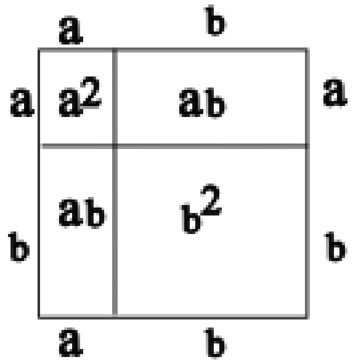


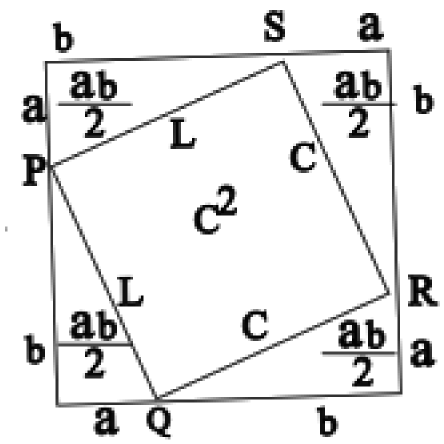


Proof of the Pythagorean Theorem

9. We should like to show that the Pythagorean Property is true for all right triangles, there being several proofs of this property. 10. Let us discuss one of them. 11. Before giving the proof let us state the Pythagorean Property in mathematical language. 12. In the triangle above, *c* represents the measure of the hypotenuse, and *a* and *b* represent the measures of the other two sides.







13. If we construct squares on the three sides of the triangle, the area-measure will be a^2, b^2 and c^2. 14. Then the Pythagorean Property could be stated as follows: $c^2 = a^2 + b^2$. 15. This proof will involve working with areas. 16. To prove that $c^2 = a^2 + b^2$ for the triangle above, construct two squares each side of which has a measure $a + b$ as shown above. 17. Separate the first of the two squares into two squares and two rectangles as shown. 18. Its total area is the sum of the areas of the two squares and the two rectangles.

$$A = a^2+2ab+b^2$$

19. In the second of the two squares construct four right triangles. 20. Are they congruent? 21. Each of the four triangles being congruent to the original triangle, the hypotenuse has a measure *c*. 22. It can be shown that *PQRS* is a square, and its area is c^2. 23. The total area of the second square is the sum of the areas of the four triangles

and the square *PQRS*. $A = c^2 + 4\ (½\ ab)$. The two squares being congruent to begin with[2], their area measures are the same. 25. Hence we may conclude the following:

$$a^2+2ab+b^2 = c^2+4(½\ ab)$$

$$(a^2 + b^2) + 2ab = c^2 + 2ab$$

26. By subtracting $2ab$ from both area measures we obtain $a^2 + b^2 = c^2$ which proves the Pythagorean Property for all right triangles.

XIV. SQUARE ROOT

1. It is not particularly useful to know the areas of the squares on the sides of a right triangle, but the Pythagorean Property is very useful if we can use it to find the length of a side of a triangle. 2. When the Pythagorean Property is expressed in the form $c^2 = a^2 + b^2$, we can replace any two of the letters with the measures of two sides of a right triangle. 3. The resulting equation can then be solved to find the measure of the third side of the triangle. 4. For example, suppose the measures of the shorter sides of a right triangle are 3 units and 4 units and we wish to find the measure of the longer side. 5. The Pythagorean Property could be used as shown below:

$c^2 = a^2+b^2, \quad c^2 = 3^2+4^2, \quad c^2 = 9+16, \quad c^2 = 25.$

6. You will know the number represented by c if you can find *a* number which, when used as a factor twice, gives a product of 25. 7. Of course, 5x5 = 25, so $c = 5$ and 5 is called the positive square root (корень) of 25. 8. If a number is a product of two equal factors, then either (любой) of the equal factors is called a square root of the number. 9. When we say that y is the square root of K we merely (всего лишь) mean that $y^2 = K$. 10. For example, 2 is a square root of 4 because $2^2 = 4$. 11. The product of two negative numbers being a positive number, —2 is_also a square root of 4 because $(—2)^2 = 4$. The following symbol √ called a radical sign is used to denote the positive square root of a number. 13. That is $\sqrt{K}$ means the positive square root of K. 14. Therefore $\sqrt{4} =2$ and $\sqrt{25} = 5$. 15. But suppose you wish to find the $\sqrt{20}$. 16. There is no integer whose square is 20, which is obvious from the following computation. $4^2= 16$ so $\sqrt{16} = 4$; $a^2 = 20$ so $4<a<5$, $5^2 = 25$, so

$\sqrt{25} = 5$. 17. $\sqrt{20}$ is greater than 4 but less than 5. 18. You might try to get a closer approximation of $\sqrt{20}$ by squaring some numbers between 4 and 5. 19. Since $\sqrt{20}$ is about as near to 4^2 as[1] to 5^2, suppose we square 4.4 and 4.5.

$$4.4^2 = 19.36 \quad a^2 = 20 \quad 4.5^2 = 20.25$$

20. Since $19.36 < 20 < 20.25$ we know that $4.4 < a < 4.5$. 21. 20 being nearer to 20.25 than to 19.36, we might guess that $\sqrt{20}$ is nearer to 4.5 than to 4.4. 22. Of course, in order to make sure[2] that $\sqrt{20} = 4.5$, to the nearest tenth, you might select values between 4.4 and 4.5, square them, and check the results. 23. You could continue the process indefinitely and never get the exact value of 20. 24. As a matter of fact, $\sqrt{20}$ represents an irrational number, which can only be expressed approximately as rational number. 25. Therefore we say that $\sqrt{20} = 4.5$ approximately (to the nearest tenth).

XV. History of computer science

The **history of computer science** began long before the modern discipline of computer science that emerged in the twentieth century. The progression, from mechanical inventions and mathematical theories towards the modern concepts and machines, formed a major academic field and the basis of a massive world-wide industry.

Early history. Early computation

The earliest known tool for use in computation was the abacus, and it was thought to have been invented in Babylon circa 2400 BCE. Its original style of usage was by lines drawn in sand with pebbles. This was the first known computer and most advanced system of calculation known to date - preceding Greek methods by 2,000 years. Abaci of a more modern design are still used as calculation tools today.

In 1115 BCE, the South Pointing Chariot was invented in ancient China. It was the first known geared mechanism to use a differential gear, which was later used in analog computers. The Chinese also invented a more sophisticated abacus from around the 2nd century BCE, known as the Chinese abacus.

In the 5th century BCE in ancient India, the grammarian Pāṇini formulated the grammar of Sanskrit in 3959 rules known as the Ashtadhyayi which was highly systematized and technical. Panini used metarules, transformations and recursions with such sophistication that his grammar had thecomputing power equivalent to a Turing machine. Between 200 BCE and 400 CE, Jaina mathematicians in India invented the logarithm. From the 13th century, logarithmic tables were produced by Muslim mathematicians.

The Antikythera mechanism is believed to be the earliest known mechanical analog computer. It was designed to calculate astronomical positions. It was discovered in 1901 in the Antikythera wreck off the Greek island of Antikythera, between Kythera and Crete, and has been dated to "circa" 100 BC.

Mechanical analog computer devices appeared again a thousand years later in the medieval islamic world and were developed by Muslim astronomers, such as the equatorium by Arzachel, the mechanical geared astrolabe by Abū Rayhān al-Bīrūnī and the torquetum by Jabir ibn Aflah. The first programmable machines were also invented by Muslim engineers, such as the automatic flute player by the Banū Mūsā brothers Teun Koetsier (2001). musical automata, looms, calculators", "Mechanism and Machine theory" and the humanoid robots by Al-Jazari. Muslim mathematicians also made important advances in cryptography, such as the development of cryptanalysis and frequency analysis by Alkindus. When John Napier discovered logarithms for computational purposes in the early 17th century, there followed a period of considerable progress by inventors and scientists in making calculating tools.

None of the early computational devices were really computers in the modern sense, and it took considerable advancement in mathematics and theory before the first modern computers could be designed.

Algorithms

In the 7th century, Indian matematician Brahmagupta the first explanation of the Hindu-Arabic numeral system and the use of zero as both aplaceholder and a decimal digit.

Approximately around the year 825, Persian mathematician Al-Khwarizmi wrote a book, "On the Calculation with Hindu Numerals", that was principally responsible for the diffusion of the Indian system of numeration in the Middle East and then Europe. Around the 12th century, there was translation of this book written into Latin: "Algoritmi de numero Indorum". These books presented newer concepts to perform a series of steps in order to accomplish a task such as the systematic application of arithmetic to algebra. By derivation from his name, we have the term algorithm.

Binary logic

Around the 3rd century BC, Indian mathematician Pingala discovered the binary numeral system. In this system, still used today to process all modern computers, a sequence of ones and zeros can represent any number.

In 1703, Gottfried Leibniz developed logic in a formal, mathematical sense with his writings on the binary numeral system. In his system, the ones and zeros also represent "true" and "false" values or "on" and "off" states. But it took more than a century before George Boole published his Boolean algebra in 1854 with a complete system that allowed computational processes to be mathematically modeled.

By this time, the first mechanical devices driven by a binary pattern had been invented. The industrial revolution had driven forward the mechanization of many tasks, and this included weaving. Punch cards controlled Joseph Marie Jacquard's loom in 1801, where a hole punched in the card indicated a binary "one" and an unpunched spot indicated a binary "zero". Jacquard's loom was far from being a computer, but it did illustrate that machines could be driven by binary systems.

The Analytical Engine

It wasn't until Charles Babbage, considered the "father of computing," that the modern computer began to take shape with his work on the Analytical Engine. The device, though never successfully built, had all of the functionality in its design of a modern computer. He first described it in 1837 – more than 100 years before any similar device was successfully constructed. The difference between Babbage's Engine and preceding devices is simple - he designed his to be "programmed".

During their collaboration, mathematician Ada Lovelace published the first ever computer programs in a comprehensive set of notes on the analytical engine. Because of this, Lovelace is popularly considered the first computer programmer, but some scholars contend that the programs published under her name were originally created by Babbage.

Birth of computer science

Before the 1920s, "computers" were human clerks that performed computations. They were usually under the lead of a physicist. Many thousands of computers were employed in commerce, government, and research establishments. Most of these computers were women, and they were known to have a degree in calculus. Some performed astronomical calculations for calendars.

After the 1920s, the expression "computing machine" referred to any machine that performed the work of a human computer, especially those in accordance with effective methods of the Church-Turing thesis. The thesis states that a mathematical method is effective if it could be set out as a list of instructions able to be followed by a human clerk with paper and pencil, for as long as necessary, and without ingenuity or insight.

Machines that computed with continuous values became known as the "analog" kind. They used machinery that represented continuous numeric quantities, like the angle of a shaft rotation or difference in electrical potential.

Digital machinery, in contrast to analog, were able to render a state of a numeric value and store each individual digit. Digital machinery used difference engines or relays before the invention of faster memory devices.

The phrase "computing machine" gradually gave away, after the late 1940s, to just "computer" as the onset of electronic digital machinery became common. These computers were able to perform the calculations that were performed by the previous human clerks.

Since the values stored by digital machines were not bound to physical properties like analog devices, a logical computer, based on digital equipment, was able to do anything that could be described "purely mechanical." Alan Turing, known as the Father of Computer Science, invented such a logical computer known as the Turing Machine, which later evolved into the modern computer. These new computers were also able to perform non-numeric computations, like music.

From the time when computational processes were performed by human clerks, the study of computability began a science by being able to make evident which was not explicit into ordinary sense more immediate.

Emergence of a discipline

The theoretical groundwork

The mathematical foundations of modern computer science began to be laid by Kurt Gödel with his incompleteness theorem (1931). In this theorem, he showed that there were limits to what could be proved and disproved within a formal system. This led to work by Gödel and others to define and describe these formal systems, including concepts such as mu-recursive functions and lambda-definable functions.

1936 was a key year for computer science. Alan Turing and Alonzo Church independently, and also together, introduced the formalization of analgorithm, with limits on what can be computed, and a "purely mechanical" model for computing.

These topics are covered by what is now called the Church–Turing thesis, a hypothesis about the nature of mechanical calculation devices, such as electronic computers. The thesis claims that any calculation that is possible can be performed by an algorithm running on a computer, provided that sufficient time and storage space are available.

Turing also included with the thesis a description of the Turing machine. A Turing machine has an infinitely long tape and a read/write head that can move along the tape, changing the values along the way. Clearly such a machine could never be built, but nonetheless, the model can simulate the computation of any algorithm which can be performed on a modern computer.

Turing is so important to computer science that his name is also featured on the Turing Award and the Turing test. He contributed greatly to British code-breaking successes in the Second World War, and continued to design computers and software through the 1940s, but committed suicide in1954.

At a symposium on large-scale digital machinery in Cambridge, Turing said, "We are trying to build a machine to do all kinds of different things simply by programming rather than by the addition of extra apparatus".

In 1948, the first practical computer that could run stored programs, based on the Turing machine model, had been built — the Manchester baby.

In 1950, Britain's National Physical Laboratory completed Pilot ACE, a small scale programmable computer, based on Turing's philosophy.

hannon and information theory

Up to and during the 1930s, electrical engineers were able to build electronic circuits to solve mathematical and logic problems, but most did so in an "ad hoc" manner, lacking any theoretical rigor. This changed with Claude Elvin's publication of his 1937 master's thesis, A Symbolic Analysis of Relay and Switching Circuits. While taking an undergraduate philosophy class, Shannon had been exposed to Boole's work, and recognized that it could be used to arrange electromechanical relays (then used in telephone routing switches) to solve logic problems. This concept, of utilizing the properties of electrical switches to do logic, is the basic concept that underlies all electronic digital computers, and his thesis became the foundation of practical digital circuit design when it became widely known among the electrical engineering community during and after World War II.

Shannon went on to found the field of information theory with his 1948 paper entitled A Mathematical Theory of Communication, which appliedprobability theory to the problem of how to best encode the information a sender wants to transmit. This work is one of the theoretical foundations for many areas of study, including data compression and cryptography.

Wiener and Cybernetics

From experiments with anti-aircraft systems that interpreted radar images to detect enemy planes,Norbert Wiener coined the term cybernetics from the Greek word for "steersman." He published "Cybernetics" in 1948, which influenced artificial intelligence. Wiener also compared computation, computing machinery, memory devices, and other cognitive similarities with his analysis of brain waves.

XVI. A Description of Antivirus Programs

A revolution in personal computers, the IBM PC the first PC.

By Mary Bellis, ***About.com Guide*** http://inventors.about.com

In July of 1980, IBM representatives met for the first time with Microsoft's Bill Gates to talk about writing an operating system for IBM's new hush-hush "personal" computer.

IBM had been observing the growing personal computer market for some time. They had already made one dismal attempt to crack the market with their IBM 5100. At one point, IBM considered buying the fledgling game company Atari to commandeer Atari's early line of personal computers. However, IBM decided to stick with making their own personal computer line and developed a brand new operating system to go with.

IBM PC aka Acorn

The secret plans were referred to as "Project Chess". The code name for the new computer was "Acorn". Twelve engineers, led by William C. Lowe, assembled in Boca Raton, Florida, to design and build the "Acorn". On August 12, 1981, IBM released their new computer, re-named the IBM PC. The "PC" stood for "personal computer" making IBM responsible for popularizing the term "PC".

IBM PC Open Architecture

The first IBM PC ran on a 4.77 MHz Intel 8088 microprocessor. The PC came equipped with 16 kilobytes of memory, expandable to 256k. The PC came with one or two 160k floppy disk drives and an optional color monitor. The price tag started at $1,565, which would be nearly $4,000 today.

What really made the IBM PC different from previous IBM computers was that it was the first one built from off the shelf parts (called open architecture) and marketed by outside distributors (Sears & Roebucks and Computerland). The Intel chip was chosen because IBM had already obtained the rights to manufacture the Intel chips. IBM had used the Intel 8086 for use in its Displaywriter Intelligent Typewriter in exchange for giving Intel the rights to IBM's bubble memory technology.

IBM PC Man of the Year

Less than four months after IBM introduced the PC, Time Magazine named the computer "man of the year"

On August 12, 1981, IBM introduced its new revolution in a box, the "Personal Computer" complete with a brand new operating system from Microsoft, a 16-bit computer operating system called MS-DOS 1.0.

What is an Operating System

The operating system or`OS is the foundation software of a computer, that which schedules tasks, allocates storage, and presents a default interface to the user between applications. The facilities an operating system provides and its general design exerts an extremely strong influence on the applications created for the computer.

IBM & Microsoft History

In 1980, IBM first approached Bill Gates of Microsoft, to discuss the state of home computers and what Microsoft products could do for IBM. Gates gave IBM a few ideas on what would make a great home computer, among them to have Basic written into the ROM chip. Microsoft had already produced several versions of Basic for different computer system beginning with the Altair, so Gates was more than happy to write a version for IBM.

Gary Kildall

As for an operating system (OS) for an IBM computer, since Microsoft had never written an operating system before, Gates had suggested that IBM investigate an OS called CP/M (Control Program for Microcomputers), written by Gary Kildall of Digital Research. Kindall had his Ph.D. in computers and had written the most successful operating system of the time, selling over 600,000 copies of CP/M, his operating system set the standard at that time.

The Secret Birth of MS-DOS

IBM tried to contact Gary Kildall for a meeting, executives met with Mrs Kildall who refused to sign a non-disclosure agreement. IBM soon returned to Bill Gates and gave Microsoft the contract to write a new operating system, one that would eventually wipe Gary Kildall's CP/M out of common use.

The "Microsoft Disk Operating System" or MS-DOS was based on Microsoft's purchase of QDOS, the "Quick and Dirty Operating System" written by Tim Paterson of Seattle Computer Products, for their prototype Intel 8086 based computer.

However, ironically QDOS was based (or copied from as some historians feel) on Gary Kildall's CP/M. Tim Paterson had bought a CP/M manual and used it as the basis to write his operating system in six weeks. QDOS was different enough from CP/M to be considered legally a different product. IBM had deep enough pockets in any case to probably have won an infringement case, if they had needed to protect their product. Microsoft bought the rights to QDOS for $50,000, keeping the IBM & Microsoft deal a secret from Tim Paterson and his company, Seattle Computer Products.

Deal of the Century

Bill Gates then talked IBM into letting Microsoft retain the rights, to market MS-DOS separate from the IBM PC project, Gates and Microsoft proceeded to make a fortune from the licensing of MS-DOS. In 1981, Tim Paterson quit Seattle Computer Products and found employment at Microsoft.

"Life begins with a disk drive." - Tim Paterson.

XVII. The History of the Graphical User Interface or GUI – The Apple Lisa

By Mary Bellis, ***About.com Guide*** http://inventors.about.com

No, Steve, I think its more like we both have a rich neighbor named Xerox, and you broke in to steal the TV set, and you found out I'd been there first, and you said. "Hey that's no fair! I wanted to steal the TV set! - Bill Gates' response after Steve Jobs accused

www.image.yandex.ru

Microsoft of borrowing the GUI (Graphical User Interface) from Apple for Windows 1.0*

The Lisa - The Personal Computer That Works The Way You Do - Apple promotional material

A GUI (pronounced GOO-ee) is a graphical user interface to a computer. Most of you are using one right now. Take a look at your computer screen, the GUI provides you with windows, pull-down menus, clickable buttons, scroll bars, icons, images and the mouse or pointer. The first user interfaces to computers were not graphical or visually oriented; they were all text and keyboard commands. MS-DOS is an example of a text and keyboard method of computer control that you can still find on many PCs today.

The very first graphical user interface was developed by the Xerox Corporation at their Palo Alto Research Center (PARC) in the 1970s, but it was not until the 1980s when GUIs became widespread and popular. By that time the CPU power and monitors necessary for an effective GUI became cheap enough to use in home computers.

Steve Jobs, co-founder of Apple Computers, visited PARC in 1979 (after buying Xerox stock) and was impressed by the "Alto", the first computer ever with a graphical user interface. Several PARC engineers were later hired by Apple and worked on the Apple Lisa and Macintosh. The Apple research team contributed much in the way of originality in their first GUI computers, and work had already begun on the Lisa before Jobs visited PARC. Jobs was definitely inspired and influenced from the technology he saw at PARC, however, enough for Bill Gates to later defend

Microsoft against an Apple's lawsuit overWindows 1.0 having too much of the "look and feel" of a Apple MacIntosh. Gates' claim being, "hey, we both got it from Xerox." The lawsuit ended when Gates finally agreed that Microsoft would not use MacIntosh technology in Windows 1.0, but the use of that technology in future versions of Windows was left open. With that agreement, Apple lost its exclusive rights to certain key design elements.

In 1978, Apple Computers started on a business system to complement their successful Apple II/III line of home computers. The new project was code named Lisa, unofficially after the daughter of one of its designers and officially standing for Local Integrated Software Architecture. Steve Jobs was completely dedicated to new project, implementing feature after feature and delaying the release of Lisa, until he was finally removed as project manager by then Apple president Mark Markkula. The Lisa was finally released in January 1983.

Side Note: Don't worry about Jobs. He then turned his attention to the Macintosh.

The Lisa was the first personal computer to use a GUI. Other innovative features for the personal market included a drop-down menu bar, windows, multiple tasking, a hierarchal file system, the ability to copy and paste, icons, folders and a mouse. It cost Apple $50 million to develop the Lisa and $100 million to write the software, and only 10,000 units were ever sold. One year later the Lisa 2 was released with a 3.5" drive instead of the two 5.25" and a price tag slashed in half from the original $9,995. In 1985, the Lisa 2 was renamed the Macintosh XL and bundled with MacWorks system software. Finally in 1986, the Lisa, Lisa 2 and Macintosh XL line was scrapped altogether, literally ending up as landfill, despite Steve Jobs saying, "We're prepared to live with Lisa for the next ten years."

Specifications	**The Lisa/Lisa 2/Mac XL**
CPU:	MC68000
CPU speed:	5 Mhz

FPU:	None
Motherboard RAM:	minimum 512 k - maximum 2MB
ROM:	16k
Serial Ports:	2 RS-323
Parallel Ports:	1 Lisa - 0 Lisa 2/MacXL
Floppy Drive:	2 internal 871k 5.25" 1 internal 400k Sony 3.5" Lisa 2/MacXL
Hard Drive:	5 MB internal;
Monitor:	Built-In 12" - 720 x 360 pixels
Power Supply:	150 Watts
Weight:	48 lbs.
Dimensions:	15.2" H x 18.7" W x 13.8" D
System Software:	LisaOS/MacWorks
Production:	January 1983 to August 1986
Initial Cost:	$9,999

The high cost and delays in its release date helped to create the Lisa's demise, but where the Lisa failed the Macintosh succeeded. Continue reading about Apple's history with our next chapter on the Macintosh.

A month after the Lisa line was cut; Steve Jobs quit his job at Apple. However, do not worry about what happened to Jobs. He then turned his attention to the NeXT computer.

XVIII. The Invention of the Apple Macintosh - Apple Computers - Steve Jobs and Steve Wozniak

By* Mary Bellis*, About.com Guide http:/inventors.about.com

"Hello, I am Macintosh. Never trust a computer you cannot lift... I'm glad to be out of that bag" - talking Macintosh Computer.

In December, 1983, Apple Computers ran its' famous "1984" Macintosh television commercial, on a small unknown station solely to make the commercial eligible for awards during 1984. The commercial cost 1.5 million and only ran once in 1983, but news and talk shows everywhere replayed it,making TV history.

The next month, Apple Computer ran the same ad during the NFL Super Bowl, and millions of viewers saw their first glimpse of the Macintosh computer. The commercial was directed by Ridley Scott, and the Orwellian scene depicted the IBM world being destroyed by a new machine, the "Macintosh".

Could we expect anything less from a company that was now being run by the former president of Pepsi-Cola. Steve Jobs, co-founder of Apple Computers had been trying to hire Pepsi's John Sculley since early 1983. In April of that year he succeeded. But Steve and John discovered that they did not get along and one of John Sculley's first actions as CEO of Apple was to boot Steve Jobs off the Apple "Lisa" project, the "Lisa" was the first consumer computer with a graphical user interface or GUI. Jobs then switched over to managing the Apple "Macintosh" project begun by Jeff Raskin. Jobs was determined that the new "Macintosh" was going to have a graphical user interface, like the "Lisa" but at a considerably lower cost.

Note: The early Mac team members (1979) consisted of Jeff Raskin, Brian Howard, Marc LeBrun, Burrell Smith. Joanna Hoffman and Bud Tribble. Others began working working on the Mac at later dates.

Specifications	**Macintosh 128K**
CPU:	MC68000
CPU speed:	8 Mhz
FPU:	None
RAM:	128k Dram not expandable
ROM:	64k

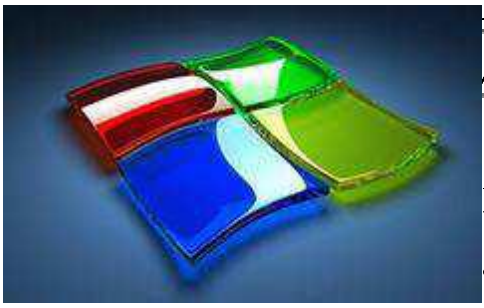
Serial Ports:	2
Floppy:	1 3.5" 400k
Monitor:	9" 512x384 square pixels built-in B/W
Power:	60 Watts
Weight:	16.5 lbs.
Dimensions:	13.6" H x 9.6" W x 10.9" D
System Software:	Mac OS 1.0
Production:	January 1984 to October 1985
Cost:	$2,495

Seventy-four days after the introduction of the "Macintosh", 50,000 units had been sold, not that strong a show. Apple refused to license the OS or the hardware, the 128k memory was not enough and a single floppy was difficult to use. The "Macintosh" had "Lisa's" user friendly GUI, but initially missed some of the more powerful features of the "Lisa" like multitasking and the 1 MB of memory. Jobs compensated by making sure developers created software for the new "Macintosh", Jobs figured that software was the way to win the consumer over.

In 1985, the "Macintosh" computer line received a big sales boost with the introduction of the LaserWriter printer and Aldus PageMaker, home desktop publishing was now possible. But 1985 was also the year when the original founders of Apple left the company.

Steve Wozniak returned to college and Steve Jobs was fired, his difficulties with John Sculley coming to a head. Jobs had decided, to regain control of the company away from Sculley, he scheduled a business meeting in China for Sculley and planned for a corporate take-over, when Sculley would be absent. Information about Jobs' true motives, reached Sculley before the China trip, he confronted Jobs and asked Apple's Board of Directors to vote on the issue. Cveryone voted for Sculley and Jobs quit, in lieu of being fired. Jobs later rejoined Apple in 1996 and has happily worked there ever since. Sculley was eventually replaced as CEO of Apple.

XIX. The Unusual History of Microsoft Windows



By Mary Bellis, About.com Guide http://inventors.about.com

On November 10, 1983, at the Plaza Hotel in New York City, Microsoft Corporation formally announced Microsoft Windows, a next-generation operating system that would provide a graphical user interface (GUI) and a multitasking environment for IBM computers.

Introducing Interface Manager

Microsoft promised that the new product would be on the shelf by April 1984. Windows might have been released under the original name of Interface Manager if marketing whiz, Rowland Hanson had not convinced Microsoft's founder Bill Gates that Windows was the far better name.

Did Windows Get Top View?

That same November in 1983, Bill Gates showed a beta version of Windows to IBM's head honchos. Their response was lackluster probably because they were working on their own operating system called Top View. IBM did not give Microsoft the same encouragement for Windows that they gave the other operating system that Microsoft brokered to IBM. In 1981, MS-DOS became the highly successful operating system that came bundled with an IBM computer.

Top View was released in February of 1985 as a DOS-based multitasking program manager without any GUI features. IBM promised that future versions of Top View would have a GUI. That promise was never kept, and the program was discontinued barely two years later.

A Byte Out of Apple

No doubt, Bill Gates realized how profitable a successful GUI for IBM computers would be. He had seen Apple's Lisa computer and later the more successful Macintosh or Mac computer. Both Apple computers came with a stunning graphical user interface.

Wimps

Side Note: Early MS-DOS diehards liked to refer to MacOS (Macintosh operating system)as "WIMP", an acronym for the Windows, Icons, Mice and Pointers interface.

Competition

As a new product, Microsoft Windows faced potential competition from IBM's own Top View, and others. VisiCorp's short-lived VisiOn, released in October 1983, was the official first PC-based GUI. The second was GEM (Graphics Environment Manager), released by Digital Research in early 1985. Both GEM and VisiOn lacked support from the all-important third-party developers. Since, if nobody wanted to write software programs for an operating system, there would be no programs to use, and nobody would want to buy it.

Microsoft finally shipped Windows 1.0 on November 20, 1985, almost two years past the initially promised release date.

"Microsoft become the top software vendor in 1988 and never looked back" - Microsoft Corporation.

Apple Bytes Back

Microsoft Windows version 1.0 was considered buggy, crude, and slow. This rough start was made worse by a threatened lawsuit from Apple Computers. In September 1985, Apple lawyers warned Bill Gatesthat Windows 1.0 infringed on

Apple copyrights and patents, and that his corporation stoled Apple's trade secrets. Microsoft Windows had similar drop-down menus, tiled windows and mouse support.

Deal of the Century

Bill Gates and his head counsel Bill Neukom, decided to make an offer to license features of Apple's operating system. Apple agreed and a contract was drawn up. Here's the clincher: Microsoft wrote the licensing agreement to include use of Apple features in Microsoft Windows version 1.0 and all future Microsoft software programs. As it turned out, this move by Bill Gates was as brilliant as his decision to buy QDOS from Seattle Computer Products and his convincing IBM to let Microsoft keep the licensing rights to MS-DOS. (You can read all about those smooth moves in our feature on MS-DOS.)

Windows 1.0 floundered on the market until January 1987, when a Windows-compatible program called Aldus PageMaker 1.0 was released. PageMaker was the first WYSIWYG desktop-publishing program for the PC. Later that year, Microsoft released a Windows-compatible spreadsheet called Excel. Other popular and useful software like Microsoft Word and Corel Draw helped promote Windows, however, Microsoft realized that Windows needed further development.

Microsoft Windows Version 2.0

On December 9, 1987, Microsoft released a much-improved Windows version 2.0 that made Windows based computers look more like a Mac. Windows 2.0 had icons

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to represent programs and files, improved support for expanded-memory hardware and windows that could overlap. Apple Computer saw a resemblance and filed a 1988 lawsuit against Microsoft, alleging that they had broken the 1985 licensing agreement.

Copy This Will You

In their defense, Microsoft claimed that the licensing agreement actually gave them the rights to use Apple features. After a four-year court case, Microsoft won. Apple claimed that Microsoft had infringed on 170 of their copyrights. The courts said that the licensing agreement gave Microsoft the rights to use all but nine of the copyrights, and Microsoft later convinced the courts that the remaining copyrights should not be covered by copyright law. Bill Gates claimed that Apple had taken ideas from the graphical user interface developed by Xerox for Xerox's Alto and Star computers.

On June 1, 1993, Judge Vaughn R. Walker of the U.S. District Court of Northern California ruled in Microsoft's favor in the Apple vs. Microsoft & Hewlett-Packard copyright suit. The judge granted Microsoft's and Hewlett-Packard's motions to dismiss the last remaining copyright infringement claims against Microsoft Windows versions 2.03 and 3.0, as well as HP NewWave.

What would have happened if Microsoft had lost the lawsuit? Microsoft Windows might never have become the dominant operating system that it is today.

On May 22, 1990, the critically accepted Windows 3.0 was released. Windows 3.0 had an improved program manager and icon system, a new file manager, support for sixteen colors, and improved speed and reliability. Most important, Windows 3.0 gained widespread third-party support. Programmers started writing Windows-compatible software, giving end users a reason to buy Windows 3.0. Three million copies were sold the first year, and Windows finally came of age.

On April 6, 1992, Windows 3.1 was released. Three million copies were sold in the first two months. TrueType scalable font support was added, along with multimedia capability, object linking and embedding (OLE), application reboot capability, and more. Windows 3.x became the number one operating system installed in PCs until 1997, when Windows 95 took over.

Windows 95

On August 24, 1995, Windows 95 was released in a buying fever so great that even consumers without home computers bought copies of the program. Code-named www.image.yandex.ru

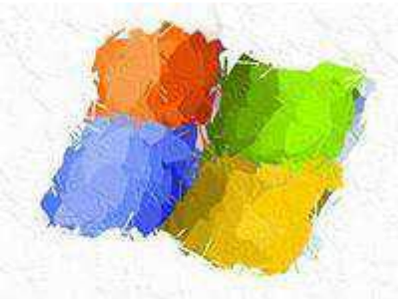
Chicago, Windows 95 was considered very user-friendly. It included an integrated TCP/IP stack, dial-up networking, and long filename support. It was also the first version of Windows that did not require MS-DOS to be installed beforehand.

Windows 98

On June 25, 1998, Microsoft released Windows 98. It was the last version of Windows based on the MS-DOS kernel. Windows 98 has Microsoft's Internet browser "Internet Explorer 4" built in and supported new input devices like USB.

Windows 2000

Windows 2000 (released in 2000) was based on Microsoft's NT technology. Microsoft now offered automatic software updates over the Internet for Windows starting with Windows 2000.



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Windows XP

According to Microsoft, "the XP in Windows XP stands for experience, symbolizing the innovative experiences that Windows can offer to personal computer users." Windows XP was released in October 2001 and offered better multi-media support and increased performance.

Windows Vista

Codenamed Longhorn in its development phase, Windows Vista is the latest edition of Windows.

XX. A Description of Antivirus Programs

By Carole Ann, eHow Contributor, //htpp: www ehow.com› facts_6818930_description-antivirus…

Protection

Antivirus software can offer protection from the threat of worms, trojans, spyware, viruses and malware. According to Top Ten Reviews, a good antivirus program can also protect your computer from phishing scams, keyloggers, rootkits and email-borne threats. Phishing scams are programs that appear to be legitimate sites in an attempt to obtain sensitive information from the user. Keyloggers track every keystroke made on your computer to steal passwords and account information. A rootkit takes control of your computer without your knowledge.

Installation/Use

Installation and setup of security software should be simple and quick. In addition, it should be user-friendly, even for beginners. Top Ten Reviews notes that everyday users want to be able to install the program and forget about it, without the need for ongoing maintenance.

Updates

Antivirus software should include updates as new viruses are identified. Automatic updates are often built into the software. Consumer Search notes that most programs include one year of free updates before requiring the purchase of a subscription or a new version.

Signature Checking

Signature checking is by far the most common method used by antivirus programs to detect malicious threats. The software has an extensive database of known viruses and malware, and each time it scans a file it compares the results to the information contained in its database. If the software finds a "signature" match, it will either warn the user or remove it right away, mostly depending on the seriousness of the threat. Some threats can be quarantined by the antivirus program, as well. Basically, it encrypts the file with different code to render it useless instead of removing it altogether. Of course, with new viruses coming out every day, the database must be kept completely up to date for the software to detect incoming threats.

Behavior Monitoring

Another way to detect malicious files or programs on a computer is through monitoring its behavior. Programs that attempt to access certain parts of the rootkey registry or modify an existing executable file (*.exe) for instance, will send a red flag up, and the software will take action against the threat if necessary. This approach is a good one to use because it can then detect malicious software that has not yet been added to the database simply by the way it is acting. However, this can also lead to the program warning the user about every single thing it finds, which may get irritating over time. Antivirus software is becoming more advanced by the second, though, and these false warnings are being lessened every day.

Emulation

The third common way for antivirus programs to pick out threats is to emulate the file in a safe environment created by the software itself. For instance, if a suspicious file or files has entered the computer, the program will take the executable files of the program and run them behind the scenes in a simulated setting to see what it does. If the software finds it is indeed malicious and a threat, it will then either quarantine or delete the harmful material before real damage can be done. This method can also trigger false warnings, and at that point it usually leaves it up to the user what to do with the file. If the user recognizes and trusts the program, the antivirus software will let it remain. If the user chooses for the program to take action against it, the perceived threat will be removed.

Active Vocabulary

Russian-English Dictionary of Mathematical Terms

-А-

абсолютная величина, абсолютное значение	absolute value
абсолютный, полный квадрат	perfect square
абсцисса	abscissa
алгебра	algebra
аксиома	axiom
аксиома завершенности	completeness axiom
аксиома поля	field axiom
аксиома порядка	order axiom
алгебраическая кривая	algebraic curve
анализ	analysis
антилогарифм	antilogarithm
аргумент, независимая переменная	argument
арифметика	arithmetic
арка, дуга	arc
апофема	apothem
ассоциативный	associative

-Б-

безопасный	secure
бесконечный(о)	infinite(ly)
бесконечно малое приращение	increment
бесконечный предел	infinite limit
бесконечная производная	infinite derivative
бесконечный ряд	infinite series
боковой, латеральный	lateral

-В-

вводить	to introduce
величина, значение	value
вертикальный	vertical
вершина (вершины)	vertex (vertices)
ветвь (у гиперболы)	branch
внешний *(угол)*	exterior
вносить вклад	to contribute
внутренние точки	interior points
внутренний *(угол)*	interior
вогнутый	concave
воображаемый	fictitious
вписанный круг	inscribed circle
вращение	rotation
выбирать	to select
выбор	choice
выводить, получать, извлекать (о знании)	to derive
выдающийся	distinguished
выпуклый	convex
вырожденный	degenerating
вырождаться	to degenerate
высота под наклоном	slant height
высота треугольника	altitude
вычисление	computation
вычислять	compute

-Г-

геометрическое место точек	locus (pl. loci)
горизонтальный	horizontal
гнуть, сгибать, изгибать	to bend (bent-bent)
грань	face
грань, фаска, ребро	edge
градиент	gradient
график	graph

-Д-

двучленный, биноминальный	binomial
действовать	to operate
действительное число	real number
делать вывод	to conclude

делимое	dividend
делитель	divisor
десятичный логарифм	common logarithm
детерминант, определитель	determinant
директриса	directrix (pl. Dirextrices)
дискриминант	discriminant
дистрибутивный	distributive
дифференциальное исчисление	differential calculus
дифференцирование	differentiation
додекаэдр, двенадцатигранник	dodecahedron
дробь	fraction
доказывать	to prove
доказательство	proof
дуга, арка	arc

-Е-

Евклидова геометрия	Euclidean geometry

-И-

идентичный	identical
изгиб, наклон	slope
измерение, мера, предел, степень	measure
изнурение, истощение, исчерпание	exhaustion
изображение, образ, отражение	image
изобретать	to invent
икосаэдр, двадцатигранник	icosahedron
икосидодекаэдр, тридцатидвухгранник	icosidodecahedron
интеграл	integral
интегральное исчисление	integral calculation
интегрирование	integration
интервал	interval
интерпретация	interpetation
иррациональный	irrational
иррациональность	irrationality
исчисление	calculus

-З-

замкнутый, закрытый	closed

закрытая кривая	closed curve
закрытый интервал	close interval
зеркальное отражение	mirror image
знаменатель	denominator
значительный	significant

-К-

касательная	tangent
касательная плоскость	tangent plane
касаться	to concern
кратное число	multiple
квадрант, четверть круга	quadrant
квадратный (об уравнениях)	quadratic
коммутативный	commutative
комплексное	complex
комплексное число	complex nuber
комплектовать	to complete
конгруэнтный	congruent
конечный	finite
конический	conic
конфигурация, очертание	configuration
копланарный, расположеннный в одной плоскости	coplanar
кривая	curve
кривизна	curvature
круглый, круговой	circular
кубическое	cubic
кубооктаэдр, трехгранник	cuboctahedron

-Л-

линейный	linear
линия отсчета	reference line
логарифм	logarithm

-М-

мантисса	mantissa
математический	mathematical
мгновенный, моментальный	instantaneous
метод бесконечно малых величин	infinitesimal method

многогранник	polyhedron
многогранный, полиэдрический	polyhedral
многочленный	polynomial
многоугольник	polygon
множество	set
множитель, фактор	factor
момент инерции	moment of inertia

-Н-

наклонная линия, косая линия	oblique
направление	direction
направленные числа	directed numbers
натуральный логарифм	natural logarithm
начало координат	origin
начальная ось	initial axis
независимый	independent
неизменный	unvarying
непрерывная, функция	continuous function
неопределенный	undefined
неуловимый	elusive
нулевой угол	null angle

-О-

обобщать	to generalize
обозначать	to denote
обозревать	to review
общее значение	total
общий	in common
образующая поверхности	generator - generatrix
обратная величина	reciprocal
обратно	conversely
объем	volume
одновременный	simultaneous
однозначное соответствие, отображение	one-to-one mapping
однообразный	uniform
октаэдр, восьмигранник	octahedron
определять	to determine
ордината	ordinate
основной, главный	principal
ось	axis
открытый	open

открытая кривая	open curve
отношение	relation
отражать	to ret1ect
отрезок	segment
отрицательный	negative
очевидный	obvious

-П-

параллелограмм	parallelogram
пентаграмма	pentagram
переменная величина, функция	fluent
пересекаться	to intersect
перпендикулярный	perpendicular
пирамида	pyramid
Платонов, относящийся к Платону	Platonic
плоскостная кривая	plane curve
плоскостной, плоский	planar
плоскость, плоскостной	plane
площадь всей поверхности	total surface area
поверхность	surface
подмножество	subset
подразделяться, распадаться на	to fall (fell,fallen) into
подразумевать	to imply
подчиняться правилам (законам)	to obey laws
познакомиться с	to be familiar (with)
полный угол	round angle
положительный	positive
полуправильный	semiregular
понятие	notion
понятие, концепт	concept
по часовой стрелке	clockwise
против часовой стрелки	anticlockwise
правильный *(о многоугольниках и т.д.)*	regular
предел отношения	limit of a ratio
предельный случай	limiting case
предполагать	to assume, to suppose
представлять	to imagine, to represent
преобразование	translation
призма	prism
применение	application
приписывать	to credit

проекция	projection
произведение	product
производная	derivative
производная, флюксия	fluxion
простой	simple
простое *(число)*	prime
противоречить	to contradict
противоречие	contradiction
процедура	procedure
прямой	straight
пятиугольник	pentagon
пятиугольный	pentagonal

-Р-

равносторонний	equilateral
равноугольный	equiangular
радиус	radius
развернутый угол	flat angle
развитие	development
разлагать	to resolve
разложение множителей	factorization
располагаться между	to lie between
рассматривать	to regard
расстояние	distance
рациональный	rational
решать	to solve
рост	growth

-С-

сводить в таблицу	tabulate
свойство	property
сечение	section
система прямоугольных координат	Cartesian coordinates
система записи	notation
скорость, быстрота	velociy
скорость изменения	rate of change
сложение	addition
сокращать	to cancel
сокращать, преобразовывать	to reduce
соответствовать	to correspond
средний	mean

средняя величина (значение)	average
ссылаться на	to refer (to)
степень	degree
стереографический	stereographic
сторона (в уравнении)	side
сфера	sphere
сумма	sum
существовать	to exist

-Т-

таблица	table
твердое тело	solid
тетраэдр, четырехгранник	tetrahedron
точка	point
трансцендентный	transcendental
треугольный, трехсторонний	triangular
трехмерный, объемный, пространственный	three-dimensional

-У-

увеличивать	to enlarge
угол понижения (падения)	depression angle
угол возвышения	elevation angle
удлиненный	elongated
удобство	convenience
удовлетворять	to satisfy
указывать	to indicate
умножение	multiplication
уравнение	equation
усекать, обрезать; отсекать верхушку	to truncate
ускорение	acceleration
установить	to establish

-Х-

характеристика	characteristic

-Ц-

целый, весь, полный	entire
целое число	integer
цель	purpose

центр массы (тяжести)	centroid

-Ч-

частное	quotient
часть	unit
числа со знаками	signed numbers
числитель	numerator
числа со знаками	signed numbers

-Ш-

шестиугольник	hexagon
шестиугольный	hexagonal

-Э-

элемент, составная часть	element
элементарный	elementary
эллипс	ellipse
эллиптический	elliptical

The Monolingual Dictionary of Computer Science Terminology

A

Accamulator	a register in a CPU in which intermediate arithmetic and logic results are stored
ATX	ATX (Advanced Technology eXtended) is a motherboard form factor specification developed by Intel in 1995 to improve on previous de facto standards like the AT form factor.
AT (form factor)	The AT form factor referred to the dimensions and layout (form factor) of the motherboard for the IBM AT.
AGP	The Accelerated Graphics Port (often shortened to AGP) is a high-speed point-to-point channel for attaching a video card to a computer's motherboard, primarily to assist in the acceleration of 3D computer

Bus	a subsystem that transfers data between computer components inside a computer or between computers
Blu-ray Disc	a optical disc storage medium designed to supersede the DVD format
BASIC	BASIC is a family of general-purpose, high-level programming languages whose design philosophy emphasizes ease of use - the name is an acronym from Beginner's All-purpose Symbolic Instruction

	Code.

C

Cache	a small, but fast memory that transparently improves the performance of a larger, but slower memory or storage device.
CD-ROM	a pre-pressed compact disc that contains data accessible to a computer for data storage and music playback. It is read in an optical disc drive.
Chip	a miniaturized electronic circuit (consisting mainly of semiconductor devices, as well as passive components) that has been manufactured in the surface of a thin substrate of semiconductor material.
Control core	the memory that stores the microcode of a CPU; originally read-only memory was employed.
Core memory	in modern usage, a synonym for main memory, dating back from the time when the dominant main memory technology was magnetic core memory.
CPU	the portion of a computer system that carries out the instructions of a computer program, and is the primary element carrying out the computer's functions.
Conventional PCI	Conventional PCI (PCI is an initialization formed from Peripheral Component Interconnect, part of the PCI Local Bus standard and often shortened to PCI) is a computer bus for attaching hardware devices in a computer.
Computer case	A computer case (also known as a computer chassis,

Computer form factor	cabinet, box, tower, enclosure, housing, system unit or simply case) is the enclosure that contains most of the components of a computer (usually excluding the display, keyboard and mouse). in computing, the form factor is the name used to denote the dimensions, power supply type, location of mounting holes, number of ports on the back panel, etc.
Chipset	a chipset, PC chipset, or chip set refers to a group of integrated circuits, or chips, that are designed to work together. They are usually marketed as a single product.
Channel I/O	in computer science, channel I/O is a generic term that refers to a high-performance input/output (I/O) architecture that is implemented in various forms on a number of computer architectures, especially on mainframe computers.

D

DVD	an optical disc storage media format, and was invented and developed by Philips, Sony, TOSHIBA, and Time Warner in 1995. Its main uses are video and data storage. DVDs are of the same dimensions as compact discs (CDs), but store more than six times as much data.
DASD	mainframe terminology introduced by IBM denoting secondary storage with random access, typically

	(arrays of) hard disk drives.
DIMM	DIMM which means (dual in-line memory module) comprises a series of dynamic random-access memory integrated circuits. These modules are mounted on a printed circuit board and designed for use in personal computers, workstations and servers. DIMM replaced SIMM which is the single in-line memory module.
DisplayPort	displayPort is a digital display interface developed by the Video Electronics Standards Association (VESA). The interface is primarily used to connect a video source to a display device such as a computer monitor, though it can also be used to transmit audio, USB, and other forms of data.
DVI	digital Visual Interface (DVI) is a video display interface developed by the Digital Display Working Group (DDWG). The digital interface is used to connect a video source to a display device, such as a computer monitor.
DRAM	Dynamic random-access memory (DRAM) is a type of random-access memory that stores each bit of data in a separate capacitor within an integrated circuit.

E

Expansion card	a printed circuit board that can be inserted into an expansion slot of a computer motherboard to add functionality to a computer system

Express card	ExpressCard is an interface to allow peripheral devices to be connected to a computer, usually a laptop computer. Peripherals include Firewire 800,USB 2.0/3.0,soundcards, TV Tuner cards, PCIe graphics cards and CAC cards.
EEPROM	stands for Electrically Erasable Programmable Read-Only Memory and is a type of non-volatile memory used in computers and other electronic devices to store small amounts of data that must be saved when power is removed.
EPROM	an EPROM (rarely EROM), or erasable programmable read only memory, is a type of memory chip that retains its data when its power supply is switched off.

F

Firewall	a hardware device or software to protect a computer from viruses, malware, trojans etc.
Firmware	fixed, usually rather small, programs and data structures that internally control various electronic devices.
Floppy disk	a data storage medium that is composed of a disk of thin, flexible ("floppy") magnetic storage medium encased in a square or rectangular plastic shell.
Floppy disk drive	a device for reading floppy disks.
Flash memory	a type of non volatile computer storage chip that can

	be electrically erased and reprogrammed. It was developed from EEPROM (electrically erasable programmable read-only memory) and must be erased in fairly large blocks before these can be rewritten with new data. The high density NAND type must also be programmed and read in (smaller) blocks, or pages, while the NOR type allows a single machine word (byte) to be written or read independently.

H

Hard disk drive	a non-volatile storage device that stores digitally encoded data on rapidly rotating rigid (i.e. hard) platters with magnetic surfaces.
Hardware	multiple physical components of a computer, upon which can be installed an operating system and a multitude of software to perform the operator's desired functions.
HDMI	(High-Definition Multimedia Interface) is a compact audio/video interface for transferring encrypted uncompressed digital audio/video data from a HDMI-compliant device ("the source" or "input") to a compatible digital audio device, computer monitor, video projector, and digital television.

I

Input device	any peripheral piece of computer hardware equipment) used to provide data and control signals to an information processing system.
Input/output	the communication between an information processing system (such as a computer), and the outside world possibly a human, or another information processing system.
IOPS	(Input/Output Operations Per Second, pronounced eye-ops) is a common performance measurement used to benchmark computer storage devices like hard disk drives (HDD), solid state drives (SSD), and storage area networks (SAN). As with any benchmark, IOPS numbers published by storage device manufacturers do not guarantee real-world application performance.

K

Keyboard	an input device, partially modeled after the typewriter keyboard, which uses an arrangement of buttons or keys, to act as mechanical levers or electronic

Mainframe	powerful computers used mainly by large organizations for critical applications, typically bulk data processing such as census, industry and consumer

	statistics, enterprise resource planning, and financial transaction processing.
Motherboard	the central printed circuit board (PCB) in many modern computers and holds many of the crucial components of the system, while providing connectors for other peripherals.
Memory	devices that are used to store data or programs (sequences of instructions) on a temporary or permanent basis for use in an electronic digital computer.
Monitor	an electronic visual display for computers. The monitor comprises the display device, circuitry, and an enclosure.
Mouse	a pointing device that functions by detecting two-dimensional motion relative to its supporting surface.
Mini-VGA	Mini-VGA connectors are used on some laptops and other systems in place of the standard VGA connector.
Microcode	a layer of hardware-level instructions or data structures involved in the implementation of higher level machine code instructions in many computers and other processors; it resides in special high-speed memory and translates machine instructions into sequences of detailed circuit-level operations.
Mask ROM	a type of read-only memory (ROM) whose contents are programmed by the integrated circuit manufacturer.

N

Network	a collection of computers and devices connected by communications channels that facilitates communications among users and allows users to share resources with other users.
Nonvolatile memory	or non-volatile storage is computer memory that can retain the stored information even when not powered.
Non-volatile random- access memory	is random-access memory that retains its information when power is turned off (non-volatile). This is in contrast to dynamic random-access memory (DRAM) and static random-access memory (SRAM), which both maintain data only for as long as power is applied.

O

Optical disc drive	is a disk drive that uses laser light or electromagnetic waves near the light spectrum as part of the process of reading or writing data to or from optical discs.
Operating system	is a set of software that manages computer hardware resources and provide common services for computer

Pen drive	another name for a USB flash drive.
Peripheral	

	a device attached to a host computer but not part of it, and is more or less dependent on the host. It expands the host's capabilities, but does not form part of the core computer architecture. Some computer peripheral include (Express Card, USB Drive, SD Card Memory Stick, router, external SSD & HDD Drives).
Personal computer	any general-purpose computer whose size, capabilities, and original sales price make it useful for individuals, and which is intended to be operated directly by an end user, with no intervening computer operator.
Printer	a peripheral which produces a text or graphics of documents stored in electronic form, usually on physical print media such as paper or transparencies.
Power supply unit	A unit of the computer that converts mains AC to low-voltage regulated DC for the power of all the computer components.
Programmable read-only memory	is a form of digital memory where the setting of each bit is locked by a fuse or antifuse.
PCI Express	is a computer expansion bus standard designed to replace the older PCI, PCI-X, and AGP bus standards.
PCI-X	is a computer bus and expansion card standard that enhances the 32-bit PCI Local Bus for higher bandwidth demanded by servers.

R

RAID	an umbrella term for computer data storage schemes

	that can divide and replicate data among multiple hard disk drives in order to increase reliability, allow faster access, or both.
RAM	a form of computer data storage. Today, it takes the form of integrated circuits that allow stored data to be accessed in any order (i.e., at random).
ROM	a class of storage media used in computers and other electronic devices.

S

Server	any combination of hardware or software designed to provide services to clients. When used alone, the term typically refers to a computer which may be running a server operating system, but is also used to refer to any software or dedicated hardware capable of providing services.
Software	a general term primarily used for digitally stored data such as computer programs and other kinds of information read and written by computers. Today, this includes data that has not traditionally been associated with computers, such as film, tapes and records.
Simm	or single in-line memory module, is a type of memory module containing random access memory used in computers from the early 1980s to the late 1990s.
Solid-state-drive	is a data storage device that uses integrated circuit assemblies as memory to store data persistently.
Static random-access memory	is a type of semiconductor memory where the word

Synchronous dynamic random-access memory	static indicates that, unlike dynamic RAM (DRAM), it does not need to be periodically refreshed. is dynamic random access memory (DRAM) that is synchronized with the system bus.

T

Tape drive	A peripheral device that allows only sequential access, typically using magnetic tape.
Terminal	an electronic or electromechanical hardware device that is used for entering data into, and displaying data from, a computer or a computing system.
Trackpad	a pointing device consisting of specialized surface that can translate the motion and position of a user's fingers to a relative position on screen

U

USB	a specification to establish communication between devices and a host controller (usually a personal computers). USB is intended to replace many varieties of serial and parallel ports.
USB flash drive	a flash memory data storage device integrated with a USB (Universal Serial Bus) 1.1, 2.0, or 3.0 interface. USB flash drives are typically removable and rewritable, and much smaller than a floppy disc.

V

VGA	A Video Graphics Array (VGA) connector is a three-row 15-pin DE-15 connector. The 15-pin VGA connector is found on many video cards, computer monitors, and some high definition television sets. On laptop computers or other small devices, a mini-VGA port is sometimes used in place of the full-sized VGA connector.
Volatile memory	also known as volatile storage, is computer memory that requires power to maintain the stored information.
Virus	a computer program that can replicate itself and spread from one computer to another. The term "virus" is also commonly, but erroneously, used to refer to other types of malware, including but not limited to adware and spyware programs that do not have a reproductive ability.

W

Webcam	is a video camera that feeds its images in real time to a computer or computer network, often via USB, ethernet, or Wi-Fi.