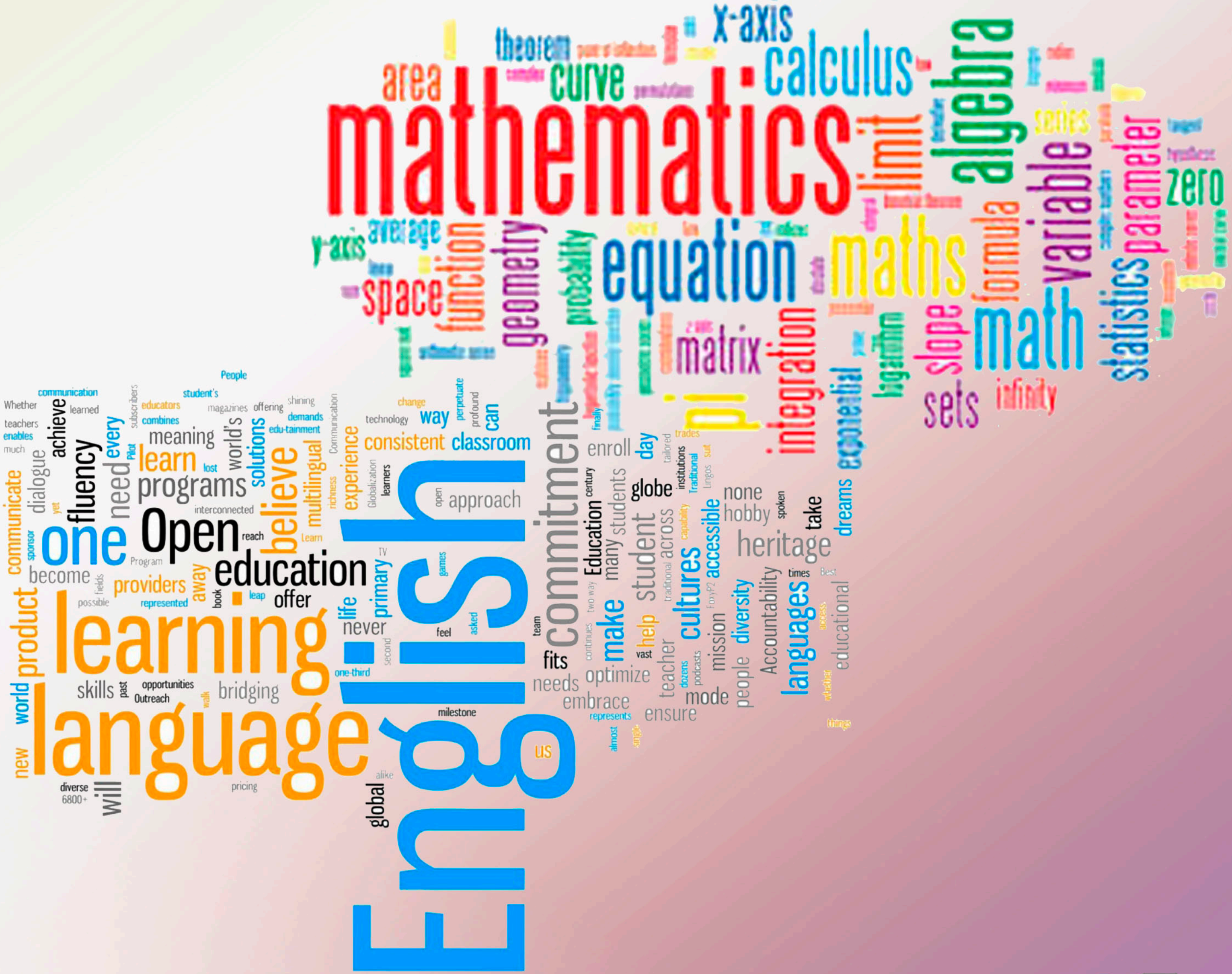
З. Ф. Галимова

BASIC MATH IN ENGLISH



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З. Ф. Галимова

BASIC MATH IN ENGLISH

Учебно-практическое пособие

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Учебно-практическое пособие предназначено для студентов бакалавриата направлений «Прикладная математика и информатика», «Математика и компьютерные науки», «Механика и математическое моделирование».

Пособие ориентировано на чтение современной математической литературы на английском языке. Пособие включает задания, направленные на развитие следующих умений: умения переводить тексты с английского языка на русский, реферировать и пересказывать тексты на анлийском языке, умение понимать математические задачи на английском языке, а также умения анализировать грамматические явления, которые встречаются при чтении текстов.

Пособие может быть использовано на аудиторных занятиях, для самостоятельного изучения, а также во время переводческой практики студентов, получающих дополнительную квалификацию по направлению «Переводчик в сфере профессиональной коммуникации».

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ПРЕДИСЛОВИЕ

Учебно-практическое пособие предназначено для студентов бакалавриата направлений «Прикладная математика и информатика», «Математика и компьютерные науки», «Механика и математическое моделирование».

Пособие соответствует программным требованиям Федерального государственного образовательного стандарта.

Актуальность создания данного пособия обусловлена тем, что не существует современных узкоспециализированных учебных изданий по английскому языку. Данное пособие поможет студентам ориентироваться в английской научной литературе, составить словарь-минимум по математике, освоить практику решения математических задач на английском языке.

Пособие способствует формированию таких компетенций, как умение анализировать аутентичный материал, извлекать информацию для дальнейшего практического применения, умение понимать узкоспециальную литературу, умение составлять словарь по математическим терминам, умение участвовать в обсуждении тем, связанных со специальностью (задавать вопросы и адекватно реагировать на них). Каждый текст снабжён гиперссылками для самостоятельного изучения предложенных тем.

Цели учебного пособия «Basic Math in English» следующие: во-первых, научить студентов читать математическую литературу, извлекая при этом научную информацию с нужной степенью полноты и точности, во-вторых, студенты должны уметь переводить аутентичные математические тексты с английского языка на русский язык, в-третьих, студенты должны достичь определённого уровня владения устной речью, который позволил бы им беседовать по специальности и делать устные научные сообщения.

При разработке данного учебного пособия учитывались следующие факторы: 1) цель обучения английскому языку на математическом факультете; 2) степень подготовленности студентов и специфика восприятия языка студентами; 3) требования программы и количество часов, отведенное на занятия; 4) системность и последовательность подачи материала.

Пособие состоит из трёх разделов (chapters): «Arithmetic», «Algebra», «Practical Grammar» и приложения. Каждый раздел объединяет темы (units). В каждой теме присутствуют задания, нацеленные на отработку знания терминологии, развитие грамматических навыков, а также предложены тексты для реферирования и перевода с русского языка на английский язык и наоборот. В каждом теме имеется рубрика об интересных математических фактах, шуточные математические задачи и стихотворения, высказывания о математике, задания на логику.

В первом разделе «Arithmetic» содержится семь тем (units). В каждой теме представлены два аутентичных текста по математике. Каждый текст направлен на совершенствование навыков различных видов чтения, расширение словарного запаса, составление терминологических словарей, а также представлены задания на перевод с русского языка на английский и на реферирование английских текстов.

Второй раздел «Algebra» состоит из восьми тем (units), в которых студенты знакомятся с алгебраическими выражениями, логарифмами и т.д. Все тексты являются аутентичными.

Третий раздел «Practical Grammar» состоит из восемнадцати тем. Цель данного раздела – дать объяснение грамматических явлений, которые встречались при чтении текстов в первой и во второй главах, а также представить задания на отработку знаний о грамматики. В данном разделе грамматический материал изложен в форме таблиц на русском языке, что даёт возможность студентам лучше понять грамматическое явление. После объяснения грамматического материала предлагаются задания на закрепление полученных знаний. В разделе представлен список латинских терминов и примеры их использования в математических текстах.

В приложении (Appendix) предоставлена информация о математических символах, таких как алгебраические символы, символы вероятности, логические символы и т.д.

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Chapter 1. ARITHMETIC

Unit 1. The Ultimate Guide to Number Classification

We have been using numbers in everyday life. Everything from 0 to 22/7 might sound the same to most, but numbers differ from one another. Based on their characteristics, they are classified in groups. Read below for more details on each number group.

Real Numbers (R)

– All kinds of numbers that you usually think of – from bus route numbers, to your weight, to pi and even the square root of pi! In short everything!! Everything? Really? Real numbers are all numbers on a number line. The set of **R** is the union of all rational numbers and all irrational numbers.

Imaginary numbers

– Have you ever tried finding the square root of -1? If you haven't, try it on your calculator. It might show an error (if it is a dumb calc) or it might show an 'i'. That little 'i' is called an imaginary number. In short square roots of negative numbers make imaginary numbers.

An imaginary number is a number which square is a negative real number, and is denoted by the symbol i, so that $i^2 = -1$. E.g.: $-5i$, $3i$, $7.5i$, &c.

In some technical applications, j is used as the symbol for imaginary number instead of i.

Complex Numbers (C)

– It's rather simple! Make a combination of real and imaginary numbers and voila! You get a complex number. Stuff like 3+2i or 3/4i make up complex numbers. Just think of it when you mix a real number with an imaginary one, things do get a bit complex!

A complex number consists of two part, real number and imaginary number, and is also expressed in the form $\mathbf{a + b}\boldsymbol{i}$ (i is notation for imaginary part of the number). E.g.: $7 + 2i$

Rational Numbers (Q)

– Any number that can be written as a fraction is a rational number. So numbers like S, s, even 22/7 and all integers are also rational numbers.

A rational number is the ratio or quotient of an integer and other non-zero integer: Q = {n/m | n, m ∈ Z, m ≠ 0 }. E.g.: -100, -20j, -1.5, 0, 1, 1.5.

Irrational Numbers

– Simply the opposite of rational numbers i.e. numbers that can not be written as fraction, like square roots of prime numbers, the golden ratio, the real value of pi (22/7 is a mere approximation not the real value of pi) are irrational numbers.

Irrational numbers are numbers which cannot be represented as fractions. E.g.: $\sqrt{2}$, $\sqrt{3}$; π, e.

Integers (**Z**)

– Any number that is not a fraction and does not have a tail after the decimal point is an integer. This includes both negative as well as positive numbers as well as zero.

Integers extend **N** by including the negative of counting numbers: **Z** = { ..., -4, -3, -2, -1, 0, 1, 2, 3, 4, ... }. The symbol **Z** stands for Zahlen, the German word for "numbers".

Fractions

– Numbers that are expressed in a ratio are called fractions. This classification is based on the number arrangement and not the number value. Remember that even integers can be expressed as fractions – 3 = 6/2 so 6/2 is a fraction but 3 is not.

Proper Fractions

– Whenever the value of the numerator in a fraction is less than the value of the denominator, it is called a proper fraction. i.e. it's bottom heavy.

Improper Fractions

- Whenever the value of the denominator in a fraction is less than the value of the numerator, it is called a improper fraction. i.e. it's top heavy.

Mixed Fractions

– All improper fractions can be converted into an integer with a proper fraction. This combination of an integer with a proper fraction is called a mixed fraction.

Natural Numbers (N)

– All positive integers(not including the zero) are Natural numbers.

Simply put, whatever you can count in Nature uses a natural number. Natural numbers are defined as non-negative counting numbers: **N** = { 0, 1, 2, 3, 4, ... }. Some exclude 0 (zero) from the set: **N** * = **N** \{0} = { 1, 2, 3, 4, ... }.

Whole Numbers

– All positive integers inclusive of the zero are whole numbers. Not a big deal different from natural numbers.

Even Numbers

– All integers that end with a 0, 2, 4, 6, or 8 (including the numbers 0, 2, 4,6 & 8 themselves) are even numbers. Note that '0' itself is an even number. Also note that negative numbers can also be even so long as they can be integrally divided by 2.

Odd Numbers

– All integers that are not even numbers are odd number.

Prime Numbers

- A natural number, more than one, which has exactly two distinct natural number divisors: 1 and itself - is called a Prime number. There can be infinite prime numbers.

Composite Numbers

– A positive integer which has a positive divisor other than one or itself is a composite number. In other words, all numbers that are not prime are composite. http://myhandbook.info/class_number.html

Text for reading

Mathematics (from Greek μάθημα *mбthēma*, "knowledge, study, learning") is the abstract study of topics encompassing quantity, structure, space, change, and other properties; it has no generally accepted definition.

Mathematicians seek out patterns and formulate new conjectures. Mathematicians resolve the truth or falsity of conjectures by mathematical proof. The research required to solve mathematical problems can take years or even centuries of sustained inquiry. Since the pioneering work of Giuseppe Peano (1858–1932), David Hilbert (1862–1943), and others on axiomatic systems in the late 19th century, it has become customary to view mathematical research as establishing truth by rigorous deduction from appropriately chosen axioms and definitions. When those mathematical structures are good models of real phenomena, then mathematical reasoning can provide insight or predictions about nature.

Through the use of abstraction and logical reasoning, mathematics developed from with application mathematical knowledge counting, calculation, measurement, and the systematic study of the shapes and motions of physical objects. Practical mathematics has been a human activity for as far back as written records exist. Rigorous arguments first appeared in Greek mathematics, most notably in Euclid's *Elements*. Mathematics developed at a relatively slow pace until the Renaissance, when mathematical innovations interacting with new scientific discoveries led to a rapid increase in the rate of mathematical discovery that has continued to the present day.

Galileo Galilei (1564–1642) said, "The universe cannot be read until we have learned the language and become familiar with the characters in which it is written. It is written in mathematical language, and the letters are triangles, circles and other geometrical figures, without which means it is humanly impossible to comprehend a single word. Without these, one is wandering about in a dark labyrinth." Carl Friedrich Gauss (1777–1855) referred to mathematics as "the Queen of the Sciences." Benjamin Peirce (1809–1880) called mathematics "the science that draws necessary conclusions." David Hilbert said of mathematics: "We are not speaking here of arbitrariness in any sense. Mathematics is not like a game whose tasks are determined by arbitrarily stipulated rules. Rather, it is a conceptual system possessing internal necessity that can only be so and by no means otherwise." Albert Einstein (1879–1955) stated that "as far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality."

Mathematics is used throughout the world as an essential tool in many fields, including natural science, engineering, medicine, and the social sciences. Applied mathematics, the branch of mathematics concerned of to other fields, inspires and makes use of new mathematical discoveries, which has led to the development of entirely new mathematical disciplines, such as statistics and game theory. Mathe-

maticians also engage in pure mathematics, or mathematics for its own sake, without having any application in mind. There is no clear line separating pure and applied mathematics, and practical applications for what began as pure mathematics are often discovered.

http://www.whatismathematics.com/what-is-mathematics/

EXERCISES

1. Translate the following words into Russian.

might, differ, weight, almost, dumb, rather, make up, complex, value, approximation, tail, decimal point, include, as well as, voila! arrangement, convert, whenever, simply put, inclusive, not a big deal, integrally, infinite, distinct, in other words, encompass, properties, accept, seek out, conjecture, resolve, falsity, sustained inquiry, research, rigorous, appropriately, definition, phenomena, insight, prediction, logical reasoning, exist, increase, familiar concept, characters, comprehend, conclusions, determine, stipulated, by no means, essential, tool, applied mathematics, inspire, pure mathematics, for one`s sake.

2. Find the Latin abbreviations in the texts.

i.e .- id est - то есть, etc.-et cetera - и так далее, e.g.- exempli gratia - лат; "ради примера" – например.

3. Translate the words into English.

вкратце, а также, и, о чудо, всякий раз когда, проще говоря, ничего страшного, в целом виде; нацело (о делении); четко различимые, бесконечный, иными словами, вместить; вмещать, свойства, принять, разыскать, гипотеза; предложение, разрешить, никоим образом не, ради, с учётом, прикладная математика, понимание, интуиция, знакомое понятие.

4. Guess the meaning of these words.

base – based, classify – classification, every – everything, approximate – approximation, proper – improper, false – falsity, deduce – deduction, predict – prediction, reason – reasoning, count – counting, measure – measurement, conclude – conclusion, concept – conceptual, apply – applied – application.

5. Translate the text into Russian.

The numerical digits we use today such as 1, 2 and 3 are based on the Hindu-Arabic numeral system developed over 1000 years ago. It is important to notice that no symbols for zero occur in any of these early Hindu number system. They contain symbols for numbers like twenty, forty, and so on. A symbol for zero had been invented in India. The invention of this symbol for zero was very important, because its use enabled the nine Hindu symbols 1, 2, 3, 4, 5, 6, 7, 8 and 9 to suffice for the representation of any number, no matter how great. The work of a zero is to keep the other nine symbols in their proper place. Different names for the number 0 include zero, nought, naught, nil, zilch and zip.

6. Choose from the terms above to complete each sentence.

additive, inverse, opposite, graph, integer, origin, quadrant, *x*-coordinate, *y*-axis, negative integer, absolute value

1. Vertical bars before and after a number indicate _______, the distance a number is from zero on a number line.
2. A(n) _____ is a number that can be graphed on a number line. 3. When you _____ a point, you locate its position on a coordinate plane by drawing a dot at the location of its ordered pair.
4. The _______ is the opposite of any number. When added to the number, the sum equals 0.
5. The ______ is the first number of an ordered pair. It corresponds to a number on the *x*-axis.
6. The ______ is the vertical number line of a coordinate plane.
7. A(n) _________ is an integer less than zero.
8. The point at which the number lines of a coordinate plane intersect is called the ________ .
9. Two integers that are the same distance from 0 on a number line, but on opposite sides of 0, are called ______ .
10. A(n) ________ is one of four sections of a coordinate plane.

7. Translate the text into English.

Десятичная система нумерации возникла в Индии. Впоследствии её стали называть «арабской», потому что она была перенесена в Европу арабами. Цифры, которыми мы пользуемся, тоже называются арабскими. В этой системе важное значение имеет число «десять», и поэтому система носит название десятичной системы нумерации.

8. Translate the following text.

Here are few amazing prime numbers, these prime numbers were proved by the XVIIIth century.

31
331
3331
33331
333331
3333331
33333331

The next number 333333331 is not a prime number. Whereas it is multiplied by 17×19607843 = 333333331.

9. Solve the following problems.

- Can you put ten sugar lumps into three cups so there is an add number of lumps in each cup?
- Tell me quickly: What time is it when it`s 60 minutes to 2?
- Frederick the frog quite liked Freda the frog who was sitting on the next stone to him on the pond. He began to wonder how many jumps it would take him to land on the same stone as her. The 11 stones were equally spaced in a circle around the pond. Frederick could jump over two stones at a time, landing three away, while Freda could clear one stone in each jump, landing two away. They both jumped simultaneously and Freda always jumped anticlockwise. In which direction should Frederick keep jumping for the quickest rendezvous, clockwise or anti-clockwise?

Unit 2. The Laws of Arithmetic

When evaluating expressions, you don't always have to follow the order of operations strictly. Sometimes you can play around with the expression first. You can **commute** (with addition or multiplication), **associate** (with addition or multiplication), or **distribute** (multiplication or division over addition or subtraction).

When simplifying an expression, consider whether the laws of arithmetic help to make it easier.

Example: 57(71) + 57(29) is much easier to simplify if, rather than using the order of operations, you use the "distributive law" and think of it as 57(71 + 29) = 57(100) = 5,700.

The Commutative and Associative Laws

Whenever you add or multiply terms, the order of the terms doesn't matter, so pick a convenient arrangement. To commute means to move around. (Just think about what commuters do!)

Example: 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 = 1 + 9 + 2 + 8 + 3 + 7 + 4 + 6 + 5 (Think about why the second arrangement is more convenient than the first!) Whenever you add or multiply, the grouping of the terms doesn't matter, so pick a convenient grouping. To associate means to group together. (Just think about what an association is!)

Example: (32 × 4) × (25 × 10) × (10 × 2) = 32 × (4 × 25) × (10 × 10) × 2 (Why is the second grouping more convenient than the first?) Whenever you subtract or divide, the grouping of the terms does matter. Subtraction and division are neither commutative nor associative. Whenever you subtract or divide, the grouping of the terms does matter. Subtraction and division are neither commutative nor associative.

Example: 15 − 7 − 2 ≠ 7 − 15 − 2 (So you can't "commute" the numbers in a difference until you convert it to addition: 15 + −7 + −2 = −7 + 15 + −2.) 24 ÷ 3 ÷ 2 ≠ 3 ÷ 2 ÷ 24 (So you can't "commute" the numbers in a quotient until you convert it to multiplication:

$$24 \times \frac{1}{3} \times \frac{1}{2} = \frac{1}{3} \times \frac{1}{2} \times 24$$

The Distributive Law

When a grouped sum or difference is multiplied or divided by something, you can do the multiplication or division first (instead of doing what's inside parentheses, as the order of operations says) as long as you "distribute." Test these equations by plugging in numbers to see how they work:

Example: $a(b + c) = ab + ac$

$$\frac{(b+c)}{a} = \frac{b}{a} + \frac{c}{a}$$

Distribution is never something that you have to do. Think of it as a tool, rather than a requirement. Use it when it simplifies your task. For instance, 13(832 + 168) is actually much easier to do if you don't distribute: 13(832 + 168) = 13(1,000) = 13,000. Notice how annoying it would be if you distributed. Use the distributive law "backwards" whenever you factor polynomials, add fractions, or combine "like" terms.

Example:

$$\frac{3}{b} + \frac{a}{b} = \frac{3+a}{b} \qquad 5\sqrt{7} - 2\sqrt{7} = 3\sqrt{7}$$

Follow the rules when you distribute! Avoid these common mistakes:

$(3+4)^2$ is not $3^2 + 4^2$ (Tempting, isn't it? Check it and see!) 3(4 × 5) is not 3(4) × 3(5).

It is interesting to know…

- 111111111 x 111111111 = 12345678987654321
- What comes after a million, billion and trillion? A quadrillion, quintillion, sextillion, septillion, octillion, nonillion, decillion and undecillion.
- The smallest ten prime numbers are: 2, 3, 5, 7, 11, 13, 17, 19, 23 and 29.
- The name of the popular search engine 'Google' came from a misspelling of the word 'googol', which is a very large number (the number one followed by one hundred zeros to be exact).

http://www.kidsmathgamesonline.com/facts/numbers.html

The life and numbers of Fibonacci

Have you ever wondered where we got our decimal numbering system from? The Roman Empire left Europe with the Roman numeral system which we still see, amongst other places, in the copyright notices after TV programmes (1997 is MCMXCVII).

The Roman numerals were not displaced until the 13th Century AD when Fibonacci published his Liber abaci which means "The Book of Calculations".

Fibonacci, or more correctly Leonardo da Pisa, was born in Pisa in 1175AD. He was the son of a Pisan merchant who also served as a customs officer in North Africa. He travelled widely in Barbary (Algeria) and was later sent on business trips to Egypt, Syria, Greece, Sicily and Provence.

In 1200 he returned to Pisa and used the knowledge he had gained on his travels to write Liber abaci in which he introduced the Latin-speaking world to the decimal number system. The first chapter of Part 1 begins:

These are the nine figures of the Indians: 9 8 7 6 5 4 3 2 1. With these nine figures, and with this sign 0 which in Arabic is called *zephirum*, any number can be written, as will be demonstrated.

Root finding

Fibonacci was capable of quite remarkable calculating feats. He was able to find the positive solution of the following cubic equation:

$$x^3 + 2x^2 + 10x = 20$$

What is even more remarkable is that he carried out all his working using the Babylonian system of mathematics which uses base 60. He gave the result as 1;22,7,42,33,4,40 which is equivalent to:

$$1 + \frac{22}{60} + \frac{7}{60^2} + \frac{42}{60^3} + \frac{33}{60^4} + \frac{4}{60^5} + \frac{40}{60^6}$$

It is not known how he obtained this, but it was 300 years before anybody else could find such accurate results. It is quite interesting that Fibonacci gave the result in this way at the same time as telling everybody else to use the decimal number system!

Fibonacci sequence

Fibonacci is perhaps best known for a simple series of numbers,

introduced in Liber abaci and later named the Fibonacci numbers in his honour. The series begins with 0 and 1. After that, use the simple rule: Add the last two numbers to get the next. 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987,...You might ask where this came from? In Fibonacci's day, mathematical competitions and challenges were common. For example, in 1225 Fibonacci took part in a tournament at Pisa ordered by the emperor himself, Frederick II. It was in just this type of competition that the following problem arose:

Beginning with a pair of rabbits, if every month each productive pair bears a new pair, which becomes productive when they are 1 month old, how many rabbits will there be after n months?

http://plus.maths.org/content/life-and-numbers-fibonacci

EXERCISES

1. Read the words and translate them into Russian.

evaluate expression, follow, strictly, simplify an expression, consider, rather than, whenever, it doesn`t matter, convenient, arrangement, neither ... nor, convert, instead of, tool, for instances, annoy, notice, avoid, introduce, order, wonder, gain, capable, carry out, remarkable, accurate, sequence, competition, challenge, take part.

2. Guess the meaning of these words.

arrange – arrangement, commute – commuter, group – grouping, differ – different, require – requirement, express- expression, commute – commuter – commutative, remark – remarkable, associate – associative, distribute – distributive, compete – competition, spell – misspell.

3. Translate the words into English.

ни … ни, определить, следовать, строго, упростить, рассматривать, вместо того, чтобы, всегда, когда, это не имеет значения, удобный, правильная конфигурация, свести; сводить, вместо, инструмент, например, заметить, избегать, порядок, способный, приобрести, выполнить, выдающийся, точно определённый, последовательность, соревнование, испытание, принять участие.

4. Replace the words in Russian with English words.
understanding, essential, important, simple, concise, bad, conventional, correct, easy

1. This statement is (самое сжатое). 2. This definition is (не такое существенное, как) the previous one. 3. These symbols are (более общеприняты, чем) the new ones. 4. This feature is (столь же важна, как) the other one. 5. The direct method is (самый простой) 6. This relation is (самое правильное). 7. He has a (лучшее понимание) of all these relations. 8. She understands English (хуже, чем) I do.

5. Translate the text into Russian.
Can you understand your calculator when it speaks to you? Enter the number 0.7734 and turn your calculator upside down. What does it say? Is your calculator happy or sad? Enter the number 334.334 and turn your calculator upside down. What's the answer? Your calculator has got an English name. Enter the number 227. Multiply it by 2 and then by 17 and turn your calculator upside down. What's its name? Is your calculator rich? What has he got in his pockets? Multiply 3319 by 16, add 600 and turn your calculator upside down to find the answer.

6. Solve the following puzzles.

- The Dopey Dice Company manufacture dice with opposite faces that do not all total seven, contrary to the case with normal dice. Not only that, but sometimes they make a die whose faces are orientated differently to those of their regular dice. This is the case in the diagram above, where three of the views are of the same die and the other view is of a rogue die Which is the odd one out?
- At the reading of Elijah Polyp's will, his two sons Nabber and Grabber were eagerly waiting to learn how much land they had inherited. The big moment had arrived. The lawyer, who was rather drunk, fumbled in his briefcase, took out the will, and belched loudly. 'Out of the 8235 acres left to my two sons, Nabber gets 1647, and Grabber gets the rest.' With that, the lawyer wrote the message 'Nabber 1647/8235' on his notepad and went in search of the toilet. Being mean, Grabber took the notepad and a rubber, and tried to reduce Nabber's share by rubbing out exactly one digit in the numerator and denominator. Curiously, the remaining six digits gave the same magnitude as before. So Grabber rubbed out a further digit on the top and bottom. Still the same magnitude! Footsteps in the corridor signalled the lawyer's return. In a last act of desperation, Grabber erased one last digit from the top and bottom. As the lawyer entered the room, Grabber realised that all his attempts had failed to alter the magnitude in front of him. The lawyer returned the notepad to his briefcase and Nabber and Grabber got their rightful proportions. What was the order of the three pairs of digits that Grabber erased?
- The cost of a car tire is \$45 plus \$10 per order regardless of the number of tires purchased. If Mrs. Sato places an order for \$190, use the equation $45t + 10 = 190$ to find the number of tires t she purchased.
- Which number when added to 5/4 gives the same result as when it is multiplies by 5/4?
- A two-digit number, read from left to right, is 4.5 times as large as the same number read from the right to left. What is the number?

7. Translate the following jokes into Russian.

- Mathematicians never die, they just lose their functions!
- Q: When things go wrong, what can you always count on?
  A: Your fingers.
- Several people were asked the following problem: Prove that all odd integers higher than 2 are prime! Mathematician: "3 is prime, 5 is prime, 7 is prime, and by induction, we have that all the odd integers are prime." Statistician: "100% of the sample 5, 13, 37, 41 and 53 is prime, so all odd numbers must be prime."
- Q: How do you know when you've reached your Math Professors voice-mail?
  A: The message is "The number you have dialed is imaginary. Please, rotate your phone by 90 degrees and try again..."

http://www.jokes4us.com/miscellaneousjokes/mathjokes/mathriddl

Unit 3. The Order of Operations

Don’t confuse the key words for the basic operations: *Sum* means the result of addition, *difference* means the result of subtraction, *product* means the result of multiplication, and *quotient* means the result of division.

The Inverse Operations

Every operation has an inverse, that is, another operation that “undoes” it. For instance, subtracting 5 is the inverse of adding 5, and dividing by - 3.2 is the inverse of multiplying by -3.2. If you perform an operation and then perform its inverse, you are back to where you started. For instance, 135 × 4.5 ÷ 4.5 × 135. No need to calculate!

Using inverse operations helps you to solve equations. For example, $3x - 7 = 38$

To “undo” - 7, add 7 to both sides: $3x = 45$

To “undo”× 3, divide both sides by 3: $x = 15$

Alternative Ways to Do Operations

Every operation can be done in two ways, and one way is almost always easier than the other. For instance, subtracting a number is the same thing as *adding the opposite number.* So subtracting -5 is the same as adding 5. Also, dividing by a number is exactly the same thing as *multiplying by its reciprocal.* So dividing by 2/3 is the same as multiplying by 3/2. When doing arithmetic, always think about your options, and do the operation that is easier! For instance, if you are asked to do 45 ÷ -1/2, you should realize that it is the same as 45 × -2, which is easier to do in your head.

The Order of Operations

Rules for doing mathematical operations in the correct order

P operate within the parenthesis first

E exponents (or powers) next

D division and

M multiplication (left to right)

A addition and

S subtraction (left to right)

Don’t forget the order of operations: P-E-MDAS. When evaluating, first do what’s grouped in *parentheses* (or above or below frac-

tion bars or within radicals), then do *exponents* (or roots) from left to right, then *multiplication* or *division* from left to right, and then do *addition* or *subtraction* from left to right. What is 4 – 6 ÷ 2 × 3? If you said, you mistakenly did the multiplication before the division. (Instead, do them left to right). If you said -3 or -1/3, you mistakenly subtracted before taking care of the multiplication and division. If you said -5, pat yourself on the back!

How to Train Your Brain

Your brain, like all of the other muscles in your body, needs exercise and training. A lot of people have completely untrained brains. Do you want to get your brain in shape? Following the steps below you can improve your brain usage, "exercise" your brain, and keep your brain from becoming too lazy:

- **Include some basic problems in your day.** These can include, but aren't limited to: basic arithmetic, puzzles like crossword and sudoku, games that require thought like chess, etc. These problems require your brain to work and not only help train your brain, but make you better at these things (maybe you'll become a chess master).
- **Include exercise in your day.** Not only can exercising your brain help it, but exercising other parts of your body may help, too. Exercise has many mental benefits such as improving cognitive functioning, reducing the risk of developing dementia, and many other benefits, too. You can also supposedly think better after exercise, so it would also be a good idea to exercise your body immediately before you exercise your brain.
- **Eat a good breakfast.** Eating the right breakfast can have quite an impact on brainpower. It has been shown that kids who have fizzy drinks and sugary snacks for breakfast perform poorly on tests of memory and attention. Eating a good breakfast everyday will also insure that you have the energy throughout the day to exercise your mind and body. Eating a diet rich in nutrients can help. Studies show that a diet rich nutrients like antioxidants and vitamins boosts cognition and memory.

• **Limit the television you watch.** When you watch TV, your brain goes into neutral. In one study says that people watching TV had increased alpha brain waves – their brains were in a passive state as if they were just sitting in the dark. TV watching has been tied to low achievement of course, and why would you want that?

• **Laugh.** Studies have shown that people are typically better at solving exercises designed to measure creative thinking right after exposure to comedy. Subjects claimed that they felt more alert, active, interested, and excited after watching comedy. There's a caveat, though: Humor can be distracting and may decrease performance on non-creative tasks.

• **Learn something new.** By learning something else, you are exercising an important skill of your brain - the ability to learn. By searching wikihow or some other site, you can learn something that will be helpful to you in the future and help your brain, too.

• **Try fun challenging mental tasks** like reading a hard book, learning a different language, or using your other hand for something you typically do (like eating, brushing your teeth, writing a story, or playing an instrument for starters, in order from least to most difficult). This will be fun and strengthens the connections (synapses) between nerve cells in the brain.

• **Don't do stuff you don't want to do.** If you get bored doing mental Math problems, don't do them. Don't feel you have to do it just to make your brain better. If you don't enjoy it, you won't learn anything! Exercising your brain isn't just something you do once. Try fitting in these steps every day. Like other exercise, it is only really effective if it is done more than once.

http://www.wikihow.com/Train-Your-Brain

EXERCISES

1. Read the words and translate them into Russian.

confuse, mean, inverse, for instance, perform, solve, almost, reciprocal, options, realize, do in your head, forget, evaluate, braces, brackets, untrained, improve, usage, include, benefit, cognitive, reduce, supposedly, immediately, impact, brainpower, memory, attention, insure, throughout, achievement, measure, thinking, exposure, claim,

alert, caveat, distract, nutrient, boost, once, challenge, strengthen.

2. Form nouns of the following verbs.

-ing – to count, to move, to place, to contain, to find, to mean, to solve, to try, to undertake, eat, exercise.
-ation – to determine, to represent, to evaluate.
-ion – to express, to operate, multiply.

3. State the functions of the Participle I.

1. We have defined these sets as being equal. 2. Let us try dividing these numerals. 3. It is no use performing this operation now. 4. Having reduced the fraction we obtained the expected result. 5. The entire situation is being slightly changed. 6. We know of their having succeeded in finding an appropriate explanation. 7. When working with these signs one must be very careful. 8. On obtaining the difference one must check the result by addition to make sure it is correct.

4. Find the solutions to these problems.

➢ Without parentheses, the expression $8 + 30 \div 2 + 4$ equals 27. Place parentheses in the expression so that it equals 13; then 23. Use the order of operations and the digits 2, 4, 6, and 8 to create an expression with a value of 2.
➢ After taking Mother to the cinema, I began to take her home. However, when I looked back I saw that I'd left Father. What was his name?
➢ If it takes four men eight days to dig four holes, how long does it take one man to dig half a hole?

5. Try to do these operations.

Think of any number greater than five. What is your number?

1. Multiply your number by ten. What is the result? 2. Add sixteen to your new number. What is the result? 3. Divide your new number by two. What is the result? 4. Subtract three from your new number. What is the result? 5. Square your new number. What is the final number?

Unit 4. Types of Fractions

In this Unit you will deal with fractions. Fractions consist of two numbers: *a numerator* (which is above the line) and a *denominator* (which is below the line).

Sometimes it helps to think of the dividing line (in the middle of a fraction) as meaning "out of." In other words, 3/5 would also mean 3 "out of" 5 equal pieces from the whole pie. All rules for signed numbers also apply to fractions.

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: mathematical concepts and principles are just as valid in the case of rational numbers (fractions) as in the case of integers (whole numbers).

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.

How do you reduce a fraction to its lowest terms?

Reducing a faction to lower terms means finding an equal fraction with a smaller numerator and denominator. Reduce 8/10 to lowest terms. The fraction 4/5 is in lowest terms because no number except 1 will divide evenly into both 4 and 5. Check your work by cross-multiplying. The fractions 8/10 and 4/5 are equal fractions. Both parts of the fraction need to be divisable by the same figure then that will give you a lower term. i.e. 2/4 is divisable by 2 hence it is 1/2.

Fractions which represent the same fractional are called equivalent fractions. 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.

Types of Fractions The three types of fractions are: *proper fraction, improper fraction, mixed fraction.*

Proper fraction: *Fractions whose numerators are less than the denominators are called proper fractions.* The proper fraction is known as the numerator part is smaller than the denominator value. The common format of the fraction is numerator / denominator.

Improper fraction: *Fractions with the numerator either equal to or greater than the denominator are called improper fraction.* Improper fraction is a fraction, where the top number of fraction that the numerator is greater than or equal to its own denominator (bottom number) and the value of that fraction is greater than or equal to one. Fractions representing values less than 1, like two thirds, for example, are called proper fractions. Fractions which name a number equal to or greater than 1, like two seconds or three seconds, are called improper fractions.

Mixed fraction: *A combination of a proper fraction and a whole number is called a mixed fraction.* It is the combination of integer + proper fraction otherwise we tell as integer followed by proper fractions (please note that for integers we should only consider the negative integers, as every whole number is an integer but not every integers are not whole numbers).

It can be also explained as a combination of both whole number and a proper fraction. There are numerals, like one and one second, which name a whole number and a fractional number. Such numerals are called mixed fractions. http://www.math-only-math.com/Types-of-Fractions.html

It is interesting to know:

- The word "fraction" originates from the Latin word. The Latin word "fractus" is also the root for the English word "fracture". A fraction can be written in the form of a/b, where the "/" symbol is called a slash or a vinculum, e.g. 1/3 = 0.333333... can be written as 0.3 (which a vinculum above the value 3 in 0.3) to indicate that the value 3 repeats itself infinitely. It is used in Boolean algebra (AND, OR, NOT), too. For example, A (with a vinculum above the letter A) means NOT A.
- The Riemann hypothesis is now regarded as the most significant unsolved problem in mathematics. It claims there is a hidden pat-tern to the distribution of prime numbers—numbers that can't be factored, such as 5, 7, 41, and, oh, 1,000,033.

Why do we study Math in the first place?

I won't lie to you. The chances of you ending with a job that requires you to use Sin, Cos and Tan every day, or know all six circle theorems, is pretty remote. And when you are older, the chances of a gorgeous woman/man coming up to you and saying "I would love to go out with you, but if you could just tell me four properties of a trapezium first" are pretty slim as well.

But that is not why we study Math. We study Math because it teaches us a way of thinking. It provides us with a method of solving a whole host of life's problems away from the classroom.

Firstly, there are the obvious ones like making sure you have enough change for the bus, deciding whether those pair of jeans that are in the sale are actually the bargain of the year or not, and working out whether buying the 2kg packet of salted peanuts is actually better value than the 200g one, and debating whether you need 2kg of salted peanuts in the first place.

But there are much bigger and much more important problems than that. I am talking about problems such as deciding where is best to go for your holidays, how big a mortgage you can afford, which new car should you buy and what type of vehicle financing is available, should you go on a diet, should you take that new job, is this person really going to be the love of your life?

These problems may not appear to have anything to do with the Math you study in school. But they do. All problems we encounter every day have something in common. They all contain a certain amount of information which must be weighed up, sorted out, and then processed in a certain order. And once that information has been processed, it must be interpreted so that an intelligent decision can be made. All this requires planning, logical thinking, maybe a bit of experimentation, and then some evaluating and testing to make sure that the decision you have reached is the best one.

Well, believe it or not, many of these skills are needed and developed when studying Math. Imagine you are presented with nasty looking question about a tower casting a shadow across the ground, and given some information about the length of the shadow and the

angle of the sun, you have to work out the height of the tower. Sounds like fun, hey?

Now, let's just think about what you would need to do to get the answer. Firstly, you would need to weight up all the information and decide what kind of problem this was. Once you are happy that it is trigonometry, next you need to present all the information in a simple, manageable way, maybe by drawing a right-angled triangle. Next up you must decide what formula you need to use and what calculations you need to do. This then requires skills such as multiplying, dividing, re-arranging formulae, calculator skills, and rounding. When you have your answer, you must then check it makes sense by putting it back into the context of the question. Does it make sense for the tower to be 3,569m high? Probably not, so you may have made a mistake, so you go back and look through your working to solve it.

That's a lot of processes involved in answering a question, but studying Math teaches you to do all of them automatically, without even really thinking too much about what you are doing. Studying Math trains you up to be an expert problem solver, and if you can solve life's many problems, then you will be doing alright.

http://www.mrbartonmaths.com/whatuse.htm

EXERCISES

1. Read the words and translate them into Russian.

deal with, consist of, let us know, equal, consider, thus, in other words, mean, apply, reduce, determine, the greatest common factor, conclusion, concept, valid, case, except, check, cross-multiplying, hence, value, either … or, explain, both ... and, a trapezium, slim, as well, provide, host, obvious, bargain, work out, mortgage, afford, available, appear, encounter, weigh up, sort out, process, require, evaluate, imagine, make sure, skill, make sure, skill, manageable, rearrange, formulae, rounding, check, make sense, tower, make a mistake, look through, solve.

2. Read the words and try to guess their meanings.

follow – following, conclude – conclusion, fraction – fractional, change – unchanged, rational – rationalize – irrational, to reduce – reduction – reducing, even – evenly, divide – divisible, relative – relatively, according – accordingly, common – uncommon, divisible – divisibility, equal – unequal, quantity – quantitative, represent – representation, value – valuable – valueless, name – nameless, great – greatness, to mix – mixture – mixer, change – unchanged – changeless, simple – simplify – simplicity.

3. Answer the following questions.

1. What is a common fraction called? 2. What is a proper fraction called? 3. Is the value of a proper fraction more or less than 1? 4. What do we call mixed numbers? 5. How do you reduce a fraction to its lower terms?

4. Translate the words from Russian into English.

позволить себе, ошибаться, решить, встретиться, взвесить, дешёвая покупка, рассматривать, оценивать, представить, разбираться, решать, умение, определить, вывод, объяснить, другими словами, либо..либо, значение, применить, кроме, проверить, и…и, следовательно, наибольший общий делитель, четырёхугольник с непараллельными сторонами.

5. Make up the questions to each sentence.

1. She is to agree with him. (why) 2. We are to write that test during the previous lesson. (what kind of) 3. He is able to turn the switch. (how) 4. You are to multiply these prime numbers. (how) 5. She can summarize the results. (when) 6. You may know the associative property. (why) 7. He is to group all the even numbers on the one side. (how) 8. He may read his paper at the seminar. (who)

5. Translate the sentences into English

1. Дробь, у которой числитель меньше знаменателя, называется правильной дробью. Правильная дробь меньше единицы. 2. Дробь, у которой числитель равен знаменателю или больше его, называется неправильной дробью. Таким образом, неправильная дробь или равна единице, или больше её. 3. Числа, которые со-

стоят из целого числа и дроби, называется смешанными числами. 4. Сокращением дроби называется замена её другой, равной ей дробью с меньшими членами, путем деления числителя и знаменателя на одно и то число. Это число называется наибольшим общим делителем. 5. Мы уже знаем, что каждая дробь имеет числитель и знаменатель. 6. На что указывает знаменатель? 7. На что указывает числитель? 8. Дроби, называющие число больше, чем единица, называют неправильными дробями. 9. Дайте пример смешанной дроби. 10. Что вы знаете об эквивалентных дробях?

6. Translate the text into Russian.

Fractions indicate division, the numerator being a dividend, the denominator a divisor, and the value of the fraction the quotient. A fraction can be reduced to lower terms if the numerator and the denominator are divisible by a single number that is if they have a common divisor. In order to reduce a fraction to its lowest terms, therefore, it is seen at once that the greatest common divisor must be used.

7. Find the solutions to these problems.

➢ Five children enter for a checkers match. Each one has to play every other one. How many games must they play?

➢ The summer Olympics occur every four years. If the last summer Olympics happened in 2000, when are the next three times that it will occur? What type of sequence do the Olympic years form?

➢ A friend of mine`s grandfather is younger than his father? How is this possible?

➢ A certain family has three children, and half the children are boys. How is this?

8. Translate the following jokes into Russian.

- Theorem. A cat has nine tails.Proof. No cat has eight tails. Since one cat has one more tail than no cat, it must have nine tails.
- Q: What is very old, used by farmers, and obeys the fundamental theorem of arthimetic? An antique tractorization domain.

Unit 5 . Addition, Subtraction, Multiplication and Division of Fractions

Adding and Subtracting Fractions

Just as 2 apples + 3 apples = 5 apples, so 2 sevenths + 3 sevenths = 5 sevenths! So it's easy to add fractions if the denominators are the same. But if the denominators are different, just "convert" them so that they *are* the same. When "converting" a fraction, always multiply (or divide) the numerator and denominator by the same number.

Example:

$$\frac{2}{5}=\frac{2\times 5}{5\times 5}=\frac{10}{25}$$

If the denominator of one fraction is a multiple of the other denominator, "convert" only the fraction with the smaller denominator. One easy way to add fractions is with "zip-zapzup": cross-multiply for the numerators, and multiply denominators for the new denominator. You may have to simplify as the last step.

Multiplying and Dividing Fractions

To multiply two fractions, just multiply straight across. *Don't* cross-multiply (we'll discuss that in the next lesson), and *don't* worry about getting a common denominator (that's just for adding and subtracting). To multiply a fraction and an integer, just multiply the integer to the numerator (because an integer such as 5 can be thought of as 5/1). To divide a number by a fraction, remember that *dividing by a number is the same as multiplying by its reciprocal.* So just "flip" the second fraction and multiply.

Simplifying Fractions

Always try to simplify complicated-looking fractions. To simplify, *just multiply or divide top and bottom by a convenient number or expression*. If the numerator and the denominator have a common factor, *divide* top and bottom by that common factor. If there are fractions within the fraction, *multiply* top and bottom by the common denominator of the "little" fractions. Be careful when "canceling" in fractions. Don't "cancel" anything that is not a common *factor*. To avoid the common canceling mistakes, be sure to *factor before canceling*.

How will I ever use math in the real world?

Many students wonder when they will ever use math after graduation. It's understandably difficult to picture yourself ever using inverse trig functions after high school, but that's not the point. You may never differentiate a function in your job, but by learning the process you have trained your brain to problem solve while also reinforcing the basics of math.

Even a toddler is taught the very basics of counting, 1-2-3 up to 10. Whenever this toddler plays with his friends he can already tell them to trade three marbles for a piece of candy, or play with stuff involving simple counting. Through basic situations like this, math is assimilated within the innocent mind of a child.

When an individual is enrolled at school, his has different experiences with math. Have the teachers able to inject in their teaching the relevance of the subject to the real life? Or were the students forced to like the subject, memorize and recite the formulas, and read thick text books about Calculus, and other higher languages of numbers? The relevance of math in the real world is not fully introduced by most teachers.

Every day we use math. Some students ordering lunch at the local fast food chain use math to count change or plan a budget. Its use is very valuable in everyday transactions that do not only involve money, but exchange of goods or any other simple business deal. Corporate executives or regular citizens who are buying a car use math to discuss mileage or cost. College students who are tasked to cook or bake follow a recipe. The simple decorating of a home requires math principles as well to measure carpet or wallpaper. For thousands of years these same math principles have been practiced by all mankind around the globe. In order to get things done, especially in a modern society, you simply have to use mathematical concepts.

Math is a universal language. Anywhere you go, you can interact with people of all walks of life and they can understand you when you speak Math. The language of numbers or math can help anyone perform daily tasks and craft essential decisions. Your proficiency in math, or even just a bit of knowledge of the basic operations can help you shop wisely and remain within a budget. The math concepts can help you understand population growth or vote counts and opinion polls. If you bet on a horse, the mathematical concepts of probability can help you to place the best bet. Or, it may even convince you that over time you can't win.

Math is critical in widely different professions. Whether one is rich or poor, educated or uneducated, if one is taught the basic operations, he or she can become a millionaire through excellent disposition in life and wise financial transactions. Hence, similar to being literate in reading and writing, counting also prevails in life.

Even more important, though, than all of these real life applications of math are the less obvious benefits of a strong math background. Many jobs and hobbies will require a quick mind that is logical and able to creatively solve problems. Each of those skills can be perfected by studying math. It may not seem like you will use the things you learn, but they will improve your mind and your ability to be flexible with what you want to do in life.

http://www.freemathhelp.com/math-real-world.html

EXERCISES

1. Read and translate the words in Russian.

subtract, unlike, multiply, result, change, cross, equivalent, quotient, application, diverse, curved lines, convincingly, significance, differential equations, the rules of calculation, duplication of the cube, the squaring of the circle, abundance, encourage, evolve, appreciable, appear, wonder, graduation, inverse, that`s not the point, reinforce, toddler, enroll, inject, memorize, recite, order, valuable, involve, exchange, deal, executive, require, measure, mankind, in order to, anywhere, perform, essential, proficiency, wisely, remain, bet, convince, critical, disposition, transactions, hence, prevail, obvious benefits, require, a quick mind, can be perfected, improve, ability.

2. Translate the Latin abbreviations and word combinations into Russian.

exempli gratia – "for example: "Many real numbers cannot be expressed as a ratio of integers, e.g., the square root of two."

nota bene – literally, "note well:" Usually abbreviated 'n.b.', this is a way of saying, "take note of this."

3. Answer the following questions.

1. What should one do in order to add fractions having the same denominator (different denominators)? 2. What should one do in order to subtract having the same denominator (different denominators)? 3. How do you multiply fractions having the same (different) denominators? 4. How do you multiply a mixed number and a fraction?

4. Read these sentences and note the Infinitive.

a. To solve this equation multiply each term in it by the quantity that proceeds it. The first step in solving such a problem is to read the problem carefully *to understand* it correctly. *In order to leave* the number unchanged in value we are to multiply it by the same power of ten. We are to consider the following condition *so as to imagine* the consequences.

b. To prove this theorem means to find a solution for the whole problem. *To check* the result of the calculation is very important. *To give* a true picture of the natural world around us is the aim of science. *To define* which of these numerals is greater is not difficult.

5. Translate the text into Russian.

A small group of high school hooligans has dyed their hair bright pink, and they have been sent home. The teacher must report what percentage of her students is absent, but she only knows that before she sent those hooligans home, two fifths of her class had blonde hair, one seventh had red hair, and one sixth had brown hair.

So first off, we can convert all those fractions to decimals. To convert fraction x/y into decimal form, you simply divide the numerator (x) by the denominator (y). 2/5=2 divided by 5=0.4

1/6=0.167

1/7=0.143

If it helps, remember that all fractions add up to 1 whole. Likewise, decimals add up to one whole (decimals are really just fractions out of 100!)

So, we can add all these decimals up to get the total group of non-pink students: 0.4+0.167+0.143=0.71
We can subtract 0.71 from the whole (1) to get the decimal of pink-haired students: 1-0.71=0.29
0.29 is 29%, so 29% of the class was sent home!

http://www.tumblr.com/tagged/math%20jokes

6. Translate the sentences into English.

1. Чтобы сложить дроби с одинаковыми знаменателями, надо сложить их числители и оставить тот же знаменатель. 2. Чтобы сложить дроби с разными знаменателями, нужно предварительно (beforehand) привести их к наименьшему потому знаменателю, сложить их числители и написать общий знаменатель. 3. Чтобы вычесть дробь из дроби, нужно предварительно принести дроби к наименьшему общему знаменателю, затем из числителя уменьшенной дроби вычесть числитель вычитаемой дроби и под полученной разностью написать общий знаменатель. 4. Чтобы умножить дробь на целое число, нужно умножить на это целое число числитель и оставить тот же знаменатель. 5. Чтобы разделить дробь на целое число, нужно умножить на это число знаменатель, а числитель оставить тот же.

7. Try to test your logic.

- Some months have 30 days and some have 31. How many months have 28 days?
- How many children does a man have if he has ten sons and each son has a sister?
- I am a woman. If Sally's daughter is my daughter's mother, what relationship am I to Sally? (a) her grandmother (b) her mother (c) her daughter (d) her aunt
- If you had only one match and entered a dark room containing an oil lamp, a newspaper, and some kindling wood, what would you light first?
- Find the next letter in the series. A, E, F, H, I, K, L, M, N,?
- What is special about the number 8,549,176,320?

Unit 6. Converting Fractions to Decimals and Vice Versa

First, we're going to take a look at converting fractions to decimals. In order to do this conversion, we're going to need to use long division.

Remember that a fraction indicates division. For example, if you have 3/5 (three fifths), this actually means "three divided by five." Of course, if you want your answer in the form of a fraction, you leave it as 3/5. However, if you want to figure out the decimal number, you will perform that division, like this:

$$\begin{array}{r|l} & 0.6 \\ \hline 5 & 3.0 \\ & -3\,0 \\ \hline & 0 \end{array}$$

Notice that we put our divisor, 5, on the outside of the division sign, and our dividend, 3, on the inside of the division sign. The numerator of the fraction will always be placed on the inside, as the dividend, and the denominator of the fraction will always be placed on the outside, as the divisor. Then, we performed normal long division. Since we know we cannot put 5 into 3, we added a decimal point, and a zero (0) and then we placed a decimal point in our answer, so that we wouldn't forget that it's part of the answer. Then, we continued with division and ended up with 0.6 as our answer. This means that 3/5 can also be written as 0.6—they mean the exact same thing. Therefore, 3/5 = 0.6

Let's try one more. Let's say you have the fraction 16/20 and you want to change it into a decimal. Set up long division, as normal, like this:

$$\begin{array}{r|l} & 0.8 \\ \hline 20 & 16.0 \\ & -160 \\ \hline & 0 \end{array}$$

Thus, 16/20 can also be written as a decimal, which is 0.8. Therefore, 16/20 = 0.8

Converting Decimals to Fractions

Just as we can change fractions into decimals, we can also change decimals into fractions! In order to change decimals into fractions, you need to remember place value. The first decimal place after the decimal is the "tenths" place. The second decimal place is the "hundredths" place. The third decimal place is the "thousandths" place, the fourth decimal place is the "ten thousandths" place, and the fifth decimal place is the "hundred thousandths" place, and so on. It's important to remember, and know, how many decimal places you have before you can convert decimals to fractions.

For example, let's say we have the decimal number 0.45 and we want to change it into a fraction. The first step is to figure out what decimal place value you're working with. In our example, there are two decimal place values filled, which means it is filled to the hundredths place value. Now, we can write our decimal as a fraction. The numerator is the decimal number we see, so in this example the numerator would be 45. The denominator is the place value reached in the decimal, so for this example, since the decimal reaches the hundredths place value, we use 100 as our denominator. Thus, our fraction is 45/100.

The last step of this process is to make sure the fraction is reduced (simplified) all the way. Our fraction is not reduced, so we need to reduce it. Here is the work for reducing our fraction:

$$\frac{45}{100} \div \frac{5}{5} = \frac{9}{20}$$

Thus, our final answer is 9/20. We know that 9/20 cannot be reduced any further, because there are no common factors (besides 1) between 9 and 20. Therefore, we end with 9/20 as our answer.

Let's try this one more time. Now your decimal is 0.535, and you want to change it into a fraction. Try it on your own, and then we'll go through the problem so you can check your answer.

First, you need to figure out how many decimal place values are filled. You see that there are 3 place values filled, so you know that the thousandths place value is filled. Next, you take the decimal number you see, and convert it into the numerator. In this case, your numerator is 535. Finally, you take the place value number, in this case, it's 1,000, and use it as the denominator. Thus, your fraction is 535/1,000.

Did you remember to reduce it? This one can be reduced, like this:

$$\frac{535}{1000} \div \frac{5}{5} = \frac{107}{200}$$

Thus, your final answer is 107/200.

http://www.wyzant.com/help/math/elementary_math/conversions

Mathematical model

A mathematical model is an abstract model that uses mathematical language to describe the behaviour of a system.

Mathematical models are used particularly in the natural sciences and engineering disciplines (such as physics, biology, and electrical engineering) but also in the social sciences (such as economics, sociology and political science); physicists, engineers, computer scientists, and economists use mathematical models most extensively.

Eykhoff (1974) defined a mathematical model as 'a representation of the essential aspects of an existing system (or a system to be constructed) which presents knowledge of that system in usable form'.

Mathematical models can take many forms, including but not limited to dynamical systems, statistical models, differential equations, or game theoretic models. These and other types of models can overlap, with a given model involving a variety of abstract structures. There are six basic groups of variables: decision variables, input variables, state variables, exogenous variables, random variables, and output variables. Since there can be many variables of each type, the variables are generally represented by vectors.

Mathematical modelling problems are often classified into black box or white box models, according to how much a priori information is available of the system. A black-box model is a system of which there is no a priori information available. A white-box model (also called glass box or clear box) is a system where all necessary information is available. Practically all systems are somewhere between the black-box and white-box models, so this concept only works as an intuitive guide for approach. Usually it is preferable to use as much a priori information as possible to make the model more accurate. http://www.sciencedaily.com/articles/m/mathematical_model.htm

EXERCISES

1. Read and translate the words in Russian.

convert, in order to, indicate, however, figure out, notice, leave, sign, dividend, perform, since, continue, mean, exact, try, change, set up, therefore, so on, reach, thus, make sure, reduce, in this case, define, essential, including, overlap, random, according to, guide, accurate.

2. Translate the words into English.

в данном случае, и так далее, важный, включая, определить, сократить, согласно, знак, для того, чтобы, заметить, изменить, оставить, делимое, случайное, удостовериться, продолжать, однако, достигать, исполнять, поскольку, следовательно, преобразовать, таким образом, вычислять, частично совпадать, устанавливать.

3. Guess the meaning of the words.

convert – conversion, simplify – simplification – simplicity, develop – development, reason – reasoning, satisfy – satisfying, require – requirement, deduce – deduction, correct – correctness, simultaneous – simultaneously, success – successfully.

4. Answer the following questions.

1. What is an equivalent fraction? 2. How do you change a mixed number to an improper fraction? 3. How do you change an improper fraction to a whole number or mixed number? 4. How do you change a whole number to an improper fraction with a specific denominator? 5. What must you do to compare unlike fractions? 6. How do you compare fractions?

5. Translate the sentences into Russian.

1. When denominators and numerators of different fraction are both different, the values of the fractions cannot be con pared until they are converted so as to have the same d nominators. 2. Since fractions

indicate division, all changes in the term of a fraction (numerator and denominator) will affect value (quotient) according to the general principles of division. 3. These relations constitute the general principles fractions.

6. Make up a question to each sentence.

The boy will be asked to solve an equations. (what about) 2. I won`t be told to present my abstract. (what) 3. All these questions will be discussed by the students during the seminar. (when) 4. The results will be checked by that scientist. (who) 5. Such numerals won`t be easily multiplied. (what) 6. Another example will be given by our teacher. (what) 7. They will be given those periodicals last week. (when) 8. He won`t be asked a lot of questions by the examiner during the exam. (what)

7. Translate the sentences into English.

1. Чтобы обратить неправильную дробь в смешанное число, нужно числитель дроби разделить на знаменатель и найти остаток. 2. Если числитель дроби уменьшить в несколько раз, не меняя знаменателя, то дробь уменьшится во столько же раз. 3. Если числитель и знаменатель дроби увеличить в одинаковое число раз, то дробь не изменится.

8. Try to solve the problems.

- A farmer had 17 sheep. All but 9 died. How many did he have left?
- If a brick weighs seven pounds plus half a brick, what is the weight of a brick and a half?
- If ninety-one teams enter the FA Cup, how many matches will be played, not counting replays?

9. Translate the joke into Russian.

A: What is the shortest mathematicians joke?

Q: Let epsilon be smaller than zero.

Unit 7. Introduction to Decimals

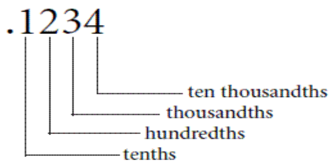
The first decimal lesson is an introduction to the concept of decimals. It explains the relationship between decimals and fractions, teaches you how to compare decimals, and gives you a tool called rounding for estimating decimals.

A decimal is a special kind of fraction. You use decimals every day when you deal with measurements or money. For instance, $10.35 is a decimal that represents 10 dollars and 35 cents. The decimal point separates the dollars from the cents.

If there are digits on both sides of the decimal point, like 6.17, the number is called a **mixed decimal;** its value is always greater than 1. In fact, the value of 6.17 is a bit more than 6. If there are digits only to the right of the decimal point, like .17, the number is called a **decimal;** its value is always less than 1. Sometimes these decimals are written with a zero in front of the decimal point, like 0.17, to make the number easier to read. A whole number, like 6, is understood to have a decimal point at its right (6.).

Decimal Names

Each decimal digit to the right of the decimal point has a special name. Here are the first four:



The digits have these names for a very special reason: The names reflect their fraction equivalents.

0.1 = 1 tenth
0.02 = 2 hundredths
0.003 = 3 thousandths
0.0004 = 4 ten thousandths

As you can see, decimal names are ordered by multiples of 10: 10^{th}s, 100^{th}s, $1,000^{th}$ s, $10,000^{th}$ s, $100,000^{th}$ s, $1,000,000^{th}$ s, etc. Be careful not to confuse decimal names with whole number names, which are very similar (tens, hundreds, thousands, etc.). The naming difference can be seen in the *ths*, which are used only for decimal

digits. Thus, 6.017 is read as *six and seventeen thousandths*

Thus, 0.28 (or .28) is read as *twenty-eight hundredths*, and its fraction equivalent is $\frac{28}{100}$. You could also read 0.28 as *point two eight*, but it doesn't quite have the same intellectual impact as 28 *hundredths!* http://www.education.com/study-help/article/i

Phrase	Decimal
fifty-six hundredths	0.56
nine tenths	0.9
thirteen and four hundredths	13.04
twenty-five and eighty-one hundredths	25.81
nineteen and seventy-eight thousandths	19.078

Rounding off a decimal

Rounding off a decimal is a technique used to estimate or approximate values. Rounding is most commonly used to limit the amount of decimal places. Instead of having a long string of decimals places, or even one that goes on forever, we can approximate the value of the decimal to a specified decimal place. We can round to any place. After rounding, the digit in the place we are rounding will either stay the same, referred to as rounding down, or increase by 1, referred to as rounding up. The question now becomes, when do we round up or down?

When to Round Up

Rounding up means that we increase the terminating digit by a value of 1 and drop off the digits to the right. If the next place beyond where we are terminating the decimal is greater than or equal to five, we round up. For example, if we round 5.47 to the tenths place, it can be can be rounded up to 5.5.

When to Round Down

If the number to the right of our terminating decimal place is four or less (4, 3, 2, 1, 0), we round down. This is done by leaving our last decimal place as it is given and discarding all digits to its right. For example, if we round 6.734 to the hundredths place, it can be rounded down to 6.73.

Rounding Off in Everyday Life

Rounding occurs all the time in everyday life. For example, cash registers are programmed to round off automatically to the nearest hundredth. Since one cent is one hundredth of a dollar, what we are charged must be rounded off to the hundredths place. For example, if the sales tax is 8.25%, or .0825, you could have the following table of taxes charged for different sale amounts.

http://cstl.syr.edu/fipse/decUnit/roundec/roundec.htm

It is interesting to know…

- What is origin of the word decimal? It's origins are from the Medieval Latin word 'decimlis' which means 1 tenth of a whole.
- The number Pi (the ratio of the circumference to the diameter of a circle) can't be expressed as a fraction, making it an irrational number. It never repeats and never ends when written as a decimal.

Modular Arithmetic

Modular (often also Modulo) Arithmetic is an unusually versatile tool discovered by K.F.Gauss (1777-1855) in 1801. Two numbers a and b are said to be equal or congruent modulo N iff N|(a-b), i.e. iff their difference is exactly divisible by N. Usually (and on this page) a,b, are nonnegative and N a positive integer. We write a = b (mod N).

The set of numbers congruent to a modulo N is denoted $[a]_N$. If b □ $[a]_N$ then, by definition, N|(a-b) or, in other words, a and b have the same remainder of division by N. Since there are exactly N possible remainders of division by N, there are exactly N different sets $[a]_N$. Quite often these N sets are simply identified with the corresponding remainders: $[0]_N = 0$, $[1]_N = 1$, ..., $[N-1]_N = N-1$. Remainders are often called *residues*; accordingly, [a]'s are also known as the *residue classes*.

It's easy to see that if a = b (mod N) and c = d (mod N) then (a + c) = (b + d) (mod N). The same is true for multiplication. These allows us to introduce an algebraic structure into the set $\{[a]_N: a = 0, 1, ..., N-1\}$:

By definition,

1. $[a]_N + [b]_N = [a + b]_N$
2. $[a]_N \times [b]_N = [a \times b]_N$

Subtraction is defined in an analogous manner $[a]_N - [b]_N = [a - b]_N$ and it can be verified that thus equipped set $\{[a]_N: a = 0, 1, ..., N-1\}$ becomes a ring with commutative addition and multiplication. Division can't be always defined. To give an obvious example, $[5]_{10} \times [1]_{10} = [5]_{10} \times [3]_{10} = [5]_{10} \times [5]_{10} = [5]_{10} \times [7]_{10} = [5]_{10} \times [9]_{10} = [5]_{10}$. So $[5]_{10}/[5]_{10}$ could not be defined uniquely. We also see that $[5]_{10} \times [2]_{10} = [5]_{10} \times [4]_{10} = [5]_{10} \times [6]_{10} = [5]_{10} \times [8]_{10} = [5]_{10} \times [0]_{10} = [0]_{10}$. Something we never had either for integer or real numbers. The situation improves for prime N's in which case division can be defined uniquely. Observe multiplication tables below for prime N. (For multiplication and division tables I have removed 0 column and row.) Every row (and column) contains all non-zero remainders mostly messed up. So every row is a permutation of the first row in the table. (This provides an easy way to construct division tables too. How?) For prime N, the set $\{[a]_N: a=0,1,...,N-1\}$ is promoted to a field. http://www.cut-the-knot.org/blue/Modulo.shtml

EXERCISES

1. Read and translate the words into Russian.

explain, compare, tool, deal with, for instance, represent, separate, in terms of, indicate, estimate, value, reflect, confuse, similar, impact, technique, approximate, instead of, refer, increase, round down, round up, mean, discard, occur, round off, versatile, iff, permutation, by definition.

2. Guess the meaning of these words.

introduce – introduction, relation – relationship, round – rounding, measure – measurement, intersect – intersection, care-careful, differ – difference, intellect – intellectual, remain – remainder, identify – identified, define – definition, subtract – subtraction, according – accordingly, exact – exactly, multiply – multiplication.

3. Answer the following questions.

1. What is the decimal fraction? 2. How do we write decimal fractions? 3. How do we round off a decimal to a particular place? 4. How do you compare decimal fractions? 5. How do you change decimal fractions?

4. Translate the sentences into English.

1. Дроби, знаменателями которых являются числа, выраженные единицей с последующими нулями (одним или несколькими), называются десятичными. 2. Из двух десятичных дробей та больше, у которой число целых больше; при равенстве целых та дробь больше, у которой число десятых больше и т.д. 3. Перенесение запятой на один знак вправо увеличивает число в десять раз. 4. Чтобы увеличить его в сто раз, нужно перенести запятую на два знака вправо.

5. State the function of the Gerund.

1. By applying your knowledge of geometry you can locate the point in the plane. (how) 2. In measuring the volume of an object one must be very careful. (when) 3. We discussed improving the shape of the model. (what) 4. Imagining the shape of the earth is easy. (what) 5. We cannot draw a complete picture of cosmic space without knowing the dimensions of the sun. (why) 6. Instead of being moved to the right the dot is moved to the left.

6. Translate the text into Russian.

How to Calculate Time in Decimals

1. Record the integer number of hours of the time given. In this example, it is 5. 2. Divide the number of minutes by 60 to convert them into a fraction of an hour. In our example, it is 27/60 = 0.45. 3. Divide the number of seconds by 3,600 to calculate them as a fraction of an hour. This is because there are 60 seconds in a minute and 60 minutes in an hour. In our example we have 56/3600= 0.0156. 4. Sum the values from Steps 1 to 3 to obtain the answer. In our example, 5 hours, 27 minutes, 56 seconds corresponds to 5 + 0.45 + 0.0156 = 5.4656 hours. http://www.ehow.com/how_5962681_

7. Solve the following problems.

➢ Take two numbers and multiply them together. Now add the numbers. The two answers are the same. What are the two numbers? Well, they could both be 2, for 2Ч2 = 2+2. The puzzle is: How many other pairs of numbers work in this way? *Clue:* To start you off, try 1S and a whole number less than 5.

➢ Mrs. Gossip was telling her friends the latest. The woman at 5 or 9 had run off with the milkman; the couple at 5, 7 or 11 were holding a pyjama party, but without the pyjamas; the skinhead at 5, 7 or 9 had assaulted the vicar; and the hippy at 9 or 11 was high again (in fact, he was sitting on the roof). They live in separate houses and the couple live next door to the hippy. What numbers do they occupy?

➢ Auntie Sadie was tormenting her nephew Dribble. She had placed nine coloured cards face-down on the table in three rows and three columns and refused to let Dribble see them. 'If you want to know what they are,' snarled Sadie, 'you'll jolly well have to work them out.' 'But how?' asked Dribble, clutching his teddy bear. Auntie Sadie grinned maliciously. 'Well, the red card is in the first or second row. The third column has exactly two green cards. Exactly two blue cards are in the second row. Precisely three of the corners are occupied by yellow cards. In each row there is exactly one green card.' Dribble lost no time. In a flash, he and Teddy had worked them out. How were the cards laid out?

8. Translate the jokes into Russian.

- Mathematics is well and good but nature keeps dragging us around by the nose (Albert Einstein).
- Q:What is the longest table in a maths classroom? A:The times table!!!!
- A mathematics professor is giving a lecture to his students and writing equations on a blackboard. He says, "At this point, it is obvious that this equation can be derived from that one." He pauses, then turns his back on the class and spends an hour filling the entire blackboard with more work. Finally he turns and announces triumphantly, "Yes, I was correct; it is obvious!" http://maths-wiki.wikispaces.com

Unit 8. Addition, Subtraction, Multiplication, Division of decimals

Adding and Subtracting Decimals

Addition and subtraction of decimals is like adding and subtracting whole numbers. The only thing we must remember is to line up the place values correctly. The easiest way to do that is to line up the decimal points.

Multiplication of Decimals

When multiplying numbers with decimals, we first multiply them as if they were whole numbers. Then, the placement of the number of decimal places in the result is equal to the sum of the number of decimal places of the numbers being multiplied.

Division of Decimals

Division with decimals is easier to understand if the divisor (the dividend is divided by the divisor) is a whole number.

If the divisor has a decimal in it, we can make it a whole number by moving the decimal point the appropriate number of places to the right.

However, if you shift the decimal point to the right in the divisor, you must also do this for the dividend. Once you have moved the decimal point so the divisor is a whole number, you can do the division. http://cstl.syr.edu/fipse/decUnit/opdec/opdec.htm

Text for reading

Number theory is the study of natural numbers. Natural numbers are the counting numbers that we use in everyday life: 1, 2, 3, 4, 5, and so on. Zero (0) is often considered to be a natural number as well.

Number theory grew out of various scholars' fascination with numbers. An example of an early problem in number theory was the nature of prime numbers. A prime number is one that can be divided exactly only by itself and 1. Thus 2 is a prime number because it can be divided only by itself (2) and by 1. By comparison, 4 is not a prime number. It can be divided by some number other than itself

(that number is 2) and 1. A number that is not prime, like 4, is called a composite number.

The Greek mathematician Euclid (c. 325–270 B.C.) raised a number of questions about the nature of prime numbers as early as the third century B.C. Primes are of interest to mathematicians, for one reason: because they occur in no predictable sequence. The first 20 primes, for example, are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, and 71. Knowing this sequence, would you be able to predict the next prime number? (It is 73.) Or if you knew that the sequence of primes farther on is 853, 857, 859, 863, and 877, could you predict the next prime? (It is 883.)

Questions like this one have intrigued mathematicians for over 2,000 years. This interest is not based on any practical application the answers may have. They fascinate mathematicians simply because they are engrossing puzzles. http://www.encyclopedia.com/topic/number_theory.aspx

EXERCISES

1. Read and translate the words into Russian.

the only thing, line up, place value, point, appropriate, however, so, shift, by comparison, dividend, origin, equal, scholars, comparison, raise, occur, sequence, scholar, predictable, as well, fascination, will be able to predict, fascinate, application, engross.

2. Translate the words into English.

единственное, выстраивать, восхищать, вес разряда, однако, подходящий, учёные, равный, сравнение, смещать, делимое, начало координат, сравнение, возводить в степень, встречаться, применение, последовательность, уйти с головой, поэтому, сможешь предсказать, также, сравнительно.

3. Guess the meaning of these words.

place – placement, fascinate – fascination – fascinating, compare – comparison, compose – composite, predict – predictable, apply – application.

4. Answer the following questions.

1. How are decimals added? 2. How do we write decimals when we want to subtract them? 3. How do you check the answer? 4. How do we multiply (divide) decimals? 5. How do we arrange numbers in adding decimals?

5. Translate the text into Russian.

Why Does 0.999... = 1?

Consider the real number that is represented by a zero and a decimal point, followed by a never-ending string of nines: 0.99999...

It may come as a surprise when you first learn the fact that this real number is actually EQUAL to the integer 1. A common argument that is often given to show this is as follows. If S = 0.999..., then 10*S = 9.999... so by subtracting the first equation from the second, we get 9*S = 9.000... and therefore S=1. Here's another argument. The number 0.1111... = 1/9, so if we multiply both sides by 9, we obtain 0.9999...=1.

Presentation Suggestions: You might also mention that by similar arguments, every rational number with a terminating decimal expansion has another expansion that ends in a never-ending string of 9's. So, for instance, the rational 7/20 can be represented as 0.35 (the same as 0.35000...) or 0.34999...

When seeing these arguments, many people feel that there is something shady going on here. Since they do not have a clear idea what a decimal expansion represents, they cannot believe that a number can have two different representations.

We can try to clear that up by explaining what a decimal representation means. Recall that the digit in each place of a decimal expansion is associated with a (positive or negative) power of 10. The k-th place to the left of the decimal corresponds to the power 10^k. The k-th place to the right of the decimal corresponds to the power 10^(-k) or 1/10^k.

If the digits in each place are multiplied by their corresponding power of 10 and then added together, one obtains the real number that is represented by this decimal expansion. So the decimal expansion 0.9999... actually represents the infinite sum 9/10 + 9/100 +

9/1000 + 9/10000 + ... which can be summed as a geometric series to get 1. Note that 1 has decimal representation 1.000... which is just 1 + 0/10 + 0/100 + 0/1000 + ... so if one realizes that decimal expansions are just a code for an infinite sum, it may be less surprising that two infinite sums can have the same sum. Hence 0.999... equals 1.

http://www.math.hmc.edu/funfacts/ffiles/10012.5.shtml

6. Find the sentences into Russian.

1. Wishing to learn to skate, she bought herself a pair of skates. 2. Having prepared all the necessary equipment, they began the experiment. 3. Mary will stop for a few days at the seaside before going back home. 4. While translating the text I looked up many words in the dictionary. 5. I usually help mother by washing the dishes and doing the rooms. 6. Entering the room, I saw my friends smiling at me. 7. Instead of phoning his friend, he went to see him.

7. Translate the text into Russian.

Chess computers are now a very important part of chess. Most famously Garry Kasparov, world champion and known as one of the strongest players in the history of chess, was defeated by IBM’s Deep Blue in 1997 in a six-game match. Aside from claims of cheating, this was a major shock to the chess world.

In 2006 world champion Vladimir Kramnik was defeated by Deep Fritz, furthering the statement of the strength of chess computers. Today chess programs are easily available to chess players that are essential in analyzing games and improving. They commonly rate within the same strength of Grandmasters.

Chess is often cited by psychologists as an effective way to improve memory function. Also allowing the mind to solve complex problems and work through ideas, it is no wonder that chess is recommended in the fight against Alzheimer’s. Some contend that it can increase one’s intelligence, though that is a more complex topic.

http://www.toptenz.net/top-10-interesting-facts-about-chess.php#ixz

8. Translate the following joke into Russian.

What is the integral of "one over cabin" with respect to "cabin"? Answer: Natural log cabin + c = houseboat.

Unit 9. Percent

We have already learned two ways of writing fractional parts: common fractions and decimal fractions. Another method is by using percents. Percent tells the number of parts in every hundred. This number is followed by the percent sign (%). The word "percent" and sign % actually refer to the denominator of a fraction expressed as hundredths. The percent sign (%) is the symbol used to indicate a percentage (that the preceding number is divided by one hundred). When working with percent, we don`t write a word, but use the sign %, 20 percent is written 20% and so on.

In working with problems involving percentage we must be able to change percent to decimals and decimals to percents. We can change a percent to a decimal by dropping the percent sign and moving the decimal point two places to the left. We can change a percent to a common fraction with the given number as the numerator and 1000 as a denominator. One hundred percent of quantity is the entire quantity.

To find a percent of a number, change the percent to the equivalent decimal fraction or common fraction and multiply the number by the fraction. To find the percent of one number from the second number, form a fraction in which the first number is the numerator and the second number is the denominator. Divide the numerator into the denominator and change the decimal fraction to a percent. To find a number when a percent of it is known, change the percent to an equivalent decimal fraction or common fraction, divide the given number by this fraction. Related signs include the permille (per thousand) and the permyriad (per ten thousand), which indicate that a number is divided by one thousand or ten thousand respectively. Higher proportions use parts-per notation.

The Percent Equation

To solve any type of percent problem, you can use the **percent equation**, part = percent × base, where the percent is written as a decimal.

Percent of Change

A **percent of change** is a ratio that compares the change in quantity to the original amount. If the original quantity is increased, it is a **percent of increase**. If the original quantity is decreased, it is a **percent of decrease**.

Sales tax is a percent of the purchase price and is an amount paid in addition to the purchase price.

Discount is the amount by which the regular price of an item is reduced.

Simple interest is the amount of money paid or earned for the use of money. To find simple interest I, use the formula $I = prt$. Principal p is the amount of money deposited or invested. Rate r is the annual interest rate written as a decimal. Time t is the amount of time the money is invested in years.

Taking an Interest

When interest is paid on both the amount of the deposit and any interest already earned, interest is said to be compounded. You can use the formula below to find out how much money is in an account for which interest is compounded. $\boldsymbol{A = P(1+r)^n}$

In the formula, *P* represents the principal, or amount deposited, *r* represents the rate applied each time interest is paid, *n* represents the number of times interest is given, and *A* represents the amount in the account.

A customer deposited \$1,500 in an account that earns 8% per year. If interest is compounded and earned semiannually, how much is in the account after 1 year?

Since interest is earned semiannually, r =8 ч 2 or 4% and $n = 2$. $\boldsymbol{A = 1{,}500(1+0.04)^2}$**.** Use a calculator. = 1,622.40. After 1 year, there is \$1,622.40 in the account.

EXERCISES

1. Answer the following questions.

1. What methods are there for writing fractional parts? 2. Where do we put the percent sign? 3. What does the sign % actually refer? 4. How do we change a percent to a decimal fraction? 5. What do

permille and the permyriad indicate? 6. What is a simple interest? 7. How to calculate the compound interest?

2. Read and translate the words into Russian.
diminish, number, numeration system, symbol, content, property, refer, indicate, permille, permyriad, simple interest, compounded, find out, amazing, despite, precede, determining, rule, permit, available, computational skills.

3. Find the answers.
1) 25% of 176 is what number? 2) What is 90% of 20? 3) 24 is what percent of 30? 4) 80% of what number is 94? 5) What is 60% of 45? 6) 9 is what percent of 30? 7) What percent of 125 is 25? 8) What is 120% of 20? 9) 2% of what number is 5? 10) 15% of 290 is what number?

4. Estimate the percent of a number.
• A research study found that about 63% of people 18 or older who go to the movies at least once a month own a personal computer. Out of 500 people 18 and older who go to the movies once or more a month, how many of them would you expect to own a personal computer?
• Andrea ordered a computer on the Internet. The computer cost $1,499 plus 7 S% sales tax. What was the total amount Andrea paid for her computer?

5. Find the total cost or sale price to the nearest cent.
1) $49.95 CD player; 5% discount 2) $69 shoes; 6% sales tax 3) $2.99 socks; 5.5% sales tax 4) $119 coat; 40% discount 5) $299 DVD player; 7% sales tax.

6. Find the interest earned to the nearest cent for each principal, interest rate, and time.
1) $500, 4%, 2 years 2) $350, 6.2%, 3 years 3) $740, 3.25%, 2 years 4) $725, 4.3%, 2 S years 5) $955, 6.75%, 3 j years

7. Make up some questions to each sentence.
1. We have come to the conclusion that these features are essential. 2. You haven`t divided the given quantity into two parts yet. 3. They have agreed to accept these principles as the basis of their work. (which) 4. I have found the ideas developed by him very rational. 5. Some first-year students have performed this relatively simple operation. (what) 6. Professor has found the proper solution for the problem. (how)

8. Write the words that best matches each statement. You may use a term more than once.
percent of increase, percent of change, percent equation, sales tax, survey, simple interest, percent of decrease, principal, discount

1. the percent of change when the original quantity is greater than the new quantity ________ . 2. a ratio that compares a change in quantity to the original amount ________ . 3. an equation (part = percent × base) in which the percent is written as a decimal ______ . 4. the amount of money originally deposited, invested, or borrowed _____ . 5. an amount of money charged by a government on items that people buy _______ . 6. the amount by which the regular price of an item is reduced 7. given by the formula *I = prt* ______ . 8. a question or set of questions designed to collect data about a specific group of people______ . 9. the amount of money paid or earned on an investment or deposit for the use of the money ______ . 10. the percent of change when the original quantity is less than the new quantity ______ .

9. Try to test your logic.
➢ What was the highest mountain on Earth before Mount Everest was discovered?
➢ An Air France Boeing 747 crashes on the border between France and Belgium. On board are 150 French people and 200 Belgians. Where are the survivors buried in France or in Belgium?
➢ A newlaid egg drops six feet directly above a concrete floor without breaking. How is this done? (And it`s not hard-boiled)

CHAPTER 2. ALGEBRA

Unit 1. Algebraic Expressions

An *algebraic expression* is one or more algebraic terms in a phrase. It can include variables, constants, and operating symbols, such as plus and minus signs. It's only a phrase, not the whole sentence, so it doesn't include an equal sign.

Algebraic expression: $3x^2 + 2y + 7xy + 5$

In an algebraic expression, terms are the elements separated by the plus or minus signs. This example has four terms, $\mathbf{3x^2}$, **2y**, **7xy**, and **5**. Terms may consist of variables and coefficients, or constants.

Variables

In algebraic expressions, letters represent variables. These letters are actually numbers in disguise. In this expression, the variables are x and y. We call these letters "**var**iables" because the numbers they represent can **vary**—that is, we can substitute one or more numbers for the letters in the expression.

Coefficients

Coefficients are the number part of the terms with variables. In $\mathbf{3x^2 + 2y + 7xy + 5}$, the coefficient of the first term is 3. The coefficient of the second term is 2, and the coefficient of the third term is 7. If a term consists of only variables, its coefficient is 1.

Constants

Constants are the terms in the algebraic expression that contain only numbers. That is, they're the terms without variables. We call them constants because their value never changes, since there are no variables in the term that can change its value. In the expression $\mathbf{7x^2 + 3xy + 8}$ the constant term is "8."

Real Numbers

In algebra, we work with the set of real numbers, which we can model using a number line.

Real numbers describe real-world quantities such as amounts,

distances, age, temperature, and so on. A real number can be an integer, a fraction, or a decimal. They can also be either rational or irrational. Numbers that are not "real" are called imaginary. Imaginary numbers are used by mathematicians to describe numbers that cannot be found on the number line. They are a more complex subject than we will work with here.

Rational Numbers

We call the set of real integers and fractions "rational numbers". Rational comes from the word "**ratio**" because a rational number can always be written as the **ratio**, or quotient, of two integers.

Examples of rational numbers

The fraction S is the ratio of 1 to 2.

Since three can be expressed as three over one, or the ratio of 3 to one, it is also a rational number.

The number "0.57" is also a rational number, as it can be written as a fraction.

Irrational Numbers

Some real numbers can't be expressed as a quotient of two integers. We call these numbers "irrational numbers". The decimal form of an irrational number is a non-repeating and non-terminating decimal number. For example, you are probably familiar with the number called "pi". This irrational number is so important that we give it a name and a special symbol!

Pi cannot be written as a quotient of two integers, and its decimal form goes on forever and never repeats.

$$\pi = 3.14159...$$

The (Pi) sign a math symbol that relates to a transcendental or mystical number which does not really equates to a quantifiable extent or quantity or size. Mathematically expressed, Pi is the ratio of a given circle’s circumference to its diameter. Though Pi is roughly equal to 3.1416 for the sake of solving mathematical problems, its real value is a series of numbers that go on infinitely as in 3.14159265358979323846… and on. Mystical Pi symbolized the universe as Pi and the universe produce non-repeating patterns, no sequences whatsoever to make them identical. It was said that the Pi symbols is a sinister Masonic sign that only the most elite in the hierarchy of secret masons know what terror lies behind the Pi sign.

Translating Words into Algebra Language

Here are some statements in English. Just below each statement is its translation in algebra.

the sum of three times a number and eight: 3x + 8

The words "the sum of" tell us we need a plus sign because we're going to add three times a number to eight. The words "three times" tell us the first term is a number multiplied by three.

In this expression, we don't need a multiplication sign or parenthesis. Phrases like "a number" or "the number" tell us our expression has an unknown quantity, called a variable. In algebra, we use letters to represent variables.

the product of a number and the same number less 3:
x(x – 3)

The words "the product of" tell us we're going to multiply a number times the number less 3. In this case, we'll use parentheses to represent the multiplication. The words "less 3" tell us to subtract three from the unknown number.

a number divided by the same number less five:

$$\frac{x}{x-5}$$

The words "divided by" tell us we're going to divide a number by the difference of the number and 5. In this case, we'll use a fraction to represent the division. The words "less 5" tell us we need a minus sign because we're going to subtract five.

http://www.math.com/school/subject2/lessons/S2U1L1DP.html

Text for reading

An intelligence quotient, or IQ, is a score derived from one of several standardized tests designed to assess intelligence. The abbreviation "IQ" comes from the German term Intelligenz-Quotient, originally coined by psychologist William Stern. When modern IQ tests are devised, the mean (average) score within an age group is set to 100 and the standard deviation (SD) almost always to 15, although this was not always so historically. Thus, the intention is that ap-

proximately 95% of the population scores within two SDs of the mean, i.e. has an IQ between 70 and 130. IQ scores were shown to be associated with such factors as morbidity and mortality, parental social status, and, to a substantial degree, biological parental IQ. There is still debate about the significance of heritability estimates and the mechanisms of inheritance.

IQ scores are used as predictors of educational achievement, special needs, job performance and income. They are also used to study IQ distributions in populations and the correlations between IQ and other variables. The average IQ scores for many populations have been rising at an average rate of three points per decade since the early 20^{th} century, a phenomenon called the Flynn effect. It is disputed whether these changes in scores reflect real changes in intellectual abilities.

http://en.wikipedia.org/wiki/Intelligence_quotient

EXERCISES

1. Read and translate the words into Russian.

essentially, advanced, therefore, rules, major, allow, solve, include, variable, whole, such as, consist of, in disguise, vary, substitute, contain, change, quantity, amount, complex, ratio, quotient, familiar, repeat, statement, relate, equate, circumference, roughly, for the sake, intelligence, derive, assess, coin, devise, thus, intention, approximately, morbidity, mortality, substantial, heritability, debate, significance, estimate, inheritance, predictor, achievement, performance, income, distribution, abilities.

2. Translate these words into English.

следовательно, важный, продвинутый, следовательно, правила, состоит из, подменить, отношения, ум, способности, решение, заменить, корень, для того, чтобы, заменить, приблизительно, отличаться, для удобства, извлечь корень, выдающийся, решить, позволить.

3. Answer the following questions.

1. What is the relationship between arithmetic and algebra? 2. In

what operations in arithmetic do we use numbers? 3. What do we use in algebra to represent numbers? 4. What may a formula be considered? 5. What is IQ?

4. Solve the problems.

- If the area of a rectangle is 30 square centimeters and the length is 6 centimeters, use the equation $30 = 6w$ to find the width w of the rectangle.
- Near the ancient city of Citifon, the river was close to bursting its banks. Yants, the evil wizard, had wedged open the floodgates protecting the city using 12 wooden blocks, each bearing a digit, and arranged in a sum so that the top row added to the middle row gave the bottom one. Yants had declared that the gates could be closed only by removing the blocks in a definite sequence as follows. Working from top to bottom, remove one block from each row to leave three columns of digits (the pressure of the gates closes the gaps), then a second to leave two columns, then a third to leave one column, and finally the last in each to close the gates, so that a valid sum remains each time. What sequence saves the city?

5. Make up a question to each sentence.

1. The boy was asked about his family. (what about) 2. They were given very interesting examples during the lecture. (when) 3. He was asked to show the result of his work. (who) 4. Their results were used in his work. (what) 5. The result was checked. (what) 6. That combination was used in the new system. (what)

6. Translate the joke into Russian.

What is "pi"?

Mathematician: Pi is the ratio of the circumference of a circle to its diameter. Engineer: Pi is about 22/7. Physicist: Pi is 3.14159 plus or minus 0.000005. Computer Programmer: Pi is 3.141592653589 in double precision. Nutritionist: You one track Math-minded fellows, Pie is a healthy and delicious dessert!

http://www.workjoke.com/mathematicians-jokes.html

Unit 2. Less than, Equal to, Greater than Symbols

If A and B are two constant expressions, we write $A = B$ if they are equal, and $A \neq B$, if they are not. For example, for any number or expression N, $N = N$. $1 = 1$, $2.5 = 2.5$, $x + y^2 = x + y^2$. On the other hand, $1 \neq 2.5$. One can't go wrong with expressions like $N = N$ because they do not say much. The sign "=" of *equality* which is pronounced "equal to" has other, more fruitful uses.

"=" is used to make a statement

The symbol of equality "=" is used to make a statement that two differently looking expressions are in fact equal. For example, $1 + 1$ does not look like 2 but the definitions of the symbols 1, 2, +, and the rules of arithmetic tell us that $1 + 1 = 2$. So, *being equal*, does not necessarily mean *being the same*.

Also, the statement that involves the symbol "=" may or may not be correct. While $1 + 1 = 2$ is a correct statement, $1 + 2 = 4$ is not. The same holds for the symbol "≠", *not equal*. But the meaning is just the opposite from "=". While $1 + 2 \neq 4$ is a correct statement, $1 + 1 \neq 2$ is not.

"=" is used to pose a problem

If the expressions A and B are not constant, i.e., if they contain variables, then most often $A = B$ means a request to find the values of the variables, for which A becomes equal to B. For example, $x + 1 = 4$, depending of what x may stand for, may or may not be correct. The request to solve $x + 1 = 4$ means to find the value (or values) of x, which $x + 1$ is equal to 4. In this particular case, there is only one value of x which does the job, namely $x = 3$.

The terminology varies. I was taught that the statement $A = B$ in which A and B is constant, fixed expressions, is called an *equality* or *identity*. If they include variables, $A = B$ is called an *equation*. Nowadays, they use the term "equation" in both cases, the former is being said to be a *constant equation*.

The reason for the later usage I think is that in algebra a constant expression may contain variable-like symbols to denote generic numbers. For example, $(x + y)^2 = x^2 + 2xy + y^2$ is a statement that is not supposed to be solved. It simply says that the two expressions, (x

$+ y)^2$ on the left, and $x^2 + 2xy + y^2$ on the right are equal regardless of specific values of x and y. This usage is similar to the statement of physical laws. For example, in Einstein's law, $E = mc^2$, E and m are variables, while c is constant.

"=" is used to define or name an object

In algebra, one may define a function $f(x) = x^2 + 2x^3$. This is neither a statement, nor a request to solve an equation. This is a *convenience definition*. After it is given, we may talk of the powers of function f, its derivative f', or of its iterates f(f(x)), f(f(f(x))), ...

In geometry, as another example, one may introduce point A = (2, 3) and another point B = (-2, 5). The midpoint M = (A + B) /2 = (0, 4) lies on the y-axis.

Symbols "<" and ">" of comparison

Some mathematical objects can be compared, e.g, of two different integers one is greater, the other smaller. Other mathematical objects, complex numbers for one, cannot be compared if the operation of comparison is expected to possess certain properties.

Symbol ">" means "greater than"; symbol "<" means "less than". For example, $2 < 5$, $5 > 2$. To remember which is which, observe that both symbols have one pointed side where there is just one end, and one split side with 2 ends. The fact that 1 is less than 2 is expressed as $1 < 2$, which is the same as $2 > 1$, i.e., that 2 is greater than 1. The pointed end with a single endpoint points to the smaller of the two expressions.

Like the symbol of equality, the symbols of comparison, may be used to make a statement or to pose a problem. $2 < 5$ is a correct statement. $5 < 2$ is incorrect statement. $x + 2 < 5$ may be correct or not, depending on the value of x. You may be asked to find those values of x for which $x + 2 < 5$. In which case, by adding -2 to both sides of the inequality we obtain $x < 3$ which is the solution to $x + 2 < 5$.

In algebra, a statement may include generic variables, like the AM-GM inequality: $(x + y) / 2 \geq \sqrt{xy}$, which is true for all positive x and y.

By the way, symbol "≤" means "less than or equal to". The $(x + y) / 2 \geq \sqrt{xy}$, becomes equality for x = y. For example, if x = y = 2, then (x + y) /2 = (2 + 2) /2 = 2.

Also, $\sqrt{xy} = \sqrt{2\cdot 2} = 2$. If $x \neq y$, the inequality become "strict": $(x + y) / 2 > \sqrt{xy}$.

The inequality $-x^2 > x^2$ has no solutions among integers. The inequality $-x^2 \geq x^2$ has one solution: x = 0.

http://www.cut-the-knot.org/arithmetic/Less-Equal-Greater.shtml

Sequences

An arithmetic sequence is a list in which each term is found by adding the same number to the previous term. 2, 5, 8, 11, 14, … A geometric sequence is a list in which each term is found by multiplying the previous term by the same number. 2, 6, 18, 54,

Functions and Linear Equations

The solution of an equation with two variables consists of two numbers, one for each variable, that make the equation true. The solution is usually written as an ordered pair (*x*, *y*), which can be graphed. If the graph for an equation is a straight line, then the equation is a linear equation.

Short Algorithm, Long-Range Consequences

Mar. 1, 2013 — In the last decade, theoretical computer science has seen remarkable progress on the problem of solving graph Laplacians – the esoteric name for a calculation with hordes of familiar applications in scheduling, image processing, online product recommendation, network analysis, and scientific computing, to name just a few. Only in 2004 did researchers first propose an algorithm that solved graph Laplacians in "nearly linear time," meaning that the algorithm's running time didn't increase exponentially with the size of the problem.

At this year's ACM Symposium on the Theory of Computing, MIT researchers will present a new algorithm for solving graph Laplacians that is not only faster than its predecessors, but also drastically simpler. "The 2004 paper required fundamental innovations in multiple branches of mathematics and computer science, but it ended up being split into three papers that I think were 130 pages in aggregate," says Jonathan Kelner, an associate professor of applied mathematics at MIT who led the new research. "We were able to replace it with something that would fit on a blackboard."

The MIT researchers – Kelner; Lorenzo Orecchia, an instructor in applied mathematics; and Kelner's students Aaron Sidford and Zeyuan Zhu – believe that the simplicity of their algorithm should make it both faster and easier to implement in software than its predecessors. But just as important is the simplicity of their conceptual analysis, which, they argue, should make their result much easier to generalize to other contexts.

Overcoming resistance

A graph Laplacian is a matrix – a big grid of numbers – that describes a graph, a mathematical abstraction common in computer science. A graph is any collection of nodes, usually depicted as circles, and edges, depicted as lines that connect the nodes. In a logistics problem, the nodes might represent tasks to be performed, while in an online recommendation engine, they might represent titles of movies.

In many graphs, the edges are "weighted," meaning that they have different numbers associated with them. Those numbers could represent the cost – in time, money or energy – of moving from one step to another in a complex logistical operation, or they could represent the strength of the correlations between the movie preferences of customers of an online video service.

The Laplacian of a graph describes the weights between all the edges, but it can also be interpreted as a series of linear equations. Solving those equations is crucial to many techniques for analyzing graphs.

One intuitive way to think about graph Laplacians is to imagine the graph as a big electrical circuit and the edges as resistors. The weights of the edges describe the resistance of the resistors; solving the Laplacian tells you how much current would flow between any two points in the graph.

Earlier approaches to solving graph Laplacians considered a series of ever-simpler approximations of the graph of interest. Solving

the simplest provided a good approximation of the next simplest, which provided a good approximation of the next simplest, and so on. But the rules for constructing the sequence of graphs could get very complex, and proving that the solution of the simplest was a good approximation of the most complex required considerable mathematical ingenuity.

Looping back

The MIT researchers' approach is much more straightforward. The first thing they do is find a "spanning tree" for the graph. A tree is a particular kind of graph that has no closed loops. A family tree is a familiar example; there, a loop might mean that someone was both parent and sibling to the same person. A spanning tree of a graph is a tree that touches all of the graph's nodes but dispenses with the edges that create loops. Efficient algorithms for constructing spanning trees are well established.

The spanning tree in hand, the MIT algorithm then adds back just one of the missing edges, creating a loop. A loop means that two nodes are connected by two different paths; on the circuit analogy, the voltage would have to be the same across both paths. So the algorithm sticks in values for current flow that balance the loop. Then it adds back another missing edge and rebalances.

In even a simple graph, values that balance one loop could imbalance another one. But the MIT researchers showed that, remarkably, this simple, repetitive process of adding edges and rebalancing will converge on the solution of the graph Laplacian. Nor did the demonstration of that convergence require sophisticated mathematics: "Once you find the right way of thinking about the problem, everything just falls into place," Kelner explains.

Paradigm shift

Daniel Spielman, a professor of applied mathematics and computer science at Yale University, was Kelner's thesis advisor and one of two co-authors of the 2004 paper. According to Spielman, his algorithm solved Laplacians in nearly linear time "on problems of astronomical size that you will never ever encounter unless it's a much bigger universe than we know. Jon and colleagues' algorithm is actually a practical one."

Spielman points out that in 2010, researchers at Carnegie Mellon University also presented a practical algorithm for solving Laplacians. Theoretical analysis shows that the MIT algorithm should be somewhat faster, but "the strange reality of all these things is, you do a lot of analysis to make sure that everything works, but you sometimes get unusually lucky, or unusually unlucky, when you implement them. So we'll have to wait to see which really is the case."

The real value of the MIT paper, Spielman says, is in its innovative theoretical approach. "My work and the work of the folks at Carnegie Mellon, we're solving a problem in numeric linear algebra using techniques from the field of numerical linear algebra," he says. "Jon's paper is completely ignoring all of those techniques and really solving this problem using ideas from data structures and algorithm design. It's substituting one whole set of ideas for another set of ideas, and I think that's going to be a bit of a game-changer for the field. Because people will see there's this set of ideas out there that might have application no one had ever imagined."

http://www.sciencedaily.com/releases/2013/03/130302125400.htm

EXERCISES

1. Read and translate the following words into Russian.

on the other hand, fruitful, statement, same, involve, may, i.e., contain, request, stand for, value, particular, namely, identity, variables, usage, denote, simply, regardless of, define, convenience definition, possess, observe, endpoint, comparison, solution, sequence, previous, consist of, ordered pair, remarkable, familiar application, propose, exponentially, predecessor, drastically, require, aggregate, replace, implement, node, depict, task, weight, cost, describe, interpret, crucial, intuitive, resistance, current, flow, approach, consider, approximation, ingenuity, approach, straightforward, sibling, dispense, efficient, path, repetitive, converge, sophisticated, fall into place, according to, never ever , encounter, point out, make sure, substitute, game-changer.

2. Translate the words into English.

удостовериться, переломный момент, с другой стороны, утверждение, тот же самый, то есть, содержать, значение, несмотря на, предложить, состоять из, заменить, требовать, сопротивление, изысканный, согласно, вес, стоимость, описать, определить, определение, удобство, решение, последовательность, упорядоченная пара, знакомое применение, обозначать, подход, ставить на своё место.

3. Translate the following sentences into Russian.

1. We should make some remarks about this problem. 2. There was the risk that he might come. 3. He was able to turn the switch. (how) 4. You should know the associative property. (why) 5. He should find a common language with them. (how) 6. They should already know the results. (which results) 7. He was able to come just in time. (how) 8. He said that he might come.

4. Describe the pattern in each sequence and identify the sequence as *arithmetic*, *geometric*, or *neither*.

1) 2, 4, 6, 8, … 2) 6, 12, 24, 48, … 3) 1, 2, 4, 8, …4) 4, 7, 10, 13, … 5) 1, 1, 2, 3, 5, … 6) 4, 4, 4, 4, …

5. Solve the following problems.

➢ The multiples of two form a sequence as follows: 2, 4, 6, 8, 10, 12, 14, 16, … . What type of sequence do you see? What about the multiples of three? Four? Five?

➢ Suppose you start with 1 rectangle and then divide it in half. You now have 2 rectangles. You divide each of these in half, and you have 4 rectangles. The sequence for this division is 1, 2, 4, 8, 16, ... rectangles after each successive division. What type of sequence results?

➢ 'I've always been 45 years older than your dad,' said Grandma to young Trickle. Trickle always suspected that Grandma was a bit short on grey matter but now her statement of the obvious really clinched it. 'But I'll tell you what's strange about our ages now,' she continued. 'The two digits in my age are the reverse of the digits in your dad's age. And what's more, they're both prime digits.' Trickle couldn't believe his ears. He'd thought Grandma was as daft as a carrot and here she was making mathematical observations. Trickle felt ashamed as he'd often joked about Grandma's brains behind her back. Mmm, maybe that's where she'd been hiding them all these years! How old is Grandma?

6. Choose from the terms above to complete each sentence.
arithmetic sequence, geometric sequence, meter, algebraic expression, coefficient, exponent, order of operations, equation, kilogram, scientific notation, numbers written, with exponents

1. The numbers 2, 5, 8, 11, … are an example of a(n) _________ .
2. The numbers 2, 6, 18, 54, … are an example of a(n) __________ .
3. In the metric system, a(n) __________ is the base Unit of length.
4. A(n) ____ contains variables, numbers, and at least one operation.
5. The numerical factor of a term that contains a variable is called a ______ .
6. A(n) __________ tells how many times a base is used as a factor.
7. Mathematicians agreed on a(n) __________ so that numerical expressions would have only one value.
8. A(n) ____ is a mathematical sentence that contains an equals sign.
9. A(n) __________ is the base Unit of mass in the metric system.
10. The number 870,000,000 can be written in _______ as 8.7×10^2.

7. Translate the text into Russian.
An equality is a statement of two mathematical objects being equal. Like equations, equalities are written as two mathemati-cal objects connected by the equality sign "=". The meaning of two objects being equal depends very much on the nature of the objects, e.g., two matrices are equal iff they have identical di-mensions and all their corresponding elements are equal.

8. Translate the jokes into Russian.

- Mathematics is made of 50 percent formulas, 50 percent proofs, and 50 percent imagination.
- How do you make 7 even (without adding or subtracting one)? Remove the "s".

Unit 3. Monomial and Polynomial

A monomial is a variable, a real number, or a multiplication of one or more variables and a real number with whole-number exponents.
Examples of monomials and non-monomials

Monomials	9	x	9x	6xy	$0.60x^4y$
Not monomials	y - 6	x^{-1} or 1/x	$\sqrt{(x)}$ or $x^{1/2}$	6 + x	a/x

Polynomial definition:
A polynomial is a monomial or the sum or difference of mo-nomials. Each monomial is called a term of the poynomial
Important!
Terms are separated by addition signs and subtraction signs, but never by multiplication signs
A polynomial with one term is called a monomial
A polynomial with two terms is called a binomial
A polynomial with three terms is called a trinomial
Examples of polynomials:

Polynomial	**Number of terms**	**Some examples**
Monomial	1	$2, x, 5x^3$
Binomial	2	$2x + 5, x^2 - x, x - 5$
Trinomial	3	$x^2 + 5x + 6, x^5 - 3x + 8$

Difference between a monomial and a polynomial:
A polynomial may have more than one variable.
For example, $x + y$ and $x^2 + 5y + 6$ are still polynomials al-though they have two different variables x and y
By the same token, a monomial can have more than one variable. For example, $2 \times x \times y \times z$ is a monomial. http://www.basic-mathematics.com/definitio

Who invented Chess?

The person who invented chess is not known. Chess is one of the oldest games in the world and it is assumed that the origin of chess is India and then spread over to the Arabian countries. Chess is intellectually very demanding and the most complex and most fascinating game for those who know it and love it. There is an interesting story about the man, who invented chess coming from Persia and this story is around 800 years old. Long time ago a king named Shihram ruled over India. He was a despot. Around this time a wise man invented the game of chess to show the king how important everybody is, who lives in his kingdom, even the smallest among them.

The king on the chess board needs his queen, his rooks, bishops, knights and the pawns to survive. This is like in real life. The king should learn this. Shihram, the king, understood this very well and he liked this game very much and he became a chess player and ordered that this game should be played by everybody in his kingdom.

The king was very thankful, let the wise man come to his treasures and he gave him gold and silver or other valuable things.

“You are allowed to choose what you want!” he said to the man who invented chess. “I will give it to you!”

The wise man thought for a while and said to the king. "I don't desire any of your treasures. I have a special wish!" And then he went with the king to a chess board.

“My wish is to get some wheat! Please put one grain of wheat on to the first chess square and two on to the second and keep doubling up the wheat until the last square!”

The king became angry and shouted, “I have offered you all my treasures and you want just wheat? Do you want to offend me?”

“Oh no!” said the wise man. “I don't want to offend you, my king. Please respect my wish and you will see that my wish is truly great.”

The king called his servants and ordered to put the wheat on the chess board exactly as the wise man wished. The servants brought a lot of wheat. It soon filled many rooms but they realized that they could not fulfill the wise man's wish.

They went to the king and said: “We are unable to fulfill the wise man's wish.”

“Why not?” asked the king angry.

They answered: “All the wheat of your kingdom and all the wheat of other kingdoms is not enough to fulfill this wish.”

The king realized that the wise man had given him a lesson

again. He learned that you should never underestimate the small things in life.

The chess board has 64 squares and if you put just one grain on the first and double up on the next and so on, you will reach an enormous amount of grain. 1 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2

If you work this out you get an incredible amount of grain something like this: around 18.446.744 trillions of wheat grains. The man, who invented chess, whoever he was, has done a great job.

http://www.expert-chess-strategies.com/who-invented-chess.html

EXERCISES

1. Read and translate these words into Russian.

according to, indicate, neither…nor, consequently, either…or, several, for instance, thus fractional, integral, binomial, trinomial, monomial, polynomial, divided, indicated, represented, connected, assume, spread, intellectually, demanding, fascinating, rule, wise, kingdom, queen, rooks, bishop, pawn, survive, thankful, treasure, valuable, desire, wheat, square, double, until, offer, offend, order, fulfill, enough, realize, underestimate, enormous.

2. Translate the words into English.

согласно, указывать, ни.. ни, либо.. либо, например, очаровательный, правило, король, королева, ладья, слон, пешка, сохраняться, благодарный, клад, ценное, желание, пшеница, удвоить, предлагать, до тех пор, пока, недооценить, выполнить, порядок, достаточно, огромный.

3. Answer the following questions.

1. How many groups are algebraic expressions divided into? 2. What is a monomial algebraic expression? 3. By what is a monomial represented? 4. What algebraic expression is called polynomial? 5. What are terms of a polynomial?

4. Translate the text into Russian.

The amount of wheat asked by the wise man equaled the world`s wheat production for the period of some two thousand years. Thus king Shirham found that he either had to remain constantly in debt to the wise man or cut his head off. He thought it best to choose the latter alternative.

5. Translate the sentences into English.

1. Он сказал, что знает эту игру. 2. Она сказала мне, что ей нравится моя работа. 3. Он сказал, что эта машина была изобретена группой ученых. 4. Он спроси меня, сосчитал ли я количество компьютеров в комнате. 5. Я хотела узнать, увеличится ли производство этих компьютеров. 6. Они надеялись, что профессор останется в деканате. 7. Они спросили, какова другая альтернатива. 8. Он сказал мне, что постоянно думает о доказательстве этого уравнения. 9. Я хотел узнать, согласилась ли они обсудить наш доклад. 10. Они уверены, что эта игра популярна. 11. Они подтвердили, что он выполнил всё в соответствии с планом. 12. Она сказала, что вторая из двух задач более трудная.

6. Solve the following puzzles.

➢ Bumbletown had the most robbed bank in the land. The unfortunate clerk was frequently forced to open the safe, and the bank had lost so much money, that Mr Good, the bank manager, was going bald. Then one day, Mr Good had an idea. His nephew, Fumble, should be the bank clerk. Now Fumble was the ideal man for the job. His memory was so bad, one could be sure that no robber could ever force him to remember the safe combination. Furthermore, his poor powers of recall were matched by a superb talent for puzzling things out. This meant that whenever Fumble needed to know the safe combination, all he had to do was obtain the following conundrum from Mr Good, which he could solve to reveal the five digit safe combination. 'The fourth digit is four greater than the second digit. There are three pairs of digits that each sum to 11. The third of the five digits is three less than the second. The first digit is three times the fifth digit.' Of the 100 000 possible numbers, which was the correct safe combination?

➢ The sum 9+9=18 gives the reverse answer when the numbers are multiplied: 9×9=81. Find two more reversals beginning 24+… and 47+…

➢ Write 1s and three plus signs in a row in such a way that they add up to 24.

7. Translate the following poem into Russian.

There was a young man from Trinity,
Who solved the square root of infinity?
While counting the digits,
He was seized by the fidgets,
Dropped science, and took up divinity. ~Author Unknown

8. Translate the following jokes into Russian.

- Q: Why is 6 afraid of 7? A: Because 7 8 9.
- Q: What does a mathematician present to his fiancée when he wants to propose? A: A polynomial ring!
- Q: How can you add eight 8's to get the number 1,000? (only using addition) A: 888 +88 +8 +8 +8 = 1,000.
- Q: How many eggs can you put in an empty basket? A: Only one, after that the basket is not empty.
- Q: What goes up and never comes down? A: Your Age
- Q: Why do mathematicians, after a dinner at a Chinese restaurant, always insist on taking the leftovers home? A: Because they know the Chinese remainder theorem!
- What do you call a sunburned man? .... (a tan-gent)
- What would a math student say to a fat parrot? .... (poly-no-mial)
- What do mathematicians sleep on? .... (ma-trices)
- Mathematicians are like Frenchmen: whatever you say to them, they translate it into their own language, and forthwith it means something entirely different.

Unit 4. Factoring Numbers

"Factors" are the numbers you multiply to get another number. For instance, the factors of 15 are 3 and 5, because 3×5 = 15. Some numbers have more than one factorization (more than one way of being factored). For instance, 12 can be factored as 1×12, 2×6, or 3×4. A number that can only be factored as 1 times itself is called "prime". The first few primes are 2, 3, 5, 7, 11, and 13. The number 1 is not regarded as a prime, and is usually not included in factorizations, because 1 goes into everything. (The number 1 is a bit boring in this context, so it gets ignored.)

You most often want to find the "prime factorization" of a number: the list of all the prime-number factors of a given number. The prime factorization does not include 1, but does include every copy of every prime factor. For instance, the prime factorization of 8 is 2×2×2, not just "2". Yes, 2 is the only factor, but you need three copies of it to multiply back to 8, so the prime factorization includes all three copies.

On the other hand, the prime factorization includes ONLY the prime factors, not any products of those factors. For instance, even though 2×2 = 4, and even though 4 is a divisor of 8, 4 is NOT in the PRIME factorization of 8. That is because 8 does NOT equal 2×2×2×4! This accidental over-duplication of factors is another reason why the prime factorization is often best: it avoids counting any factor too many times. Suppose that you need to find the prime factorization of 24. Sometimes a student will just list all the divisors of 24: 1, 2, 3, 4, 6, 8, 12, and 24. Then the student will do something like make the product of all these divisors: 1×2×3×4×6×8×12×24. But this equals 331776, not 24. So it's best to stick to the prime factorization, even if the problem doesn't require it, in order to avoid either omitting a factor or else over-duplicating one.

In the case of 24, you can find the prime factorization by taking 24 and dividing it by the smallest prime number that goes into 24: 24 ÷ 2 = 12. (Actually, the "smallest" part is not as important as the "prime" part; the "smallest" part is mostly to make your work easier, because dividing by smaller numbers is simpler.) Now divide out the

smallest number that goes into 12: 12 ÷ 2 = 6. Now divide out the smallest number that goes into 6: 6 ÷ 2 = 3. Since 3 is prime, you're done factoring, and the prime factorization is 2×2×2×3.

http://www.purplemath.com/Units/factnumb.htm

The 10 Best Mathematicians

Alex Bellos selects the math's geniuses whose revolutionary discoveries changed our world.

Pythagoras (circa 570-495 B.C.) Vegetarian mystical leader and number-obsessive, he owes his standing as the most famous name in maths due to a theorem about right-angled triangles, although it now appears it probably predated him. He lived in a community where numbers were venerated as much for their spiritual qualities as for their mathematical ones. His elevation of numbers as the essence of the world made him the towering primogenitor of Greek mathematics, essentially the beginning of mathematics as we know it now.

Hypatia (cAD360-415) Women are under-represented in mathematics, yet the history of the subject is not exclusively male. Hypatia was a scholar at the library in Alexandria in the 4th century CE. Her most valuable scientific legacy was her edited version of Euclid's *The Elements*, the most important Greek mathematical text.

Girolamo Cardano (1501 -1576) Italian polymath for whom the term Renaissance man could have been invented. A doctor by profession, he was the author of 131 books. He was also a compulsive gambler. It was this last habit that led him to the first scientific analysis of probability. He realised he could win more on the dicing table if he expressed the likelihood of chance events using numbers. This was a revolutionary idea, and it led to probability theory, which in turn led to the birth of statistics, marketing, the insurance industry and the weather forecast.

Leonhard Euler (1707-1783) The most prolific mathematician of all time, publishing close to 900 books. When he went blind in his late 50s his productivity in many areas increased. His famous formula eiπ + 1 = 0, where e is the mathematical constant sometimes known as Euler's number and *i* is the square root of minus one, is widely considered the most beautiful in mathematics. He later took an interest in Latin squares – grids where each row and column contains each member of a set of numbers or objects once. Without this work, we might not have had sudoku.

Carl Friedrich Gauss (1777-1855) Known as the prince of mathematicians, Gauss made significant contributions to most fields of 19th century mathematics. An obsessive perfectionist, he didn't publish much of his work, preferring to rework and improve theorems first. His revolutionary discovery of non-Euclidean space (that it is mathematically consistent that parallel lines may diverge) was found in his notes after his death. During his analysis of astronomical data, he realised that measurement error produced a bell curve – and that shape is now known as a Gaussian distribution.

Georg Cantor (1845-1918) Of all the great mathematicians, Cantor most perfectly fulfils the (Hollywood) stereotype that a genius for maths and mental illness are somehow inextricable. Cantor's most brilliant insight was to develop a way to talk about mathematical infinity. His set theory leads to the counter-intuitive discovery that some infinities were larger than others. The result was mind-blowing. Unfortunately he suffered mental breakdowns and was frequently hospitalised. He also became fixated on proving that the works of Shakespeare were in fact written by Francis Bacon.

Paul Erdцs (1913-1996) Erdцs lived a nomadic, possession-less life, moving from university to university, from colleague's spare room to conference hotel. He rarely published alone, preferring to collaborate – writing about 1,500 papers, with 511 collaborators, making him the second-most prolific mathematician after Euler.

John Horton Conway (b1937) The Liverpudlian is best known for the serious math that has come from his analyses of games and puzzles. In 1970, he came up with the rules for the *Game of Life*, a game in which you see how patterns of cells evolve in a grid. Early computer scientists adored playing *Life*, earning Conway star status. He has made important contributions to many branches of pure math, such as group theory, number theory and geometry and, with collaborators, has also come up with wonderful-sounding concepts like surreal numbers, the grand antiprism and monstrous moonshine.

Grigori Perelman (b1966) Perelman was awarded $1m last month for proving one of the most famous open questions in maths, the Poincaré Conjecture. But the Russian recluse has refused to accept the cash. He had already turned down maths' most prestigious honour, the Fields Medal in 2006. "If the proof is correct then no other recognition is needed," he reportedly said. The Poincaré Conjecture was first stated in 1904 by Henri Poincaré and concerns the behaviour of shapes in three dimensions. Perelman is currently unemployed and lives a frugal life with his mother in St Petersburg.

Terry Tao (b1975) An Australian of Chinese heritage who lives in the US, Tao also won (and accepted) the Fields Medal in 2006. Together with Ben Green, he proved an amazing result about prime numbers – that you can find sequences of primes of any length in which every number in the sequence is a fixed distance apart. For example, the sequence 3, 7, 11 has three primes spaced 4 apart. The sequence 11, 17, 23, 29 has four primes that are 6 apart. While sequences like this of any length exist, no one has found one of more than 25 primes, since the primes by then are more than 18 digits long.

http://www.guardian.co.uk/culture/2010/apr/11/the-10-best-mathematicians

EXERCISES

1. Read and translate the words into Russian.

for instance, factor, regard, include, prime factorization, even though, avoid, suppose, stick to, even if, require, obsessive, owe, due to, venerate, elevation, essence, primogenitor, scholar, compulsive, gambler, likelihood, insurance, weather forecast, prolific, contribution, diverge, fulfill, inextricable, insight, develop, mind-blowing, collaborate, evolve, adore, surreal number, conjecture, recluse, turn down, concern, prove, amazing.

2. Translate the words into English.

страховка, включать, даже хотя, избегать, развивать, благодаря, быть должным, требовать, прогноз погоды, преклоняться, неразрешимый, страдающий навязчивой идеей, обожать, учёный, сотрудничать, загадка, доказать, проницательность, предок, отшельник, отвергать, картёжник, отклоняться, удивительный, например.

3. Write whether each sentence is *true* or *false*. If *false*, replace the underlined term to make a true sentence.

- To double a number means to multiply that number by itself.
- An irrational number is a number that cannot be written as a fraction.
- A plus sign is the symbol used to indicate the positive square root of a number.
- A perfect square is the square of a rational number.
- Square roots are the factors multiplied to form perfect squares.

4. Translate the text into Russian.

The Game Theory studies winning strategies for parties involved in situations where their interest conflict with each other. Developed by John von Neumann, the theory has applications to real games (cards, chess, etc.), economics, commerce, politics and some say even military. J. Conway used his theory of surreal numbers to qualitatively evaluate game positions. Conway wrote: It's especially delightful when you find a game that somebody's already considered and possibly not made much headway with, and you find you can just turn on one of these automatic theories and work out the value of something and say, "Ah! Right is 47/64ths of a move ahead, and so she wins."

5. Make up a question to each sentence.

1. All these combinations have been repeated over and over again. 2. The necessary procedure has been followed. 3. The scientists have been shown the pattern of the future system. 4. The number has been increased recently. 5. Each step of the process has been carefully studied. (what) 6. The necessary information has just been obtained. (when)) 7. All points have been placed on the left of the straight line. 8. The order has been changed. 9. The axiom has been accepted. 10. The relations have been defined.

6. Solve the following puzzles.

- A man left his hotel and walked towards the car park. Without the benefit of moonlight or any artificial light, he was able to spot his black car 100 meters away. How was this possible?
- Which is correct: 'Nine and seven is fifteen' or 'Nine and seven are fifteen?' How many times can you take 4 from 33?
- A medieval king needed to work out how he could recruit fighting men for the battle ahead. However, there were so many distractions around the castle, his thinking became confused. So, in order to change his daze into knights, he asked for a secluded walk to be made so that he could ponder in peace. The head gardener was given the job of planting lines of high bushes. First, he planted a line running 100 paces east. Then from the end of that line he planted a line 100 paces north, then 100 west, 98 south, 98 east, 96 north, 96 west, and so on, dropping the measurement by two paces every second anticlockwise 90 degree turn. This made a square spiral path 2 paces wide. If the king intended to walk down the middle of the path, how long was the path?

7. Translate the following jokes into Russian.

- Statistics Canada is hiring mathematicians. Three recent graduates are invited for an interview: one has a degree in pure mathematics, another one in applied math, and the third one obtained his B.Sc. in statistics. All three are asked the same question: "What is one third plus two thirds?" The pure mathematician: "It's one." The applied mathematician takes out his pocket calculator, punches in the numbers, and replies: "It's 0.999999999." The statistician: "What do you want it to be?"
- A woman in a bar tries to pick up a mathematician."How old, do you think, am I?" she asks coyly. "Well - 18 by that fire in your eyes, 19 by that glow on your cheeks, 20 by that radiance of your face, and adding that up is something you can probably do for yourself..."
- "What happened to your girlfriend, that really cute math student?" "She no longer is my girlfriend – I have left her. A couple of nights ago I called her on the phone, and she told me that she was in bed wrestling with three unknowns!" http://www.101funjokes.com/math-jokes.htm

Unit 5. Solving Linear Inequalities

Solving linear inequalities involves finding solutions to expressions where the quantities are not equal.

A number on the number line is always greater than any number on its left and smaller than any number on its right. The symbol "<" is used to represent "is less than", and ">" to represent "is greater than".

From the number line, we can easily tell that 3 is greater than 2, because 3 is on the right side of -2 (or -2 is on the left of 3). We write it as $3>-2$ (or as $-2<3$). We can also derive that any positive number is always greater than negative number. Consider any two numbers, a and b. One and only one of the following statements can be true: $a>b$, $a=b$, or $a<b$. This is the Law of Trichotomy.

For an inequality with one unknown, there may be many (sometimes infinite) possible solutions.

1. Properties
2. Solving Inequalities
    2.1 Inequalities with a variable in the denominator
3. Compound Inequalities
4. Solving Inequalities with Absolute Value

1. Properties

Transitive property: For any three numbers x, y, z, if $x > y$ and $y > z$, then $x > z$.

Additive property: In an inequality, we can add or subtract the same value from both sides, without changing the sign (i.e. ">" or "<"). That is to say, for any three numbers x, y and p, if $x > y$, then $x + p > y + p$ and $x - p > y - p$.

Multiplicative property: We can multiply or divide both sides by a positive number without changing the sign. When we multiply or divide both sides by a negative number, we have to change the sign of the inequality (i.e, ">" change to "<" and vice versa).

Now we can go on to solve any linear inequalities.

Solving Inequalities

Solving inequalities is almost the same as solving linear equations. Let's consider an example: $x + 4 < 13$. All we have to do is

to subtract 4 on both sides. We will then get $x < 9$, and that is the answer! Note, however, what you get is not a single answer, but a set of solutions, i.e., any number that satisfies the condition $x < 9$ (any number that is less than 9) can be a solution to the inequality. It is very convenient to represent the solution using the number line:

Let us try another more complicated question: $3x - 2 \geq 2(x - 3)$. First, you may want to expand the right hand side: $3x - 2 \geq 2x - 6$. Then we can simply rearrange the terms so that all the unknown variables are on one side of the equation, usually the left hand side: $3x - 2x \geq -6 + 2$. Hence we can easily get the answer: $x \geq -4$. This solution is represented on the number line below. Note that the solution requires a closed circle ("●"), because the x is greater than or equal to 4.

Inequalities with a variable in the denominator

The method for solving this kind of inequality involves four steps:

1. Find out when the denominator is equal to zero. In the above example the denominator equals zero when $x = 1$.

2. Pretend the inequality sign is an = sign and solve it as such;

$$\frac{2}{x-1} = 2$$

, so $x = 2$.

3. Plot the points $x = 1$ and $x = 2$ on a number line with an unfilled circle because the original equation included < (it would have been a filled circle if the original equation included $\leq$ or $\geq$). You now have three regions: $x < 1$, $1 < x < 2$, and $x > 2$.

4. Test each region independently. In this case test if the inequality is true for $1 < x < 2$ by picking a point in this region (e.g. $x = 1.5$) and trying it in the original inequation. For $x = 1.5$ the original inequation doesn't hold. So then try for $1 > x > 2$) (e.g. $x = 3$)). In this case the original inequation holds, and so the solution for the original inequation is $1 > x > 2$).

Compound Inequalities

A compound inequality is a pair of inequalities related by the words AND or OR. In an and inequality, both inequalities must be satisfied. All possible solution values will be located between two defined numbers, and if this is impossible, the compound inequality simply has no solutions.

Consider this example: $x+6\geq 2$ and $x\leq 2$. First, solve the first inequality for x to get $x\leq -4$. All and inequalities can be rewritten as one inequality, like this: $-4\leq x\leq 2$ (write x between two ≤'s or <'s or both with the smaller number on the left and the larger number on the right).

Solving Inequalities with Absolute Value

Since "'|x| = |- x|"' A inequality involving absolute value will have to solved in two parts. Solving "'|x-6| < 5"'. The first part would be "'x-6 < 5"' which gives x < 11 . The second part would be "'-(x-6) < 5"' which solved yields x > 1. So the answer to |x-6| < 5 is 1<x<11.

http://en.wikibooks.org/wiki/Algebra/Equalities_and_Inequalities

Text for reading

The English mathematician George Boole (1815-1864) sought to give symbolic form to Aristotle's system of logic. Boole wrote a treatise on the subject in 1854, titled *An Investigation of the Laws of Thought*, on which are founded the mathematical theories of logic and probabilities, which codified several rules of relationship between mathematical quantities limited to one of two possible values: true or false, 1 or 0. His mathematical system became known as Boolean algebra.

All arithmetic operations performed with Boolean quantities have but one of two possible outcomes: either 1 or 0. There is no such thing as "2" or "-1" or "1/2" in the Boolean world. It is a world in which all other possibilities are invalid by fiat. As one might guess, this is not the kind of math you want to use when balancing a checkbook or calculating current through a resistor. However, Claude Shannon of MIT fame recognized how Boolean algebra could be applied to on-and-off circuits, where all signals are characterized as either "high" (1) or "low" (0). His 1938 thesis, titled *A Symbolic Analysis of Relay and Switching Circuits*, put Boole's theoretical work to use in a way Boole never could have imagined, giving us a powerful mathematical tool for designing and analyzing digital circuits.

In this unit, you will find a lot of similarities between Boolean algebra and "normal" algebra, the kind of algebra involving so-called real numbers. Just bear in mind that the system of numbers defining Boolean algebra is severely limited in terms of scope, and that there can only be one of two possible values for any Boolean variable: 1 or 0. Consequently, the "Laws" of Boolean algebra often differ from the "Laws" of real-number algebra, making possible such statements as 1 + 1 = 1, which would normally be considered absurd. Once you comprehend the premise of all quantities in Boolean algebra being limited to the two possibilities of 1 and 0, and the general philosophical principle of Laws depending on quantitative definitions, the "nonsense" of Boolean algebra disappears.

It should be clearly understood that Boolean numbers are not the same as binary numbers. Whereas Boolean numbers represent an entirely different system of mathematics from real numbers, binary is nothing more than an alternative notation for real numbers. The two are often confused because both Boolean math and binary notation use the same two ciphers: 1 and 0. The difference is that Boolean quantities are restricted to a single bit (either 1 or 0), whereas binary numbers may be composed of many bits adding up in place-weighted form to a value of any finite size. The binary number 100112 ("nineteen") has no more place in the Boolean world than the decimal number 210 ("two") or the octal number 328 ("twenty-six").

http://www.allaboutcircuits.com/vol_4/chpt_7/1.html

EXERCISES

1. Read and translate the words into Russian.

relative, notation, hence, strict inequality, additional, magnitude, define, unconditional inequality, hold, reverse, destroy, appear, apply, govern, properties, note, transitivity, replace, corresponding, ordered group, deal with, inverse, consider, decrease, preserve, care, evaluate, isolate, obviously, yield, respectively, occasionally, conjunction, adjacent terms, in addition to, except, contain, treatise, codify, relationship, value, outcome, invalid, checkbook, current, fame, imagine, similarity, so-called, in terms of, consequently, consider, absurd, comprehend, premise, disappear, whereas, entirely, confuse, cipher.

2. Translate the words into English.
запись, соответствующий, следовательно, строгое неравенство, дополнительный, модуль, определить, абсолютное неравенство, рассматривать, обратный, разрушать, применить, обусловливать, свойства, замечать, заменить, упорядоченная группа, иметь дело с, рассматривать, уменьшить, сохранить, осторожность, вычислять, смежный, очевидно, приводить к чему-л., в указанном порядке, изредка, союз, в дополнении к, кроме, содержать, конечный, ограничить, зашифровывать, полностью, исчезать, принимая во внимание, что, предположение, осмыслить, считать, и, следовательно, исходя из, так называемый, представить, слава.

3. Guess the meaning of the following words.
complicate – complicated, known – unknown, fill – unfilled, relate – related, written – rewritten, found – founded, probable – probability, perform – performed, similar – similarity, consequence – consequently, appear – disappear.

4. Try to solve the following problem.
The last palindromic year was 1881 – it reads the same forward or backward. What is the next palindromic year?

5. State the function of the Participle II.
1. The question answered by the student was a difficult one. 2. The process affected by the correction followed a different course. 3. The problem approached from another point of view proved simple. 4. The technique followed by this research team is very complicated. 5. Definition of the problem followed by its investigation was a difficult task. 6. Their actions influenced by the decision were wiser. 7. The fact mentioned was of great importance. 8. The problem dealt with in this article is complex.

6. Translate the joke into Russian.
- What do you call a stubborn angle? .... (obtuse)
- How do kids like their ice-cream served? …….(cone)

Unit 6. Ways to Solve Systems of Linear Equations in Two Variables

The tutorial gives an example of three ways to solve systems of linear equations in two variables: graphing, substitution method, elimination method.

Solve by Graphing

Step 1: Graph the first equation. Unless the directions tell you differently, you can use any "legitimate" way to graph the line.

Step 2: Graph the second equation on the same coordinate system as the first. You graph the second equation the same as any other equation. Refer to the first step if you need to review how to graph a line. The difference here is you will put it on the same coordinate system as the first. It is like having two graphing problems in one.

Step 3: Find the solution. If the two lines intersect at one place, then the point of intersection is the solution to the system. If the two lines are parallel, then they never intersect, so there is no solution. If the two lines lie on top of each other, then they are the same line and you have an infinite number of solutions. In this case you can write down either equation as the solution to indicate they are the same line.

Step 4: Check the proposed ordered pair solution in both equations. You can plug in the proposed solution into BOTH equations. If it makes BOTH equations true then you have your solution to the system. If it makes at least one of them false, you need to go back and redo the problem.

Solve by the Substitution Method

Step 1: Simplify if needed. This would involve things like removing ( ) and removing fractions. To remove ( ): just use the distributive property. To remove fractions: since fractions are another way to write division, and the inverse of divide is to multiply, you remove fractions by multiplying both sides by the LCD of all of your fractions.

Step 2: Solve one equation for either variable. It doesn't matter which equation you use or which variable you choose to solve for. You want to make it as simple as possible. If one of the equations is already solved for one of the variables, that is a quick and easy way to go. If you need to solve for a variable, then try to pick one that has a 1 as a coefficient. That way when you go to solve for it, you won't have to divide by a number and run the risk of having to work with a fraction.

Step 3: Substitute what you get for step 2 into the other equation. This is why it is called the substitution method. Make sure that you substitute the expression into the OTHER equation, the one you didn't use in step 2. This will give you one equation with one unknown.

Step 4: Solve for the remaining variable. Solve the equation set up in step 3 for the variable that is left. If your variable drops out and you have a FALSE statement, that means your answer is no solution. If your variable drops out and you have a TRUE statement, that means your answer is infinite solutions, which would be the equation of the line.

Step 5: Solve for second variable. If you come up with a value for the variable in step 4, that means the two equations have one solution. Plug the value found in step 4 into any of the equations in the problem and solve for the other variable.

Step 6: Check the proposed ordered pair solution in both original equations. You can plug in the proposed solution into BOTH equations. If it makes both equations true, then you have your solution to the system. If it makes at least one of them false, you need to go back and redo the problem.

Solve by the Elimination by Addition Method

Step 1: Simplify and put both equations in the form Ax + By = C if needed. This would involve things like removing ( ) and removing fractions. To remove ( ): just use the distributive property. To remove fractions: since fractions are another way to write division, and the inverse of divide is to multiply, you remove fractions by multiplying both sides by the LCD of all of your fractions.

Step 2: Multiply one or both equations by a number that will create opposite coefficients for either x or y if needed. Looking ahead, we will be adding these two equations together. In that process, we need to make sure that one of the variables drops out, leaving us with one equation and one unknown. The only way we can guarantee that is if we are adding opposites. The sum of opposites is 0. If neither variable drops out, then we are stuck with an equation with two unknowns which is unsolvable. It doesn't matter which variable you choose to drop out. You want to keep it as simple as possible. If a variable already has opposite coefficients than go right to adding the two equations together. If they don't, you need to multiply one or both equations by a number that will create opposite coefficients in one of your variables. You can think of it like a LCD. Think about what number the original coefficients both go into and multiply each separate equation accordingly. Make sure that one variable is positive and the other is negative before you add. For example, if you had a 2x in one equation and a 3x in another equation, we could multiply the first equation by 3 and get 6x and the second equation by -2 to get a -6x. So when you go to add these two together they will drop out.

Step 3: Add equations. Add the two equations together. The variable that has the opposite coefficients will drop out in this step and you will be left with one equation with one unknown.

Step 4: Solve for remaining variable. Solve the equation found in step 3 for the variable that is left. If both variables drop out and you have a FALSE statement, that means your answer is no solution. If both variables drop out and you have a TRUE statement, that means your answer is infinite solutions, which would be the equation of the line.

Step 5: Solve for second variable. If you come up with a value for the variable in step 4, that means the two equations have one solution. Plug the value found in step 4 into any of the equations in the problem and solve for the other variable.

Step 6: Check the proposed ordered pair solution in both original equations. You can plug the proposed solution into BOTH equations. If it makes BOTH equations true, then you have your solution to the system. If it makes at least one of them false, you need to go back and redo the problem.

http://www.wtamu.edu/academic/anns/mps/math/mathlab/col_algebra/col_alg_tut4

Zapping the Brain Improves Math Skills

Scientists from the University of Oxford have shown that they can improve a person's math abilities for up to six months. The research could help treat the nearly 20 percent of the population with moderate to severe dyscalculia (math disability), and could probably aid students in other subjects as well.

"I am certainly not advising people to go around giving themselves electric shocks," said Roi Cohen Kadosh, a scientist at the University of Oxford and a co-author of a new paper. "But we are extremely excited by the potential of our findings."

The UK scientists used a method known as transcranial direct current stimulation, or TDCS. This non-invasive technique involves passing electricity through the skull to increase or decrease the activity of neurons, usually for less than 15 minutes.

The amount of electricity is tiny, so small that most patients don't even know it is happening. In fact, many scientists were initially skeptical it would have any effect at all, said Jim Stinear, Director of the Neuralplasticity Laboratory at the Rehabilitation Institute of Chicago.

For this experiment the scientists directed the current into the brain's parietal lobe, which is involved in number processing. Instead of learning familiar Arabic numerals, however, the scientists had the participants learn a new series of symbols that represented numbers. Then, while their brains were being stimulated, they tested the participants ability to organize those numbers.

Patients who were on TDCS showed an improved ability to order the numbers.

The electric current makes it subtly easier or more difficult to stimulate a particular group of nerves, depending on the needs of the researchers and the patient. For example, if researchers want to make it easier for a patient to learn, then the nerves will fire more readily.

Other studies have shown that TDCS can improve a variety of brain functions, from pain management to rehabilitation after traumatic events, said Jim Stinear, Director of the Neuralplasticity Laboratory at the Rehabilitation Institute of Chicago. But what is "really

remarkable," about this new research is how long the effects lasted: six months.

If TDCS can improve number processing in normal people, it should be able to improve number processing in people who have lower than normal number processing skills, and that's who the Oxford scientists will be testing next. TDCS should be able to improve other types of learning, such as language, as long as they are near the surface of the brain.

Structures like the hippocampus, which are buried under entire lobes of the brain, are likely beyond the reach of TDCS, said Cohen Kadosh.

While the Oxford scientists don't advocate plugging yourself into a wall socket, they do eventually hope to create a device that will provide an appropriate amount of electrical current to the brain, and have filed a patent on such a device.

Such a device won't instantly make you better at math, help you recover from a stroke faster, or manage pain better, said Stinear. Anybody using a device will still have to put in a significant amount of effort.

Drawing a parallel between a popular stimulant, Stinear said that coffee can help you wake up, but if you just sit on the couch you still aren't being productive. The same goes for TDCS. "Electrical stimulation will most likely not turn you into Albert Einstein," said Kadosh, "but if we're successful it might be able to help some people to cope better with math." http://news.discovery.com/human/psychology/brain-electricity

EXERCISES

1. Read and translate the words into Russian.

tutorial, unless, legitimate, refer, intersect, infinite, indicate, plug, at least, redo, remove, substitute, make sure, remaining, drop out, mean, simplify, involve, since, look ahead, guarantee, unsolvable, accordingly, improve, treat, moderate, severe, aid, be excited, findings, increase, decrease, subtly, stimulate, fire, remarkable, skill, surface, advocate, device, recover, stroke, manage, cope with.

2. Translate the words into English.

справиться с, удостовериться, делать заново, остаток, гарантировать, отпадать, помогать, соответственно, заменить, означать, улучшить, переставить, практическое занятие, если не, допустимый, лечить, сильный, так как, быть в восторге, увеличивать, забегать, уменьшать, ссылаться, скрещиваться, неопределённый, пересекаться, подставить, по крайней мере, навык, отстоять, вылечиться.

3. Make up question to each sentence.

For example:
T.: This problem is being discussed. (where)
St.: Where is the problem being discussed?

1. The students were being informed about the meeting. (by whom) 2. The conference is being held now. (where) 3. Such methods are being developed. (why) 4. The results were being checked at 6 o'clock. (how) 5. The computer was being placed there when they entered. (what)

4. Answer the following questions.

1. What equations are termed linear? 2. What is the first operation in solving a system of two linear equations in two unknowns? 3. What do you obtain by adding or subtracting the two equations? 4. What operation do you perform to find the second unknown quantity?

5. Translate the text into English.

Уравнением называется равенство, в котором одно или несколько чисел, обозначенных буквами, являются неизвестными. Пусть, например, сказано, что сумма квадратов двух неизвестных чисел *x* и *y* равна 7. Уравнением первой степени с двумя неизвестными называется уравнение вида: $ax+ by = c,$ где *x* и *y* — неизвестные, *a* и *b* (коэффициенты при неизвестных) — данные числа, не равные оба нулю, с (свободный член — absolute term) — любое данное число.

Unit 7. Square Roots: Introduction & Simplification

"Roots" (or "radicals") are the "opposite" operation of applying exponents; you can "undo" a power with a radical, and a radical can "undo" a power. For instance, if you square 2, you get 4, and if you "take the square root of 4", you get 2; if you square 3, you get 9, and if you "take the square root of 9", you get 3:

$2^2 = 4$, so $\sqrt{4} = 2$

$3^2 = 9$, so $\sqrt{9} = 3$

The "$\sqrt{\ }$ " symbol is called the "radical" symbol. (Technically, just the "check mark" part of the symbol is the radical; the line across the top is called the "vinculum".) The expression "$\sqrt{9}$" is read as "root nine", "radical nine", or "the square root of nine".

You can raise numbers to powers other than just; you can cube things, raise them to the fourth power, raise them to the 100th power, and so forth. In the same way, you can take the cube root of a number, the fourth root, the 100th root, and so forth. To indicate some root other than a square root, you use the same radical symbol, but you insert a number into the radical, tucking it into the "check mark" part. For instance: $4^3 = 64$, so $\sqrt[3]{64} = 4$

The "3" in the above is the "index" of the radical; the "64" is "the argument of the radical", also called "the radicand". Since most radicals you see are square roots, the index is not included on square roots. While "$\sqrt[2]{\ }$ " would be technically correct, I've never seen it used.

a square (second) root is written as $\sqrt{\ }$
a cube (third) root is written as $\sqrt[3]{\ }$
a fourth root is written as $\sqrt[4]{\ }$
a fifth root is written as: $\sqrt[5]{\ }$

You can take any counting number, square it, and end up with a nice neat number. But the process doesn't always work going backwards. For instance, consider $\sqrt{3}$, the square root of three. There is no nice neat number that squares to 3, so $\sqrt{3}$ cannot be simplified as a nice whole number. You can deal with $\sqrt{3}$ in either of two ways: If you are doing a word problem and are trying to find, say, the rate of speed, then you would grab your calculator and find the decimal approximation of $\sqrt{3}$:

$\sqrt{3} \approx 1.732050808$

Then you'd round the above value to an appropriate number of decimal places and use a real-world Unit or label, like "1.7 ft/sec". On the other hand, you may be solving a plain old math exercise, something with no "practical" application. Then they would almost certainly want the "exact" value, so you'd give your answer as being simply "$\sqrt{3}$".

Simplifying Square-Root Terms

To simplify a square root, you "take out" anything that is a "perfect square"; that is, you take out front anything that has two copies of the same factor:

$\sqrt{49} = \sqrt{7^2} = 7$

$\sqrt{225} = \sqrt{15^2} = 15$

Note that the value of the simplified radical is *positive*. While either of +2 and –2 might have been squared to get 4, "the square root of four" is *defined* to be *only* the positive option, +2. When you solve the equation $x^2 = 4$, you are trying to find *all* possible values that might have been squared to get 4. But when you are just simplifying the expression $\sqrt{4}$, the ONLY answer is "2"; this positive result is called the "principal" root. (Other roots, such as –2, can be defined using graduate-school topics like "complex analysis" and "branch functions", but you won't need that for years, if ever.)

Sometimes the argument of a radical is not a perfect square, but it may "contain" a square amongst its factors. To simplify, you need to factor the argument and "take out" anything that is a square; you find anything you've got a pair of inside the radical, and you move it out front. To do this, you use the fact that you can switch between the multiplication of roots and the root of a multiplication. In other words, radicals can be manipulated similarly to powers:

$(ab)^n = a^n b^n$ and $\sqrt[n]{ab} = \sqrt[n]{a}\sqrt[n]{b}$

- **Simplify $\sqrt{144}$**

There are various ways I can approach this simplification. One would be by factoring and then taking two different square roots:

$\sqrt{144} = \sqrt{9 \times 16} = \sqrt{9}\sqrt{16} = 3 \times 4 = 12$

The square root of 144 is 12.

You probably already knew that $12^2 = 144$, so obviously the square root of 144 must be 12. But my steps above show how you can switch back and forth between the different formats (multiplication inside one radical, versus multiplication of two radicals) to help in the simplification process.

- **Simplify $\sqrt{24}\sqrt{6}$**

Neither of 24 and 6 is a square, but what happens if I multiply them inside one radical?

$\sqrt{24}\sqrt{6} = \sqrt{24 \times 6} = \sqrt{144} = \sqrt{12 \times 12} = \mathbf{12}$

- **Simplify $\sqrt{75}$**

$\sqrt{75} = \sqrt{3 \times 25} = \sqrt{25}\sqrt{3} = \mathbf{5\sqrt{3}}$

This answer is pronounced as "five, root three". It is proper form to put the radical at the end of the expression. Not only is "$\sqrt{3}5$" non-standard, it is very hard to read, especially when hand-written. And write neatly, because "$5\sqrt{3}$" is not the same as "$\sqrt[5]{3}$".

You don't have to factor the radicand all the way down to prime numbers when simplifying. As soon as you see a pair of factors or a perfect square, you've gone far enough.

- **Simplify $\sqrt{72}$**

Since 72 factors as 2×36, and since 36 is a perfect square, then:

$\sqrt{72} = \sqrt{2 \times 36} = \sqrt{2 \times \underline{6 \times 6}} = \mathbf{6\sqrt{2}}$

Since there had been only one copy of the factor 2 in the factorization 2×6×6, that left-over 2 couldn't come out of the radical and had to be left behind.

- **Simplify $\sqrt{4500}$**

$\sqrt{4500} = \sqrt{45 \times 100} = \sqrt{5 \times 9 \times 100}$

$= 3 \times 10 \times \sqrt{5} = \mathbf{30\sqrt{5}}$

http://www.purplemath.com/Units/radicals.htm

Text for reading

In this 19th-century French military strategy game, one player moves a hare while the other moves three hounds on a playing board.

The board consists of 11 squares arranged so that five squares make up the center (or middle) row. The top and bottom rows each have three squares centered over the middle row. The hare begins at the far right side of the middle row. The hounds begin at the three left sides of the three rows.

Hounds may only move vertically or forward either horizontally or diagonally, toward the right side. In other words, hounds cannot move backward. The hare can move in any direction: vertically, horizontally or diagonally, forward or backward.

The hounds move first. The hounds player may move one hound one square. Then play passes to the hare player. The hounds win by trapping the rabbit in a square where the rabbit cannot move. The hare wins by escaping, or getting past the hounds. There is no capture move as in chess; the winning move is simply a trap. If the hounds stall the rabbit by forcing it to move vertically up and down (without forward movement) 10 times in a row, the hare wins.

http://www.ehow.com/list_6188947_math-brain

EXERCISES

1. Read the words and translate them into Russian.

root, undo, raise number to power, so forth, insert, backwards, consider, deal with, approximation, application, note, define, approach, perfect square, get the square root, evolution, inverse, involution, aid, therefore, accuracy, for instance, in order to, sufficient, quantity, radical sign, conclude, cube root, estimate, recall, to raise to power, to obtain the quantity, to square the number, to take an arithmetic square root, to use a table, may be checked, conclude, arrange, trap.

2. Translate the following words into English.

корень, возвести число в степень, и так далее, вставить, обратно, рассматривать, подход, определить, иметь дело с, получить квадратный корень, ловушка, можно проверить, сделать вывод, организовать,

3. Answer the following questions.

1. What operation should be performed to square a number? 2. What is a perfect square? 3. What do we do to get the square root of a number? 4. What is the process of finding a root called? 5. How do we check the accuracy of a root?

4. Translate the text into Russian.

According to legend, the ancient Greek mathematician who proved that [redacted] could NOT be written as a ratio of integers p/q made his colleagues so angry that they threw him off a boat and drowned him!

http://hotmath.com/hotmath_help/topics/number-systems.html

5. Translate the sentences into English.

1. Чтобы возвести в квадрат число, надо умножить это число на самое себя. 2. Извлечение квадратного корня – это действие обратное возведению в квадрат. 3. Чтобы получить квадратный корень числа, мы можем пользоваться специальной таблицей. 4. Правильность извлечения квадратного корня можно проверить, возведя в квадрат подкоренное выражение; если получится данное число, то корень найден правильно.

6. Try to solve the following problems.

- How do you pair off these numbers so that the sum of each of the four pair adds up to the same number? 12345678
- A portrait of your favourite TV star costs half a dollar mare than the frame to go around it. Together they cost two dollars. How much does each cost?
- Can you make 100, a century, out of the numbers 1 through 9, using the usual signs +, □,÷, ×, and parentheses?

7. Translate the following sentences into Russian.

1. It would be a good idea if a few more facts were used for illustrating this point of view. 2. I would not take part in this discussion unless I had a definite idea on the subject. 3. It was evident that even if we went on forever with our discussion we would not reach any agreement. 4. If we considered the third example we would see that the magnitude of the common ratio was less than 1.

8. Choose from the terms above to complete each sentence.
linear equation, two-step equation, domain, inequality inverse operations, function table, Subtraction Property of Equality, range, function, slope

1. Operations that “undo” each other are called ____________ .
2. The ______ states that if you subtract the same number from each side of an equation, the two sides remain equal.
3. A(n) ______ is an equation that has two different operations.
4. A relationship where one thing depends on another is called a(n) ______.
5. The _____ of a line is the change in y with respect to the change in x.
6. The set of input values for a function is the _____________ .
7. The expression $x + 1 > 8$ is called a(n) _____________ .
8. The _____________ of a function is the set of output values.
9. A(n) ________ is an equation whose graph is a straight line.
10. When working with functions, organize the input numbers, output numbers, and function rule by using a(n) ___________ .

9. Read and translate the following jokes into Russian.

- Two math students, a boy and his girlfriend, are going to a fair. They are in line to ride the Ferris wheel when it shuts down.
- The boy says: "It's a sin for those people to keep us waiting like this!"
- The girl replies: "No - it's a cosin, silly!!!"
- Pi and i walk into a bar. Pi orders an appletini and (i) says be rational, so pi responds to (i) and says get real.
- How do you make seven even? .... (take away the "s")
- Two's company, and three's a crowd, but what is four and five? .... (nine)
- A mathematician is in Africa trying to capture a lion. When he spots one he proceeds to build a fence around himself and says, "I define this to be outside!"

Unit 8. Logarithms

Logarithms, or "logs", are a way of expressing one number in terms of a "base" number that is raised to some power. Common logs are done with base ten, but some logs ("natural" logs) are done with the constant "e" (2.718 281 828) as their base. The log of any number is the power to which the base must be raised to give that number

When we are given the base 2, for example, and exponent 3, then we can evaluate 2^3. $2^3 = 8$. Inversely, if we are given the base 2 and its power 8 -- $2^? = 8$-- then what is the exponent that will produce 8? That exponent is called a logarithm. We call the exponent 3 the logarithm of 8 with base 2. We write $3 = \log_2 8$. We write the base 2 as a subscript. 3 is the *exponent* to which 2 must be raised to produce 8. A logarithm is an exponent. Since $10^4 = 10{,}000$. Then $\log_{10} 10{,}000 = 4$. "The logarithm of 10,000 with base 10 is 4." 4 is the *exponent* to which 10 must be raised to produce 10,000. "$10^4 = 10{,}000$" is called the exponential form. "$\log_{10} 10{,}000 = 4$" is called the logarithmic form.

Common logarithms

The system of common logarithms has 10 as its base. When the base is not indicated, log 100 = 2 then the system of common logarithms – base 10 – is implied. Here are the powers of 10 and their logarithms: Logarithms replace a geometric series with an arithmetic series.

Natural logarithms

The system of natural logarithms has the number called e as its base. (e is named after the 18th century Swiss mathematician, Leonhard Euler.) e is the base used in calculus. It is called the "natural" base because of certain technical considerations.

http://www.themathpage.com/aprecalc/logarithms.htm#definition

Proof of the laws of logarithms

The laws of logarithms will be valid for any base. We will prove them for base e, that is, for $y = \ln x$. $\ln ab = \ln a + \ln b$. The function $y = \ln x$ is defined for all positive real numbers x. Therefore there are real numbers p and q such that $p = \ln a$ and $q = \ln b$. This implies $a =$

e^p and $b = e^q$. Therefore, according to the rules of exponents, $ab = e^p e^q = e^{p+q}$. And therefore $\ln ab = \ln e^{p+q} = p + q = \ln a + \ln b$.

Which is what we wanted to prove. In a similar manner we can prove the 2nd law. Here is the 3rd: $\ln a^n = n \ln a$. There is a real number p such that $p = \ln a$; that is, $a = e^p$. And the rules of exponents are valid for all rational numbers n. Therefore, $a^n = e^{pn}$. This implies $\ln a^n = \ln e^{pn} = pn = np = n \ln a$. That is what we wanted to prove.

Change of base

Say that we know the values of logarithms of base 10, but not, for example, in base 2. Then we can convert a logarithm in base 10 to one in base 2 -- or any other base -- by realizing that the values will be proportional. $\log_2 x = k \log x.$

Each value in base 2 will differ from the value in base 10 by the same constant k. Now, to find that constant, we know that $\log_2 2 = 1.$

Therefore, on putting $x = 2$ above: $\log_2 2 = k \log 2 = 1.$ That implies $k = \frac{1}{\log 2}.$ Therefore, $\log_2 x = \frac{1}{\log 2} \cdot \log x.$ That is, $\log_2 x = \frac{\log x}{\log 2}.$

By knowing the values of logarithms in base 10, we can in this way calculate their values in base 2.

In general, then, if we know the values in base a, then the constant of proportionality in changing to base b, is the *reciprocal* f its log in base a.

$$\log_b x = \frac{\log_a x}{\log_a b}.$$

http://www.themathpage.com/aprecalc/logarithms.htm#definition

History of Logarithms

The beginning of logarithms is usually attributed to John Napier (1550–1617), a Scottish amateur mathematician. Napier's interest in astronomy required him to do tedious calculations. With the use of logarithms, he developed ideas that shortened the time to do long and

complex calculations. However, his approach to logarithms was different from the form used today.

Fortunately, a London professor, Henry Briggs (1561–1630) became interested in the logarithm tables prepared by Napier. Briggs traveled to Scotland to visit Napier and discuss his approach. They worked together to make improvements such as introducing base-10 logarithms. Later, Briggs developed a table of logarithms that remained in common use until the advent of calculators and computers. Common logarithms are occasionally also called Briggsian logarithms. http://www.encyclopedia.com/topic/Logarithms.aspx

EXERCISES

1. Translate the following words into Russian.

evaluate, inversely, imply, considerations, valid, define, therefore, according to, similar, convert, realize, value, calculate, reciprocal, require, tedious, develop, shorten, complex, however, differ, approach, fortunately, together, improvements, such as, remain, until, advent, occasionally.

2. Translate the words into English.

подсчитать, в обратной зависимости, рекомендации, истинный, следовательно, согласно, похожий, сводить, осознавать, значение, подсчитывать, обратная величина, требовать, громоздкий, к счастью, однако, подход, вместе, улучшения, такие как, оставаться, до тех пор пока, появление, периодически, отличаться.

3. Answer the following questions.

1. When was the discovery of logarithms made? 2. Why was the discovery of logarithms an important step? 3. What operations can be replaced by logarithms? 4. What logarithmic system is known as the common? 5. What fact does the common logarithmic system make use of?

4. Translate the text into Russian.

In giving the logarithm of a number, the base must always be specified unless it is understood from the beginning that in any discussion a certain number is to be used as base for all logarithms. Any real number except 1 may be used as base, but we shall see later that in applications of logarithms only two bases are in common use. Suppose the logarithm of a number in one system is known and it is desired to find the logarithm of the same number in some other system. This means that the logarithm of the number is taken with respect to two bases. It is sometimes important to be able to calculate one logarithms when the other is known.

5. Translate the text into English.

Ранее изобретения логарифмов потребность в ускорении выкладок породила таблицы иного рода, с помощью которых действие умножения заменяется не сложением, а вычитанием. Устройство этих таблиц основано на тождестве $ab = \frac{(a+b)^2}{4} - \frac{(a-b)^2}{4}$, в верности которого легко убедиться, раскрыв скобки.

http://www.mathworld.ru/taxonomy/term/12?page=2

6. Make up questions to each sentence.

1. She has to present her paper next month. 2. They will have to use the binary system of notation. 3. He had to prove his statement. 4. Did you have to accept their plan? 5. Does she have to deal with that subject? 6. Will you have to check division by multiplication? 7. He does not have to produce this information.

7. Translate the following jokes into Russian.

- “Divide fourteen sugar cubes into three cups of coffee so that each cup has an odd number of sugar cubes in it.”
  “That’s easy: one, one, and twelve.”
  “But twelve isn’t odd!”
  “It’s an odd number of cubes to put in a cup of coffee…”
- Never argue with a 90 degree triangle, it's always right.
- What would a math student say to a fat parrot? .... (poly-no-mial)

Chapter 4 PRACTICAL GRAMMAR

Unit 1. Настоящее время группы *Simple* в страдательном залоге

Страдательный залог употребляется в том случае, если в центре внимания говорящего находится лицо или предмет, которые подвергаются воздействию со стороны другого лица.

Утвердительное предложение	Отрицательное предложение	Вопросительное предложение
I **am** **V3 / Ved**	I **am not** **V3 / Ved**	**Am** I **V3 / Ved** ?
He	He	he
She **is** **V3 / Ved**	She **isn`t V3 / Ved**	**Is** she **V3 / Ved** ?
It	It	it
They	They	they
We **are** **V3 / Ved**	We **aren`t V3 / Ved**	**Are** we **V3 / Ved**?
You	You	you

Если сказуемое действительного залога выражено сочетанием модального глагола с инфинитивом, то в страдательном залоге ему соответствует сочетание того же модального глагола с инфинитивом в страдательном залоге:

He ***can*** do it today. — It ***can*** be done today.

It ***might*** show an error. — An error ***might*** be shown.

Exercise 1.1. Make up questions and negative form of each sentence.

1. I am told to present my abstract. (what) 2. They are given very interesting examples during the lecture. (when) 3. He is asked to show the result of his work. (who) 4. Their results aren`t used in his work. (what) 5. Base ten numeration system is used. (what) 6. Arithmetic is taught at school. (where) 7. The result is checked. (what) 8. That combinations are used in the new system. (what) 9. The quotient is found by division. (what) 10. All these questions are discussed by the students during the seminar. (when) 11. Such numerals are easily multiplied. (what).

Exercise 1.2. Translate the sentences into Russian.
1. The tables must be placed here. 2. The questions might be studied. 3. I can be questioned in English. 4. This data can be recorded by the computer. 5. These changes might be programmed. 6. Their program can`t be changed. 7. Can various combinations be used in processing the data? 8. Might the same method be used by them? 9. The work planned must be done in time. 10. This idea was developed by him.

Exercise 1.3. Put the verbs in brackets into the correct passive or active form.

One day Einstein (to go)) to a town in Central Germany to play in a concert which (to give) to help poor students. A young inexperienced writer (to send) to report the concert. While waiting for a concert to begin, he (to whisper) nervously to the lady next to him, “Who (to be) this Einstein who (to play) tonight?”

The lady (to shock) that there (to be) someone in Germany who never (to hear) of the famous scientist. “Good heavens, you (not to know)? It (to be) the great Einstein!” – “Ah, yes, of course”, (to answer) the young reporter writing down something.

The next day, the newspaper (to report) the successful appearance of “the great musician, Albert Einstein, who (to play) with skill and feeling second to none”. It (to declare) that Einstein (to be) “the greatest master of them all”.

Einstein (to carry) this article with him until it (wear) out. His eyes usually (to twinkle) as he (to say) to a friend, “You (to think) I (to be)” a scientist? Hah! I (to be) a famous fiddler, that`s what I (to be)! He (to pull) the article out of his pocket.

But when the rich man (to send) him a violin worth 30,0000 dollars, Einstein (to return) it with a modest note, “This valuable instrument (to play) by a true artist. Please forgive me – I (to use) to my old violin”.

Unit 2. Сравнительная степень прилагательных и наречий

Качественные имена прилагательные и наречия в английском языке имеют три степени сравнения. Односложные прилагательные и наречия, а также двусложные, оканчивающиеся на -**y**, -**e**, -**er**, **ow**. Многосложные прилагательные и наречия образуют сравнительную степень при помощи слова ***more*** *более*, а превосходную степень — при помощи слова ***most*** *самый*.

	Сравнительная степень	**Превосходная степень**
Односложные, двусложные прилагательные		
kind – добрый	kinder	(the) kindest
thin – тонкий	thinner	(the) thinnest
heavy – тяжелый	heavier	the) heaviest
fast – быстро	faster	(the) fastest
few – мало	fewer	(the) fewest
Многосложные прилагательные		
talented	more talented	(the) most talented
interesting	more interesting	(the) most interesting

Особые случаи

good – хороший well – хорошо	better – лучше	(the) best – самый лучший
bad – плохой badly – плохо	worse – хуже	(the) worst – самый худший
many (books) – много much (money) – много	more – больше	(the) most – больше всех
little – мало	less – меньше	(the) least – меньше всего
old – старый	older – старше elder – старше	(the) oldest (the) eldest

Сравнительные структуры

as .... as	такой, как
not so .... as	не так ...., как
The + сравнит.ст. .... the + сравнит.ст.	чем .... тем ....

Exercise 2.1. Translate the sentences into Russian.
1. This machine is *complicated.* The new one is *more complicated.* It is the *most complicated* machine that I know of. 2. This definition is too *general.* There is *a less general* definition. 3. The result of their exam is *bad.* It is much *worse than* we expected. In fact, it is the *worst* in many years. 4. This method of research is *more interesting than the one* we followed. 5. The equation given to me was *easier than the one* he was given. 6. The remainder in this operation of division is *greater than* 1. 7. The name of Leibnitz is as *familiar* to us *as that* of Newton. 8. This system is *as interesting as the one* you are studying. 9. I have *as much* work *as* you *do.* 10. Their computer is *not so modern as the one* we have in our lab.11. I am not *much concerned* with this problem *as* he is*. 12. The sooner* we decide on this question *the better.* 13. *The later* he begins his research *the less time he* will have for writing his thesis. 14. *The more* specific definition you give *the better.*

Exercise 2.2. Translate the words in the braces into English.
1. (Чем скорее) you come (тем больше) we shall be able to do. 2. (Чем легче) the translation (тем меньше) time it will take. 3. (Чем сложнее) the problem (тем интереснее) I find it. 4. (Чем позднее) we begin the lesson (тем хуже). 5. (Чем раньше) we finish this work (тем лучше). 6. *Чем больше* we study mathematics *тем больше* we see that the ideas and conceptions involved become more divorced and remote from experience.

Exercise 2.3. Read and translate the verse into Russian.
The more you read,
The more you know.
The more you know,
The smarter you grow.
The smarter you grow,
The stronger your voice,
When speaking your mind
or making your choice. http://www.canteach.ca/elementary/songspoems37.html

Unit 3. Причастие I (the Participle I)

Причастие I (Participle I) - неличная форма глагола, обладающая свойствами глагола, прилагательного и наречия. Соответствует формам причастия и деепричастия в русском языке. Причастие I выражает действие, являющееся признаком предмета (people entering this room - люди, входящие в эту комнату), или сопутствующим действием (Entering the room, he said – Входя в комнату, он сказал…).

Формы причастия I

Participle I	Действительный залог	Страдательный залог
Non-perfect	sending	being sent
Perfect	having sent	having been sent

Неперфектная (Non-perfect) форма причастия I обозначает действие, одновременное с действием глагола-сказуемого, независимо от времени последнего.

She looked at the boys playing in the yard. – Она посмотрела на мальчиков, играющих во дворе.

Not knowing her address, I send her a letter. – Не зная её адреса, я не отправлю ей письмо.

Not knowing her address, I didn`t send her a letter. – Не зная её адреса, я не отправила ей письмо.

Перфектная (Perfect) форма причастия I обозначает действие, предшествующее действия глагола-сказуемого.

Having finished the work, he left the laboratory. - окончив работу (После того, как он окончил работу), он вышел из лаборатории.

Participle I в действительном залоге в предложении выполняет функции:
1) определения: The *working* men will be ... – *Работающие* люди будут ... The man *standing* at the desk ... – Человек, *стоящий* у стола
2) обстоятельства: *Considering* these properties we noticed ... – *Рассматривая* эти свойства, мы обратили внимание ...

While (When) *solving* a problem you must write down the equation. - *Решая (при решении)* задачи, вам следует записать уравнение.
3) части сказуемого: Students *are using* various methods of computation. – Студенты *пользуются* различными методами вычисления.

Exercise 3.1. Read and pay attention on the Participle I.
1. *reading* a book he made notes – the boy *reading* a book is my brother – the boy is *reading* a book. 2. *speaking* at the conference he said some interesting things — the man *speaking* to professor is our teacher - the man is *speaking* to professor A. 3. *writing* the equation he said ... – the boys *writing* the dictation are our students – the boys are *writing* the equations. 4. *developing* the new system we expect to get good results – the man *developing* these ideas is a famous scientist – the man was *developing* his ideas

Exercise 3.2. State the form and the function of the participle and translate the sentences
1. The *calculating* machine is complicated. 2. The student *making* a report is one of our post-graduates. 3. The students *having* an English lesson are in the next room. 4. *Having* no time I could not speak to him. 5. *Studying* this problem he found something very interesting. 6. *Taking* the abstract from him I thanked him. 7. *Using* some familiar symbols he spoke about a new system of notation. 8. Many machines using atomic power must be built in future. 9. *Switching* on the circuit he started the machine. 10. They used symbols *corresponding* to symbols familiar to everybody.

Exercise 3.3. Read the story and retell it in English.
Sitting at the bar with his friends Mr. Smith, a great hunter, was telling one of his usual stories. “That winter it was terribly cold,” he said/ “I was returning to my camp in the forest. Being terribly cold and hungry I could think of nothing else but a hot meal by the fire. Suddenly I heard somebody following me and turning back I saw a pack of wolves running up to me. I rushed to a tree standing nearby, and did my best to climb it. having tried it several times, I succeeded at last. But looking down I saw a wolf trying to catch hold of my feet.

Having pulled up my knees, I felt that I was safe for a moment. But I was too weak to hang in that position for a long time.” Mr. Smith mad a pause and drank a glass of wine. “What happened next?” asked one of the listeners/ “Well, I fell down,” answered Mr. Smith lost In thought. “And what?” cried all the listeners in one voice. “Can`t you guess?” replied the man taking another drink. “The wolves ate me, of course.”

Unit 4
Модальные глаголы *Can, May, To Be To*
CAN

Модальный глагол ***can*** имеет **две временные** формы:
can *(the Present Simple)* – ***could*** *(the Past Simple)*
Модальный глагол *can* **выражает:**
1. *Способность (умственную или физическую).*
Peter *can* speak five languages.
2. ***Объективно существующую возможность.***
Nobody *can buy* health and happiness.
3. ***Разрешение*** или ***просьбу*** **в утвердительных и вопросительных предложениях. В отрицательных предложениях сап выражает запрет.**
Can I go out? You *can* go out if you like.
You *can't* go out. It's late.
Could you close the door, please? («Не могли бы вы ...?»): Could you do me a favour?
4. *Удивление* в вопросительных предложениях соответствует русскому «Неужели?».
Can it be five o'clock already?
Can it really be Nancy?
Can he still be sleeping?
В отрицательных предложениях *can* может выражать недоверие («не может быть, чтобы»).
It *can't* be five o'clock already.
It *can't* be Nancy!
He *can't* be sleeping!
Could – прошедшее время от модального глагола can (мог,

могли), также он образует сослагательное наклонение (мог бы), т. е. форму вежливости.

He could come yesterday. – Он мог придти вчера.

Could you help me, please? – Вы не могли бы мне помочь, пожалуйста?

Для выражения действия, которое могло бы произойти, но не произошло, употребляется перфектный инфинитив в сочетании с модальным глаголом *could*.

*You **could have asked** him about it. − Вы могли (могли бы) спросить его об этом.*

You could have told them about it. – Вы могли бы сказать им об этом (но вы этого не сказали).

Exercise 4.1. **Translate the sentences into English.**
1. Она может перевести это письмо. 2. Кто может помочь мне? 3. Моя сестра не умеет готовить. 6. Ты можешь быстро бегать? 7. Я не могу пить холодное молоко. 8. Он не может сказать правду. 9. Вы видите ту девушку с черной сумкой? 10. Ты не мог бы придти раньше? 11. В прошлом году я не смог поехать в Барселону.

Exercise 4.2. Replace the following words in the sentences: to change, to contain, to turn, to consider, to omit, to concern, to place, to agree, make sense, to summarize

1. The association property (может быть рассмотрено) during the previous seminar. 2. These elements (могут содержать) some common properties. 3. We (можно изменить) the subject of our discussion. 4. He (пропустил) a few words in his translation yesterday. 5. You (должны перевернуть) the page and read. 6. This problem probably (касается) you. 7. You should (сделать обзор) all these articles. 8. All the even and odd numbers (можно поместить) on both sides of the vertical line. 9. He (можно согласиться) to answer my questions. 10. Further work (имеет смысл).

Exercise 4.3. Read and retell these texts.

Aesop`s Fables

One of the greatest tellers of fables was called Aesop. He lived in Greece in about the 6th century BC. The expressions "sour grapes" and "dog in the manger" come from two of Aesop's stories.

In the first story, a hungry fox came to a vineyard. The vines were laden with luscious fruit. The fox looked around. No humans were in sight. He entered the vineyard. But when he did so he discovered that the grapes were too high up for him to reach. He tried to jump up to them but failed. He tried again and again until he collapsed, exhausted. Finally he turned away and slunk out of the vineyard. As he did so, he said to himself, "I did-n't want the grapes anyway I couldn't have eaten them. They were too sour."

The second story is about a dog which once made his bed in a manger. When the horses came to eat their straw from it, he growled at them. "Let us eat our food," they whinnied. "You cannot eat it yourself." But the dog only snarled more fiercely. Although he could not eat the straw him-self, he would not let anyone else eat it.One of the greatest tellers of fables was called Aesop. He lived in Greece in about the 6^{th} century BC. The expressions "sour grapes" and "dog in the manger" come from two of Aesop's stories.

♣♣♣♣♣

Professor: Can you tell anything about the great chemists of the 17th century?
Student: They are all dead, sir.

♣♣♣♣♣

Professor: Hawking, what is a synonym?
Student: It's a word you use in the place of another one when you can not spell the other.

MAY

Модальный глагол may употребляется при разрешении свершения какого-либо действия, также он выражать предположение свершения действия.

Утвердительное предложение	Отрицательное предложение	Вопросительное предложение
I **may** V She / he **may** V it. They /you **may** V	I **may not** V it. She / he **may not** V They **may not** V	I **May** she **V**? we

1. Возможность, существующую благодаря объективным обстоятельствам (только в утвердительных предложениях).
You *may order* a ticket by telephone. One *may come* across such things in everyday life.
2. Разрешение, просьбу (более формальные, чем с глаголом can).
You *may take* the exam now.
May I *go* now?
Yes, you *may use my* telephone.
May I *ask* you a question, Sir?
Might I trouble you for the sugar? (очень вежливая просьба)
3. Предположение, смешанное с сомнением (соответствует русскому «возможно», «может быть»).
They *may be* at home.
It *may be true.*
It *may* happen to any person.
В этом значении за глаголом *may* могут следовать различные формы инфинитива в зависимости от того времени, когда происходит действие.
She may be at work now. (Она, возможно, на работе.)
He may *be resting* now. (Он, может быть, отдыхает сейчас.)
Kate may *have fallen ill.* (Катя, возможно, заболел.)
Stephen may *have been waiting* for us for an hour already. (Стивен, возможно, ждет нас уже час.)
The program may have been fulfilled. – Программа, возможно, осуществлена. They *may have solved* the problem. They *may have obtained* the necessary data.

Exercise 4.4. Translate the sentences into English.
1. Он сказал, что мы можем идти на пляж одни. 2. Я думал, что

мне можно смотреть телевизор. 3. Вы можете идти домой. 4. Если ты не наденешь куртку, ты можешь заболеть. 5. Не давай ему эту красивую чашку. Он может разбить ее. 6. Он может нас обмануть. 7. Можно мне взять эту ручку? – Нет, тебе нельзя брать эту ручку. 8. Скоро может пойти снег. 9. Не трогай кошку: она может поцарапать (scratch) тебя. 10. Он может забыть об этом. 11. Мы можем опоздать на поезд. 12. Можно мне выйти? 13. Они могут позвонить после 9 вечера. 14. Ты можешь упасть. 15. Мы можем поехать в Дублин летом. 16. Ты мог бы и позвонить. Я знаю, у тебя есть время. 17. Можно мы пойдем гулять? – Да, вы можете идти погулять. 18. Мама говорит, что мне можно купаться.

Exercise 4.5. Read and translate the verse into Russian.
A Happy New Year to You
May the New Year bring your way
Nice, unexpected things each day -
New joys, new dreams, new plans to make.
Worthwhile things to undertake...
And may it bring you peace of mind.
Success - the real and lasting kind.
The gift of health, the joy of friends
And happiness that never ends!

TO BE TO

Основным значением модального глагола *to **be** to* является значение предварительной взаимной ***договоренности о необходимости*** совершения какого-либо действия. Сравните в русском языке значения «условились», «договорились», «должен, обязан, суждено», «собирались». *To be to* может иметь формы настоящего и прошедшего времен.
To be to **может также выражать *приказание.***
You *are to report* to the captain. They are *to give up* that crazy plan!
В отрицательных предложениях *to be to* обозначает *запрет.*
You *are not to open* the box! She *is not to appear* here!
To be to **употребляется в вопросительных предложениях для**

получения дальнейших указаний или инструкций.
What *are* we *to do?* Are we *to leave* or *to stay* here? *Am* I *to follow* you? – No, you *are not.*

	Утвердительное предложение	Отрицательное предложение	Вопросительное предложение
Present	I **am to V**. She / he **is to V**. They **are to V**	I am **not** to **V** She **isn\`t** to **V** They **aren\`t** to **V**	**Am** I **to V**? **Is** she / he **to V**? **Are** they **to V**?
Past	I **was to V**. She **was to V**. They **were to V**. You	I **wasn\`t** to **V**. She **wasn\`t** to **V**. They **weren\`t** to **V**. You	**Was** I **to V**? **Was** she / he **to V**? **Were** they **to V**?

He *is to come* at exactly five. She *was to phone* after dinner. They *will have* to meet in court.
Примечание: Перфектный инфинитив после глагола *to be to* показывает, что действие планировалось, но не было выполнено. He *was to have come* at seven and now it's already nine. (Он не пришел.)

Сравните:
She *was to do* it. (Возможно, она это сделала.)
She was to have done it. (Но она этого не сделала.)

Exercise 4.6. Make up positive, negative sentences and question to each sentence.
1. I am to write an abstract of my thesis. 2. He was to speak at the conference. 3. Am I to give you only the general idea of our work? 4. Was he to show them the result of their recent research? 5. You are not to agree to this plan without discussion. 6. She is not to attend tomorrow\`s lecture.

Exercise 4.7. Translate the sentences into English.
1. Он должен вернуть книги в библиотеку в конце года. 2. И что мне теперь делать? 3. Он должен решить задачу в семь? 5. Он должен был выступить с докладом в понедельник.

Unit 5. Инфинитив (The Infinitive)

Инфинитив – неопределенная форма глагола. Признаком инфинитива является частица *to – to speak.* В предложении инфинитив может быть: 1) подлежащим, 2) дополнением, 3) определением, 4) обстоятельством, 5) частью сказуемого.

1. Инфинитив в функции подлежащего:

To know English is helpful. – Знание английского языка полезно. В этом случае инфинитив всегда стоит перед сказуемым.

2. Инфинитив в функции дополнения:

I expect to be given complete information. – Я рассчитываю, что мне дадут (получить) полную информацию.

Tell me how to do it. – Скажи мне, как это сделать.

I don\`t know whether to answer him or not. – Я не знаю, отвечать ему или нет.

3. Инфинитив в функции определения:

Инфинитив в функции определения всегда расположен после определяемого им существительного.

The article is to be written in time. - Статья должна быть написана вовремя.

Give me something to read. – Дайте мне что-нибудь почитать. The first thing to do is let them know. – Первое, что нужно сделать, это предупредить их.

I\`ve no idea how to get there. – Я не имею представления, как туда добраться.

4. Инфинитив в функции обстоятельства (главным образом цели и следствия):

He is too young to understand it. – Он слишком молод.

She is clever enough not to mention it. – Она достаточно умна, чтобы не упоминать об этом.

To understand the situation one must know the details. – Чтобы понять положение, надо знать подробности.

To check the result of addition you have to subtract this number from the sum obtained. – Чтобы проверить результат сложения, вы должны вычесть это число из полученной суммы.

I have come here to (in order to, so as to) speak to you. – Я *пришёл сюда (чтобы) поговорить с тобой.*

Сравните:

To operate this computer is easy. – Работать (работа) на этом компьютере легко (подлежащее – работать).

To operate this computer you must do the following. – Для того, чтобы работать на этом компьютере, вы должны сделать следующее (подлежащее – вы)

5. Инфинитив в функции части сказуемого:

- В качестве именной части после связочного глагола:
  To do this means to change the whole system. - Сделать это – значит изменить всю систему.
- В сочетании с модальными глаголами и их лексическими эквивалентами: to be sure, be certain, be likely, be unlikely. Инфинитив при данных прилагательных выражает действие, относящееся к будущему. *She is certain to raise the question. – Она обязательно поднимет вопрос. He is unlikely to refuse. – Вряд ли он откажется.*
- В сочетании со связочными глаголами seem, appear, prove, turn out.
  The problem appears to be difficult. – По-видимому, проблема сложна.
  She proved to be smart. – Оказалось, что она умна.
  I seemed to have made a mistake. – Оказалось, что я совершил ошибку.
  The idea to use these results seemed wrong to me. – Мысль о том, чтобы воспользоваться этими результатами, казалась мне неправильной (мысль об использовании).
- В сочетании с глаголом to be и прилагательными, обозначающими различные условия совершения действия, направленного на подлежащее, или выражающими отношение лица к совершаемому им действию. Такими прилагательными являются: *easy, difficult, hard, ready, slow, glad, sorry, eager* и т.п.
  He is difficult to deal with. – С ним трудно иметь дело.
- А также в сочетании с числительными и прилагательными, обозначающими очередность:
  He was the first to agree. – Он первым согласился.

Exercise 5.1. State the function of the Infinitive.

1. Our aim *is to extend* the previous definition. 2. The purpose of our article *is to show* the development of this particular area of mathematics. 3.To do this *means to reduce* the fraction to its lowest terms. 4. The procedure *to be followed* depends entirely on the student. 5. There are some important properties of division *to be considered* at this lesson. 6. The method *to be applied* is rather complicated. 7. Students *are to study* the laws of mathematics and mechanics. 8. It *is to be* noted that the decimal point separates every three numbers. 9. Use is *to be* made of the information presented. 10. In working with numerals one *is to be* very careful with the signs.

Exercise 5.2. State the function of the Infinitive.

1. To find the truth is the aim of our discussion. 2. To know the truth you must make sure that you have considered every detail. 3. One has to know all the conditions to arrive at a certain conclusion. 3. To arrive at a certain conclusion was the aim of the discussion. 4. To adjust the new program to the existing machine is the purpose of this work. 5. To adjust the new program we shall have to do a great deal of work. 6. We must use braces or brackets so as to avoid misunderstanding. 7. The purpose of his questioning was to hear everybody's viewpoint. 8. My task has been to comment on the game. 9. The method to be described is rather convenient. 10. The tools to be used for this experiment should be very precise. 11. To belong to a group means to be a member of this particular group. 12. Similar situations will be described in the chapter to follow. 3. This collection of stamps must have belonged to one of them. 14. You may have played football when being a child. 15. You are to give your viewpoint on the subject.

Exercise 5.3. Translate the text into Russian, retell it.

Two young women were out walking in the country on a hot summer’s day when they saw a beautiful lake close to the road.

‘It’s so hot! Let’s go for a swim in that lake to cool down!’ suggested the first woman.

‘But we haven’t got any swimming things to put on,’ said the other,

‘ We can’t swim naked!’

‘Oh, don’t worry about that!’ reassured the first woman, ‘ There’s nobody here to see us.’

So they took off all their clothes and got into the lovely cool water for a swim.

After only a few minutes they noticed a farmer walking towards the lake carrying a large bucket.

‘Are you here to ask us to get out of the lake?’ the first woman asked.

‘I think he’s here to look at us!’ said the second woman.

The old farmer frowned and held up the bucket for them to see.

‘No, I’m not here to tell you to get out of the lake and I didn’t come here to watch you ladies swim naked.’ he replied. ‘I’m just here to feed the alligator.’ http://esljokes.net/elem8.html

Unit 6. Будущее время группы *Simple*в страдательном залоге

В предложениях, в которых сказуемое выражено в будущем времени, часто употребляются следующие словосочетания и наречия: tomorrow (завтра), the day after tomorrow (послезавтра), in two days (через два дня), soon (скоро).

Утвердительное предложение	Отрицательное предложение	Вопросительное предложение
I He She It **will be V3 / Ved** They We	I He She It **won`t be V3 / Ved** They We	she he **Will** I **be V3 / Ved ?** it they **Will** we **be V3 / Ved ?**

Exercise 6.1. Translate the sentences into Russian.

1. These changes will be programmed. 2. Their program will be changed. 3. When will the project be fulfilled? 4. The idea won`t be applied in this theory. 5. Will the result be checked?

Exercise 6.2. Rewrite the sentences in Passive Voice.

1. Jane will buy a new computer. 2. He will install it. 3. Millions of people will visit the museum. 4. Our boss will sign the contract. 5. You will not do it. 6. They will not show the new film. 7. He won't solve the problem. 8. They will not ask him. 9. Will the company employ a new worker? 10. Will the plumber repair the shower?

Unit 7. Герундий (The Gerund)

Герундий – это неличная форма глагола, обладающая признаками как глагола, так и существительного. Подобной формы в русском языке нет. По своему значению герундий приближается к русским существительным, обозначающим процесс (хождение, выяснение, обсуждение и т.п.)

1. **Герундий может выступать в роли подлежащего:**

Travelling is my hobby. Reading helps me to live.

2. **Герундий, как предложное дополнение**, может употребляться в следующих выражениях с предлогом: *to be tired of, to be fond of* и т. д.

He is fond of cooking. I am tired of talking about this all the time.

3. **Герундий, как обстоятельство**, может употребляться после таких слов, как: besides, before, by, after, without, instead of.

He called her without hesitating. Before going to Scotland, he thought twice.

Временные формы герундия

Форма причастия	Действительный залог	Страдательный залог
Indefinite	reading	being read
Perfect	having read	having been read

He likes telling stories. – Ему нравится рассказывать истории. He likes being told stories. – Ему нравится, когда ему рассказывают истории.

He accused them of having stolen the car. – Он обвинил их в воровстве машины. He is glad of having been told the story. – Он рад, что ему рассказали историю.

Формы герундия совпадают с формами причастия настоящего времени и перфектного причастия. Indefinite Gerund выражает действие, одновременное с действием глагола-сказуемого; Perfect Gerund выражает действие, которое предшествует действию, выраженному глаголом-сказуемым.

Do you mind my buying this? – Ты не против, если я куплю это?

He approved my entering the university. – Он одобрил, что я поступаю в университет.

She thanked for my having helped her son – Она поблагодарила меня за то, что я помог ее сыну.

He left without saying a word. – Он ушел, не сказав ни слова.

He didn't agree to my going there. – Он не согласился с тем, что я пойду туда.

Exercise 7.1. Note the use of the Gerund.

1. It is evident that there is no hope of our finding a proper solution to the problem at present. 2. We insisted on their following his usual procedure. 3. Without having improved on the properties of this material one cannot expect getting better results. 4. I knew nothing of their having completed the experiment. 5. This results in the product of two or more factors being equal to zero. 6. Besides being used as an everyday word the term "work" has a special meaning in mechanics. 7. I did not know anything about your science adviser having spoken at the international congress on mechanics.

Exercise 7.2. Define the functions of the Gerund.

1. Computers like the one pictured in this book are capable of solving systems with a hundred or more unknowns, if necessary. 2. They are concerned with applying their knowledge of the subject in solving these problems. 3. Drawing a correct conclusion is not easy. 4. Seeing, feeling or moving a point is impossible since a point has no dimensions. 5. Seeing a straight line we know n is a geometric figure.

Exercise 7.3. Read and translate the jokes into Russian.

- “What on earth do you mean by telling Mary that I am a fool?”
  “Heavens! I am sorry – was it a secret?”
- “Do you know the difference between the English, Scottish and Irish?”
  “No, what is it?”
  “Well, in leaving the train, an Irishman walks off without looking to see whether he has left anything behind$ an Englishman looks back to see whether he has left anything4 and a Scotsman looks back to see whether anybody has left anything.”
- Never tell a woman a secret. She will either think it is not worth keeping or it is too good to keep.
- “The man who is always punctual in keeping an appointment never loses anything by it.”
  “No, only about half an hour waiting for the other fellow to come.”

Unit 8. Сравнение форм причастия и герундия (The Gerund or The Participle I)

Оформленные одинаково с помощью суффикса -ing, причастие действительного залога и герундий различаются по своим функциям в предложении, поэтому, чтобы правильно перевести их на русский язык, необходимо знать их синтаксические функции. Как причастие, так и герундий могут выступать в функции определения и обстоятельства, но причастие в этих функциях употребляется без предлога, а герундий обязательно с предлогом Герундий управляется различными предлогами, и наличие предлога перед словом с суффиксом -ing часто помогает правильно определить, к какой категории относится эта грамматическая форма.

Синтаксические функции причастия и герундия

Член предложения	The Participle I	The Gerund
Подлежащее	Не употребляется	Working these parts as soon as possible is absolutely necessary.
Дополнение	Не употребляется	He remembers seeing that drawing. We knew of these parts having already been worked.
Часть простого сказуемого	He is working this part. He has been working since 12 o'clock.	Не употребляется
Часть составного глагольного сказуемого	Не употребляется	We began working these parts.
Часть составного именного сказуемого	Не употребляется	He is for working these parts as soon as possible.
Определение	The man working these parts is our best worker.	The method of working these parts is the most modern.
Обстоятельство	Working these parts he used the most modern methods of work. While working these parts he used the most modern methods of work.	By working these parts ahead of time he helped us greatly. On working these parts ahead of time we overfulfilled our plan.

http://en-grammar.ru/sravnenie-form-prichastiya-i-gerundiya.html

Exercise 8.1. Find the Gerund and the Participle I in the sentences.

1. The boys continued playing football. 2. He was looking at the plane flying overhead. 3. Watching the playing kittens was great fun for the children. 4. Being frightened by the dog, the cat climbed a high fence. 5. It is no use going there now. 6. Coming out of the wood, the travellers saw a ruined castle in the distance. 7. My greatest pleasure is travelling. 8. Growing tomatoes need a lot of sunshine. 9. Growing corn on his desert island, Robinson Crusoe hoped to eat bread one day. 10. Growing roses takes a lot of care and attention. 11. Just imagine his coming first in the race! 12. The children were tired of running.

Exercise 8.2. Translate the sentences into Russian.

1. Reading such books is necessary. 2. Reading such books we obtain a lot of knowledge. 3. Knowing these rules you will be able to solve any problem. 4. Knowing these rules will help you. 5. Finding a proper answer will make it possible. 6. Finding a proper answer they can sole the equation. 7. Speaking English during the lesson students will become professionals. 8. Speaking English well is rather difficult. 9. Bringing in this example they will be able to convince them that we are right. 10. By bringing in this example they can show how smart we are.

Unit 9. Настоящее время группы *Perfect* в действительном залоге

Present Perfect чаще всего употребляется ***в начале разговора*** или сообщения, когда возникает необходимость сообщить о каком-то новом событии. Так как это форма настоящего времени и всегда соотносится с моментом речи, то она ***не употребляется*** в тех случаях, когда есть обстоятельства, указывающие на время совершения действия ***в прошлом***.

Признаки этого времени следующие: already (уже), yet (в вопросе – уже, в отрицательных предложениях – еще) just (только гто), this week (на этой неделе), this month (в этом месяце), never (никогда), ever (когда-либо, когда-нибудь), recently (недавно), lately (недавно, за последнее время), since last year (с прошлого года), for a long time (долгое время), before (до), today (сегодня).

Утвердительное предложение	**Отрицательное предложение**	**Вопросительное предложение**
You I **have V3 / Ved** They	You I **haven`t V3 / Ved** They	you **Have** I **V3 / Ved?** they
She It **has V3 / Ved** He	She It **hasn`t V3 / Ved** He	he **Has** she **V3 / Ved?** it

Такие слова, как ***already, just, ever, never***, ставятся между ***have*** и ***смысловым глаголом.***

I have already done it. – Я уже это сделал.

Такие слова, как ***yet, this week, this month, recently, lately, last year, for along time, before, today,*** ставятся в конце предложения.

I have been to London this year. – Я был в Лондоне в этом году.
***Have** you ever **tried** a shark? – Ты когда-нибудь пробовал акулу?*

Exercise 9.1. Translate these sentences into English.
1. Вы уже прочитали эту книгу? Как она вам понравилась? 2. Я хотел посмотреть этот фильм на прошлой неделе, но смог посмотреть его только позавчера. 3. В этом году я не очень часто бывал в кино и в театре. 4. Ваш сын уже окончил институт? 5. Вы уже побывали в Мадриде? – Нет, я хочу поехать туда в июле. 6. Я только что встретил его. 7. Я никогда об этом не слышал. 8. Вы уже переехали на новую квартиру? 9. Саша еще не говорил мне об этом. 10. Вы сделали много ошибок в диктанте. 11. Вы когда-нибудь видели этого писателя? 12. В этом месяце я прочитал три книги. 13. Мой приятель уехал в Лос-Анджелес неделю назад и еще не звонил мне. 14. Я не видел своего брата в последнее время. 15. Вы читали сегодня в газете статью о нашем городе? 16. Вы были когда-нибудь в Лондоне? – Нет, я поеду туда в этом году.

Exercise 9.2. Make up a special question to each sentence.
1. My research adviser has found the second chapter of my work too long. (who) 2. The examiner has found the conclusion correct. (what) 3. They haven`t given a direct answer to my question recently. (what) 4. She has just determined to fulfill this plan. 4. The scientists have changed the order of the process. (how). 5. The worst has already happened. (why) 6. We have taken part in this research. (what for) 6. My sister has already translated text from English into Russia. (from what language).

Exercise 9.3. Translate the following joke.
A one-dollar bill met a twenty-dollar bill and said, “Hey, where’ve you been? I haven’t seen you around here much.”
The twenty answered, “I’ve been hanging out at the casinos, went on a cruise and did the rounds of the ship, back to the United States for a while, went to a couple of baseball games, to the mall, that kind of stuff. How about you?”
The one dollar bill said, “You know, same old stuff … church, church, church.

Unit 10. Latin Terms used in Mathematics

Mathematics is an ancient discipline, and consequently it has picked up a good deal of terminology over the years that is not commonly used in ordinary discourse. Phrases and terms from Latin make up a large part of this terminology, and reading mathematical texts – especially more advanced ones – is made easier if one is equipped with knowledge of these terms in advance.

We review below the Latin terms most commonly used in mathematics, and follow with a more extensive list of such terms and phrases as one may run into more rarely or in other contexts. The pronunciations given are not the “correct” Latin pronunciations, but instead reflect common usage in English speaking countries.

Note that when Latin or other non-English words are used in writing, they should be italicized except where they are abbreviated as single letters. E.g., “His next remark was a *non sequitur*.”

ad infinitum - Literally, “to infinity,” indicates that a process or operation is to be carried out endlessly.

a fortiori – With stronger reason.” If every multiple of two is even, then *a fortiori* every multiple of four is even.

ad hoc – For the immediate purpose. An *ad hoc* committee is appointed for some specific purpose, after completing which it is dissolved.

ad hominem – “To the man.” An argument is *ad hominem* when it attacks the opponent personally rather than addressing his arguments.

ad nauseam – Something continues *ad nauseam* when it goes on so long you become sick of it.

alma mater – Your *alma mater* is the university or college which granted your degree.

alumnus/alumna – An *alum*, as it is sometimes shortly said, is a former member/student of a university or college. (The ‘us’ ending is masculine, the ‘a’ ending feminine. The plurals are *alumni* and *alumnae*, respectively.)

anno domini – “In the year of Our Lord.” Indicates that a date is given in the western or Gregorian calendar, in which years are counted roughly from the birth of Christ.

a posteriori – “From effect to cause.” A thing is known *a posteriori* if it is known from evidence or empirical reasoning.

a priori – A thing is known *a priori* if it is evident by logic alone from what is already known.

bona fide – “In good faith.” One’s *bona fides* are documents or testimonials establishing one’s credentials or honesty.

carpe diem – “Seize the day.” A motto which says to live in the now, and/or to not waste time or opportUnity.

exempli gratia – “For example.” Usually abbreviated to ‘e.g.’ and often confused with ‘i.e.’ Example: “Many real numbers cannot be expressed as a ratio of integers, e.g., the square root of two.”

circa – Approximately. Used with dates, e.g., Euclid wrote the *Elements circa* 300 bce.

confer – “Compare.” Usually abbreviated cf. and often used in footnotes, this indicates that one should compare the present passage or statement with the one referred to.

cum laude – “With praise.” Used on degree certificates to indicate exceptional academic standing.

de facto – “In reality.” Used to indicate that, whatever may be believed or legislated, the reality is as indicated here. E.g., she’s the *de facto* leader of the union.

dixi – That settles it. Literally, “I have spoken.”

emeritus – (feminine: *emerita*) Indicates someone who has served out his or her time and retired honorably. E.g., she is now professor *emerita*.

erratum/errata – Literally, “error/errors,” this term in fact refers to the corrections included in a paper or book after it is published to correct minor errors in the text.

et al. – Abbreviation of *et alia*, meaning “and others.” Used to indicate an unstated list of contributing authors following the main one, for instance.

et cetera – And so forth. Note the pronunciation – there is no “eks” sound.

ibidem – “In the same place.” Used in footnotes to indicate that the reference is the same as the preceding one(s).

in re – “In regards to.” Often used to head formal correspondence. When only *re* is written, it should be translated as “regarding.”

in vacuo – Literally, “in a vacuum.” Should be taken to mean “in the absence of other conditions or influences.” E.g., nobody achieves maturity *in vacuo*.

id est – Literally, “that is.” Usually abbreviated ‘i.e.’ and often confused with ‘e.g.’ Example: “She won the race, i.e., she crossed the finish line first.” The decision whether to use ‘i.e.,’ or ‘e.g.’ should be based on whether “that is” or “for example” is what is wanted in the sentence.

ipso facto – Literally, “by that very fact.” Example: “Lie group representations are useful in characterizing quantum mechanical phenomena, and they are *ipso facto* an important part of a physicist’s mathematical training.”

modus operandi – Manner or method of work characterizing a particular person's professional habits.
mutatis mutandis – With necessary changes. "*Mutatis mutandis,* this proof applies in more general cases."
non sequitur – "Not following." Used to indicate a statement or conclusion that does not follow from what has gone before.
nota bene – Literally, "note well." Usually abbreviated 'n.b.', this is a way of saying, "take note of this."
per se – "In and of itself." Example: "This argument does not force the conclusion *per se*, but with this added premise the result would follow."
post hoc, ergo propter hoc – "After, therefore because of." A common fallacy in reasoning, in which causality is ascribed to preceding conditions which were in fact irrelevant to the supposed effect.
post scriptum – "Written after." Indicates an afterword or footnote to a main text, and is often used in written correspondence **prima facie –** "On its face." Indicates that a conclusion is indicated (but not necessarily proved) from the appearance of things.
pro forma – "For form's sake." E.g., "It was a *pro forma* interview – the decision to hire her had already been made."
per impossibile – "As is impossible." Qualifies a proposition that cannot be true.
quod erat demonstrandum – "That which was to have been proved." Traditionally placed at the end of proofs, the QED is now usually indicated by a small square. A few students have clung to use of the traditional letters, in the hope they might be interpreted as "quite elegantly done."
qua– "In the capacity of." For example, "He is really very personable, but *qua* chairman he can be direct and even gruff."
quod erat faciendum – "That which was to have been shown." Abbreviated QEF, it was traditionally used to mark the end of a solution or calculation. It is rarely used now. (Impress your professor by putting it at the end of exam problems.)
quod vide –Usually abbreviated q.v., this is a scholarly way of directing the reader to a reference.
sine qua non – "That without which nothing." Indicates an essential element or condition.

tabula rasa – "Blank Slate." Often refers to a person who has not yet formed prejudices or preconceptions on a given matter.
verbatim – Word-for-word. Indicates a precise transmission of a phrase, discussion, or text.
videlicet – Usually abbreviated viz., this is translated as "namely." For example, "The math club picked a new president, viz., Carl."
http://www.mathacademy.com/pr/prime/articles/latin/

Unit 11. Прошедшее время группы *Simple* в страдательном залоге

В предложениях, в которых сказуемое выражено во времени Past Simple Passive, часто употребляются следующие словосочетания и наречия: yesterday (вчера), the day before yesterday (позавчера) last month (в прошлом месяце), last week (на прошлой неделе), long ago (давно), a minute ago (минуту назад).

Утвердительное предложение	**Отрицательное предложение**	**Вопросительное предложение**
I He She **was V3 / Ved** It They We **were V3 / Ved** You	She He I **wasn`t V3 / Ved** It They We **weren`t V3 / Ved** You	she he **Was** I **V3 / Ved ?** it they **Were** we **V3 / Ved ?** you

Exercise 11.1. Translate the following sentences.
1. The questions were studied. 2. I was questioned in English. 3. This data were recorded by the computer. 4. These changes weren`t programmed. 5. Was their program changed? 6. Various combinations were used in processing the data. 7. The same method wasn`t used by them. 8. The work planned was done in time. 11. This idea was developed by him.

Exercise 11.2. Put the verbs in brackets into the correct passive or active form.

Erich Remarque once (to introduce) to an American girl who (to travel) in Germany. She (to delight) to meet him because she (to read) all his books which (to translate) into English. Then she (to ask) why Remarque never (to visit) the U.S. His answer (to be), "English (to speak) in the U.S. but unfortunately I (not to speak) it. in fact I (to know) only four sentences." The girl (to ask). "What they (to be)?" The writer (to say), "Hello! I love you. Forgive me. Ham and eggs, please." – "Why," (to cry) the girl, "with these sentences a long tour can (to take) from Maine to California".

Exercise 11.3. Translate the text into Russian and retell it.

Alfred Briggs was a prisoner in a high security jail, serving a thirty year sentence. In his youth he had been famous for robbing jewellery stores all over the country. Even after he was arrested, tried and sentenced, Alfred had kept his secrets and no one had ever discovered where the jewels were hidden. He was married and his wife, Sally, sent him regular letters about everyday problems at home. Alfred knew for a fact that his letters were opened and read by the authorities, but still he enjoyed receiving the news from home.

One day Alfred was given a letter from his wife. He opened it and read, 'Dear Alfred, I've decided to plant some potatoes in the back garden near to the white fence. When do you think is the best time for potatoes to be planted?'

Alfred wrote this in reply, 'Dear Sally, You can plant potatoes in two or three weeks' time, but whatever you do, don't plant them in the back garden. This is very important! Please don't plant them there!'

A week later, Alfred was given another letter from his wife. 'Dear Alfred, You won't believe this! Last week ten policemen arrived at the house and dug up all of the back garden.'

Alfred wrote back, ' Dear Sally, Now is the best time to plant potatoes.'

http://www.esljokes.net/int4.html

Unit 12. Модальные глаголы *should, might* и эквивалент *be able to*

Should – следует

Модальный глагол ***should*** выражает совет и рекомендацию.

We *should* buy some more bread.

He ***should*** sleep more. – Ему следует больше спать.

Should he sleep more? – Ему следует больше спать?

He ***shouldn`t*** sleep more. – Ему не следует больше спать.

Модальный глагол **should** также может выражать удивление и возмущение.

Why *should* do it? – С какой стати я должен делать это? How ***should*** I know? – Откуда мне знать?

Exercise 12.1. Make up positive, negative sentences and question to each sentence.

1. Scientists should develop this important branch of mathematics. 2. You should think about what you are saying. 3. He should not go there so late. 4. Should we accept everything you say without proof?

Exercise 12.2. Translate the sentences into English.

1. Вам не следует так сильно волноваться. 2. Тебе не следует так много работать. 3. Нам следует ему все рассказывать. 4. Ему следует больше заниматься. 5. Тебе не следует пить так много кофе. 6. Тебе следует помочь брату. 7. Тебе не следует забывать о своем обещании. Вам нужно рассказать нам правду. 9. Нам следует ложиться спать раньше. 10. Детям следует пить больше пока. 11. С какой стати она должна помогать тебе? 11. Она не могла там больше (any longer) оставаться, нужно было идти на работу. 12. Нам нельзя курить здесь. 13. Тебе нельзя есть так много груш. У тебя будет болеть живот. 14. Что он мог сделать?

Exercise 12.3. Read and translate the following joke into Russain.

"I'm in love with two girls. One is very beautiful but has no money, the other is ugly and has lots of money. Who should I marry?"

" Well, I'm sure that you must really love the beautiful one, so I think you should marry her."

"OK, thank you very much for your advice."
"Don't mention it. By the way, I wonder if you could give me the name and telephone number of the other girl?"

MIGHT

1. Используется для просьбы о разрешении в официальном стиле: *Might I make a suggestion? You might not do it.*
2. Степень уверенности выражается модальными глаголами: +++ may, ++ might, + could. *He might come.*
3. *Might* употребляется как прошедшее время от *may* только при согласовании времен: Jack said he *might* help us. Everybody hoped the situation *might* change.

Exercise 12.4. Translate the sentences into Russian.
1. He said that we might go there. 2. They said that they might come tonight. 3. They might have solved the problem. 4. We might try to find the data. 5. She might have noted that. 6. He might give them the best places. 7. We might as well wait for an explanation.

Эквивалент модального глагола Can – To Be Able

Present	Past	Future
I **am able to V**. She he **is able to V**. They **are able to V**.	I **was able to V**. She **was able to V**. They we **were able to V.**	I She **will be able** to **V**. You We
I am **not** able to V. She **isn`t** able to V. They **aren`t** able to **V**.	I **wasn`t able to V**. She **wasn`t able to V**. They We **weren`t able to V.**	She I **won`t be able** to **V**. You We
Am I **able** to **V**? **Is** she **able** to **V**? **Are** they **able** to **V**?	**Was** I **able to V**? **Was** she **able to V**? they **Were** we **able to V?**	she **Will** I **be able** to **V?** you we

Эквиваленты не заменяют модальные глаголы, они являются наиболее сходными по смыслу, так как некоторые модальные

глаголы сами не могут образовывать будущее или прошедшее время, например: *I will **be able to** come to see you tonight.*

Exercise 12.4. Make up positive, negative sentences and question to each sentence.
1. We are able to find the necessary data. 2. He was able to give only a general definition. 3. Will we be able to consider the advantages of the method developed? 4. Was he able to find the difference? 5. She is not able to give the definition of closure. 6. They will not be able to check the result.

Exercise 12.5. Translate the sentences into English.
1. Никто не может сказать мне, почему она не пришла. 2. Вы видите тот дом на углу? 3. Мой английский не очень хороший, но мне удалось понять его. 4. Я не думаю, что он сможет поднять эту коробку. 5. Кто может разбить это стекло? 6. Она не может понять, что ты имеешь в виду. 7. Думаете, я смогу сам написать письмо на китайском? 8. Он может встретить нас в аэропорту. 9. Он сам может приготовить ужин. 10. Мы можем пойти в кино прямо сейчас. 11. Он сам может помыть посуду. 12. Не могли бы вы мне сказать, где рынок? 13. Они не могли найти дорогу из города. 14. Он может обмануть (deceive) вас. 15. Мы сможем построить дом за один год. 16. Мы могли сделать эту работу вчера.

Unit 13. Косвенная речь (Reported Speech)

При трансформации предложений из прямой речи в косвенную речь происходит изменение глагольных форм в соответствии с правилом согласования времён:

Прямая речь	Косвенная речь
He said, "I always **work** ".	He said (that) he always **worked**.
He said, "I **am working** at 1 p.m.	He said (that) he **was working** hard at 1 p.m.
He said, "I **have** just **done** it.	He said (that) he **had** just **done** it
He said, "I **worked** a day ago.	He said he **had worked** a day ago.

He said, "I **am going to work**.	He said (that) he **was going to work**.
He said, "I **will work** in a day.	He said (that) he **would work** in a day.
He said, "I **can work** hard.	He said (that) he **could work** hard.
He said, "I **may work** hard.	He said (that) he **might work** hard.
He said, "I **have to work** hard.	He said (that) he **had to work** hard.
He said, "I **must work** hard.	He said (that) he **must work** hard.
He said, "I **should work** hard.	He said (that) he **should work** hard.
He said, "I **ought to work** hard.	He said (that) he **ought to work** hard.
"What **did** Mary **say**?" I asked.	I asked what Mary had **said**.
"**Is** it raining now?" he asked.	He asked if it **was** raining then.
"**Do** you understand me?" she asked.	She asked if I **understood** her.
"**Will** you go to the cinema?" she asked	She asked if I **would** go to the cinema.
"**Did** you **call** him?" she asked.	She asked if I **had called** him.
I asked, "Who **buys** all these books?"	I wondered who **bought** all these books.
Joe said, "Please come to my party."	Joe invited me to come to his party.
I said, "Bobby, don't pull the cat's tail."	I ordered Bobby not to pull the cat's tail.
yesterday	the day before, the previous day,
today	that day, the same day
tomorrow	the day after, the following day
the day before yesterday	two days before
now	then
this	that

Exercise 13.1. Make up the sentences in reported speech.
1. She said, "I like to play tennis." 2. Sally said, "I don't like chocolate." 3. Margaret said, "I am planning a trip to the South." 4. Tom said, "I have already eaten lunch." 5. Kate said, "I called my doctor." 6. Mr. Ford said, "I'm going to fly to Chicago." 7. The speaker said, "I will come to the meeting." 8. Jane said, "I can't afford to buy a new TV-set." 9. The teacher said, "Now, children, you may go home." 10.

Ted said, "I have to finish my report." 11. Mr. Durrell said, "I must talk to the director." 12. Alison said, "I should call my parents."

Exercise 13.2. Make the reported sentences.
Образец:

Joe said, "Please come to my party."	Joe invited me to come to his party.
I said, "Bobby, don't pull the cat's tail."	I ordered Bobby not to pull the cat's tail.

1. My teacher said, "You should be more punctual." (advise) 2. My neighbour said, "You may use the phone." (allow) 3. The doctor said, "Take a deep breath." (tell the patient) 4. My mother said, "Make an appointment with the dentist." (remind) 5. The Smiths said, "Would you like to join us for dinner?" (invite) 6. The judge said, "You must pay a fine." (order) 7. Nick said, "Don't touch that hot pot!" (warn) 8. My agent said, "Don't buy a used car." (advise) 9. Mr. Harte said, "Tom, could you please open the door for me?" (ask) 10. The police officer said, "Put your hands on top of your head!" (order the thief)

Unit 14. Настоящее время группы *Perfect* в страдательном залоге

Утвердительное предложение	**Отрицательное предложение**	**Вопросительное предложение**
You I **have been V3 / Ved** They	You I **haven`t been V3 / Ved** They	you **Have** I **been V3 / Ved?** they
She It **has been V3 / Ved** He	She It **hasn`t been V3 / Ved** He	he **Has** it **been V3 / Ved?** she

Если то, над чем совершали действие нам важнее, интереснее, то используем страдательный залог. А может мы даже не знаем, кто совершил действие, или же не хотим об этом упоминать: The letter has been sent this morning.

Exercise 14.1. Make up question to each sentence.

1. Each step of the process has been carefully studied. (what) 2. The general pattern has been observed. (in what way) 3. The comma and the point have been properly placed. (what) 4. The new procedure has already been introduced. (by whom) 5. All the points have been placed on the left and on the right of the straight line. (where) 6. The necessary information has just been obtained. (what kind of) 7. The whole material has already been repeated by the students. (how) 8. All the digits have been aligned, as appropriate. (what) 9. We have been trying to obtain the diagram since Monday. (who) 10. The scientists have been studying the situation for a whole-week. (why) 11. He has been carefully observing the procedure for a long time. (for how long) 12. The new system has been tested recently.

Exercise 14.2. Compare these sentences.

Действительный залог	Страдательный залог
He has defined the relation.	The relation has just been defined.
We have accepted the axiom.	The axiom has been accepted.
We have already tried all the possible ways.	All the possible ways have already been tried.
She has changed the order.	The order has been changed.
Have they found the answers to these questions?	Have the answers to these questions been found?
Has she checked the result?	Has the result been checked?
Have you reduced the fractions?	Have these tractions been reduced?
We have not yet studied the second chapter?	The second chapter has not yet been studied.
They have not found the size of the given part yet.	The size of the given part has not yet been found.

Unit 15. Причастие страдательного залога (Participle II)

Причастие страдательного залога выражает состояние или качество предмета, явившиеся результатом воздействия на предмет извне (frightened woman напуганная женщина; broken window разбитое окно). Причастие II имеет только одну форму, которая является третьей основной формой глагола. Например, **gone, stood, sent, written.**

Participle II выполняет функцию: 1) определения, 2) обстоятельства.

Participle II в функции определения:

The *proposed* program caused much discussion. – *Предложенная* программа вызвала много споров.

The law just *referred* to was discovered by Newton. – Закон, *на который* только что *сослались,* был открыт Ньютоном.

They demonstrated the *reconstructed* machines. – Они демонстрировали *реконструированные* машины.

The information *obtained* was of great interest. – *Полученная* информация представляла большой интерес.

Participle II в функции обстоятельства:

Translated from the language of mathematics into everyday language the relation became easier to understand. – *Будучи переведенным* с языка математики на обычный язык, это соотношение стало легче для понимания. (Когда это соотношение перевели с …)

As seen from the article this kind of experiments are being carried out in quite a few laboratories. – Как видно из статьи, такого рода эксперименты проводятся во многих лабораториях.

When (if) given enough time he will write his paper. – *Если ему дадут* достаточно времени, он напишет свою статью.

Unless properly *adjusted* the computer will not give out reliallowed information. – Если вычислительную машину не *отрегулировать* должным образом, она не будет давать надежных результатов.

I *was told* about the advantages of the method accepted. – Мне *говорили* о преимуществах принятого метода.

Participle II обозначает действие, предшествующее действию, выраженному глаголом-сказуемым. Perfect Participle – *having given, having been given* выполняют функцию обстоятельства

Having read the book I returned it to the library. *Прочитав* книгу, я вернул её в библиотеку.

Having answered the teacher's questions the student left. – *Ответив* на вопросы преподавателя, студент ушел. (*После того, как он ответил ...)*

Having been given the program we began to analyse it. – *После того, как нам дали* программу, мы начали изучать ее.

Exercise 15.1. State the functions of the Participle II.
1. We have defined these sets as being equal. 2. Let us try dividing these numerals. 3. It is no use performing this operation now. 4. Having reduced the fraction we obtained the expected result. 5. The entire situation is being slightly changed. 6. We know of heir having succeeded in finding an appropriate explanation. 7. When working with these signs one must be very careful. 8. On obtaining the difference one must check the result by addition to make sure it is correct. 9. Being reduced to its lowest terms the fraction is not changed. 10. Reducing the fraction to its lowest terms 'eaves it unchanged.

Exercise 15.2. Translate the sentences into English.
1. The work done by this research team is of great importance. 2. The experiment made by the scientist proved a failure. 3. They discussed some involved problems. 4. The program corrected may be of some interest. 5. A carefully planned work gives good results. 6. Books illustrated by the painter are very popular. 7. The report presented by the laboratory is not of any importance. 8. The information obtained recently is of no use. 9. The data received is of no interest. 10. I don‘t like broken mirrors.

Exercise 15.2. Read the story and retell it in English.
Alarm-clocks are pleasant to look at, but they extremely rare, if ever, wake you up at a proper time. Once a man came to a lawyer with a demand to charge a plant, producing these alarm-clocks the fare of the flight from new York to Texas. Hearing the demand the lawyer

couldn`t help being surprised. It took the man demanding his money several minutes to explain what the matter was. The alarm-clock hadn`t rung and the man sleeping soundly missed the plane. The lawyer didn`t consider the explanation given reliable enough and decided to make an experiment. He went to a shop selling these alarm-clocks. They put four clocks to ring at seven o`clock. In the morning it turned out that two of them had stopped long before the required time. One of the tested alarm-clocks didn`t ring at all. And the last rang at 9. The data received made it possible for a man to get his money back.

Unit 16. Настоящее время группы *Continuous* в страдательном залоге

The Present Continuous в страдательном залоге может выражать:
1. Действие, происходящее в момент речи. *The kids are being watched now.*
2. Действие, охватывающее некоторый период времени в настоящем. *This problem is being solved from 3 p.m. to 5 p.m.*

Утвердительное предложение	Отрицательное предложение	Вопросительное предложение
I **am being V3 / Ved** He She **is being V3 / Ved** It They We **are being V3 / Ved**	I **am not being V3 / Ved** He She **isn`t being V3 / Ved** They We **aren`t being V3 / Ved** You	**Am** I **being V3 / Ved** ? he **Is** she **being V3 / Ved** ? they **Are** we being V3 / Ved? you

Exercise 16. 1. Translate the sentences into Russian.
1. All the necessary information is being sent to them. 2. The book is still being published. 3. This statement is not being mentioned. 4. Some symbol are being used instead of these words. 5. Is the same method is being used now? 6. You are being made fun of. 7. Why is he being laughed at now?

Exercise 16. 1. Translate the sentences into English.
1. Он решал уравнение сегодня с 15.00 и до 17.00. 2. Тихо! Не шумите! Она сейчас проходит интервью. 3. Радио «Европа-плюс» слушают во всей России. 4. Результаты экзаменов будут объявлены завтра утром. 5. Не прикасайся к забору. Его ещё не покрасили. 6. Она все ещё не решила эту задачу? 7. Сегодня с 10 утра и до 12 они слушают лекцию по дифференциальным уравнениям.

Unit 17. Модальный глагол *must* и эквивалент *to have to*
Must – должен

Модальный глагол **must** может выражать необходимость что-либо сделать, т.е. приказ, используется в законах, предписаниях; также он выражает предположение.

Проанализируйте образование вопросительных и отрицательных предложений:

*He **must** go. – Он должен идти. **Must** he go? – Он должен идти? He **must not go. – He mustn't** go. – Он не должен идти.*

*People **must** not cross the border without passports. – Люди не должны пересекать границу без паспортов.*

*You **must** do it right now. – Вы должны сделать это прямо сейчас. He **must** be at home now. – Он, должно быть, сейчас дома.*

Exercise 17.1. **Translate the sentences into English.**
1. Вы должны выучить эти слова. 2. Должно быть, трудно говорить на японском. 3. Не звони ему, он, должно быть, занят. 4. Я должен пойти к нему. 5. Она должна сделать это сегодня. 6. Мы должны быть на вокзале в семь часов. 7. Вы не должны опаздывать. 8. Кто должен это делать? 9. Должны ли мы ходить на работу каждый день? 10. Ты не должен делать это, если не хочешь.

Эквивалент модального глагола must – have to
To have to – придётся, должен (по обстоятельствам)

Проанализируйте образование вопросительного и отрицательного предложения:

He ***has to*** get up early every morning. – Ему приходится вставать

рано каждое утро.

Does* he *have to get up early every morning? – Ему приходится вставать рано каждое утро?

He ***does not have to*** get up early every morning. – Ему де приходится вставать рано каждое утро.

He ***has to*** do this work. – Ему приходится делать эту работу. **He *will have to*** do this work. – Ему придется делать работу. He ***had to*** do this work. – Ему пришлось делать эту работу.

	Утвердительное предложение	Отрицательное предложение	Вопросительное предложение
Present	You I **have to V.** they She He **has to V**.	You I **don`t have to V**. they She It **doesn`t have to V**	they **Do** you **have to V**? we **Does** she **have to V**? he
Past	I She **had to V.** We They	She I **didn`t have to V**. We They	she I **Did** we **have to V**? they
Future	She I **will have to V.** We They	She I **won`t have to V** We They	she we **Will** I **have to V**? they

Exercise 17.2. Make up positive, negative sentences and question to each sentence.
1. She will not have to answer all the questions. 2. She had to agree with him. (why) 3. She has to summarize the results. (when) 4. Regardless of what he thinks he has to agree. (why) 5. Everybody without exception has to write the translation at home. (why)

Exercise 17.3. **Translate the sentences into Russian.**
1. She has to present her paper today. 2. They will have to use the binary system of notation. 3. He had to prove his statement. 4. Did you have to accept their plan? 5. Does she have to deal with that subject? 6. Will you have to check division by multiplication? 7. He

doesn`t have to produce this information. 8. She won`t have to answer all the questions.

Exercise 17.4. **Translate the text into Russian and retell it.**

In a village in the mountains, a little old man with a beard and a young girl set up a stall in the market place one day, selling bottles of homemade medicine, labelled 'The Elixir of Life'.

'Come on, everyone!' the old man called out. 'Don't miss your chance to beat ageing. This is your opportunity to buy Archie's miracle medicine. It's the only medicine that cures old age. You only have to look at me to see the proof. I'm two hundred and five years old.'

A crowd quickly gathered around the market stall, and the old man and the girl were kept busy handing out the bottle of medicine and taking the money.

There were two younger men in the crowd, and one of them said to the other, 'You don't really think he's genuine, do you?'

'I don't know. He might be telling the truth. He's got an honest face.'

'You've got to be kidding! said the man. 'He must be lying. It has to be a trick.'

'Well, why not ask his assistant, then, if you don't believe it?' suggested his friend. So the man approached the girl and asked. 'He can't really be that old, can he? That's completely ridiculous. Tell me the truth, is he really two hundred and five years old?'

'I'm sorry, sir, but I can't really say.' the girl replied, 'I've only been working for him for the past seventy five years.'

http://www.esljokes.net/ui6.html

Unit 18. Сослагательное наклонение (Conditionals)

Сослагательное наклонение – это система глагольных форм, которые употребляются в сообщениях о фактах не реальных, а лишь мысленно допускаемых, воображаемых.

В английском есть несколько типов условных предложений.

Наиболее важно освоить три из них.

1. Реальная возможность наступления события в будущем.

Условие стоит в настоящем времени (простом или завершённом в зависимости от смысла условия), а само ожидаемое событие – в будущем.

If I see him tonight I will tell him the truth. – Если я увижу его сегодня, то скажу ему правду.

As soon as you are ready, we'll depart. – Как только ты будешь готов, мы отправимся.

Для начала обратим внимания на наречия, которыми обозначается условная часть предложения. В первую очереди это, конечно, if ("если"). Не стоит забывать и про удобное слово, не имеющее русского аналога – unless ("если не"). Применительно к первому из случаев, рассмотренных ниже, могут использоваться наречия when ("когда"), as soon as ("как только"), before ("до того как"), after ("после того как"), until ("пока не"), as long as ("до тех пор пока").

2. Условие наступления события, которого, скорее всего, не произойдёт.

В отличие от предыдущих случаев, которые соответствуют русскому "если", условия этого типа переводятся как "если бы". Условие стоит в прошедшем времени, а ожидаемое событие употребляется с вспомогательным глаголом would.

He would not help me if I asked him. – Он не помог бы мне, если бы я его попросил.

Вместо would могут употребляться глаголы might или could в значении "возможно был бы" и "смог бы" соответственно.

Стоит обратить внимание на конструкцию If I were you, где вместо was используется слово were:

If I were you, I wouldn't go there. – На твоём месте я бы не пошёл туда.

3. Условие наступления события, которое уже точно не наступило.

И условие, и событие имеют прошедшее завершённое время, только событие употребляется с тем же вспомогательным глаголом would.

If I had known that you were in Moscow I would have called you. – Если бы я знал, что ты был в Москве, я бы тебе позвонил.

Exercise 18.1. Translate these sentences into Russian.

1. If it were not for this particular advantage, the new system would hardly be accepted. 2. But for the assistance of this group of scientists no decision would have been reached on the problem under consideration. 3. Provided one knows the length of two sides of a triangle and the measure of the angle between them one can readily find the length of the third side. 4. Could I speak to him now I should give him my point of view concerning their suggestion? 5. Unless otherwise stated, the values used are taken in the decimal system. 6. Were there no computers we would not be able to do a lot of things we are capable of doing today. 7. If it had not been for their unlimited assistance the program of research would not have been realized. 8. No matter how hard you tried you would not be able to find the required magnitude without making use of logarithms.

Exercise 18.2. Define if the sentences express present, future or past situations. Translate them into Russian.

1. It would be a good idea if a few more facts were used for illustrating this point of view. 2. His paper would have been read at the conference had it been sent in due time. 3. I would not take part in the discussion unless I had a definite idea on the subject. 4. It would be helpful if more detailed information were obtained. 5. It was evident that even if we went on for-ever with our discussion we would not reach any agreement. 6. If we assumed the geometric mean of two numbers to be the square root of their product what would the geometric mean between 2 and 8 be? 7. If we considered the third example we would see that the magnitude of the common ratio was less than 1. One could go on with the computation provided it made sense. 8. Had he not been so much interested in mathematics he would have become a musician. 9. The experiment would have given more reliable results provided it had been prepared with greater care. 10. I would try to prevent them from reaching this conclusion on the question under consideration if I were you.

Exercise 18.2. Translate the texts and retell them in English.

A rich farmer had a friend who was a gardener and grew very good apples. One day the farmer came to his friend and said: "What wonderful apples you have here!"

"If you like I will give you one of my apple-trees," said the friend. He selected a fine young tree, gave it to the farmer and said, "If you take it home and plant it at once, you will have very good apples."

The farmer thanked his friend and took the tree home. But when he came home, he did not know where to plant it. If he planted it near the road, passers-by would steal the apples. If he planted it in one of his fields, his neighbours might come at night and steal the apples. If he planted it near his house, his own children might steal the fruit. Finally he planted the tree deep in the forest where no one could see it. Naturally the young tree could not grow without sunlight and soon died.

When the gardener learned about this, he said that if he had known what the farmer would do to the tree, he would never have given it to him.

"What could I do?" answered the farmer. "If I had planted the tree near the road, passers-by would have stolen the apples. If I had planted it in one of my fields, my neighbours would have come and stolen the fruit. If I had planted it near my house, my own children would have stolen the apples."

"Oh," said the gardener, "if I had known how greedy you were, I'd never have given you the tree."

Jokes

- "Don't you think I sing with feeling?"

"No, if you had any, you wouldn't sing."

- A rich man was talking to a friend, and asked him for advice. "I'm sixty years old," he said, "and I hope to get married to a young lady very shortly. Do you think I should tell her that I'm fifty?" "Well, if I were you, old man," replied the other, "I wouldn't do that. I think your chances of getting her would be a lot better if you told her you were seventy-five."

• An American lady traveling in England got into a compartment of a smoking-carriage where an Englishman was smoking a pipe. For a while she sat quietly expecting that the man would stop smoking. Then she began to cough (кашлять) and sneeze (чихать) trying to show him that she was displeased. At last seeing that the man took no notice of her and did not put out his pipe, she said, “If you were a gentleman, you’d have stopped smoking when a lady got into the carriage.”
“If you were a lady,” replied the Englishman “you wouldn’t have got into a smoking-carriage.”
“If you were my husband ” said the American lady angrily, “I’d give you poison.”
The Englishman looked at her for a moment or two.
“Well,” he said at last, “if I were your husband, I’d take it.”

APPENDIX A: MATHEMATICAL SYMBOLS

A.1. Basic Math Symbols

Symbol	Symbol Name	Meaning	Example
=	equals sign	equality	5 = 2+3
≠	not equal sign	inequality	5 ≠ 4
>	strict inequality	greater than	5 > 4
<	strict inequality	less than	4 < 5
≥	inequality	greater than or equal to	5 ≥ 4
≤	inequality	less than or equal to	4 ≤ 5
( )	parentheses	calculate expression inside first	2 × (3+5) = 16
[ ]	brackets	calculate expression inside first	[(1+2)*(1+5)] = 18

Symbol	Symbol Name	Meaning	Example
+	plus sign	addition	1 + 1 = 2
−	minus sign	subtraction	2 − 1 = 1
±	plus - minus	both plus and minus operations	3 ± 5 = 8 and -2
∓	minus - plus	both minus and plus operations	3 ∓ 5 = -2 and 8
*	asterisk	multiplication	2 * 3 = 6
×	times sign	multiplication	2 × 3 = 6
·	multiplication dot	multiplication	2 · 3 = 6
÷	division sign / obelus	division	6 ÷ 2 = 3
/	division slash	division	6 / 2 = 3
–	horizontal line	division / fraction	$\frac{6}{2} = 3$
mod	modulo	remainder calculation	7 mod 2 = 1
.	period	decimal point, decimal separator	2.56 = 2+56/100
a^b	power	exponent	$2^3 = 8$
a^b	caret	exponent	2 ^ 3 = 8
$\sqrt{a}$	square root	$\sqrt{a} \cdot \sqrt{a} = a$	$\sqrt{9} = \pm 3$
$^3\sqrt{a}$	cube root		$^3\sqrt{8} = 2$
$^4\sqrt{a}$	forth root		$^4\sqrt{16} = \pm 2$
$^n\sqrt{a}$	n-th root (radical)		for n=3, $^n\sqrt{8} = 2$
%	percent	1% = 1/100	10% × 30 = 3
‰	per-mille	1‰ = 1/1000 = 0.1%	10‰ × 30 = 0.3

Symbol	Symbol Name	Meaning	Example
ppm	per-million	1ppm = 1/1000000	10ppm × 30 = 0.0003
ppb	per-billion	1ppb = 1/1000000000	10ppb × 30 = 3×10^{-7}
ppt	per-trillion	1ppb = 10^{-12}	10ppb × 30 = 3×10^{-10}

A.2. Algebra Symbols

Symbol	Symbol Name	Meaning / definition	Example
x	x variable	unknown value to find	when $2x = 4$, then $x = 2$
≡	equivalence	identical to	
≜	equal by definition	equal by definition	
:=	equal by definition	equal by definition	
~	approximately equal	weak approximation	11 ~ 10
≈	approximately equal	approximation	$sin(0.01) \approx 0.01$
∝	proportional to	proportional to	$f(x) \propto g(x)$
∞	lemniscate	infinity symbol	
≪	much less than	much less than	1 ≪ 1000000
≫	much greater than	much greater than	1000000 ≫ 1
( )	parentheses	calculate expression inside first	2 * (3+5) = 16
[ ]	brackets	calculate expression inside first	[(1+2)*(1+5)] = 18

Symbol	Symbol Name	Meaning / definition	Example
{ }	braces	set	
$\lfloor x \rfloor$	floor brackets	rounds number to lower integer	$\lfloor 4.3 \rfloor$4??
$\lceil x \rceil$	ceiling brackets	rounds number to upper integer	$\lceil 4.3 \rceil$5??
$x!$	exclamation mark	factorial	4! = 1*2*3*4 = 24
$\| x \|$	single vertical bar	absolute value	$\| -5 \| = 5$
$f(x)$	function of x	maps values of x to f(x)	$f(x) = 3x+5$
$(f \circ g)$	function composition	$(f \circ g)(x) = f(g(x))$	$f(x)=3x$, $g(x)=x-1 \Rightarrow (f \circ g)(x)=3(x-1)$
(a, b)	open interval	$(a, b) = \{x \mid a < x < b\}$	$x \in (2,6)$
$[a,b]$	closed interval	$[a, b] = \{x \mid a \le x \le b\}$	$x \in [2,6]$
Δ	delta	change / difference	$\Delta t = t_1 - t_0$
Δ	discriminant	$\Delta = b^2 - 4ac$	
∑	sigma	summation - sum of all values in range of series	$\sum x_i = x_1+x_2+...+x_n$
∑∑	sigma	double summation	$\sum_{j=1}^{2}\sum_{i=1}^{8} x_{i,j} = \sum_{i=1}^{8} x_{i,1} + \sum_{i=1}^{8} x_{i,2}$
∏	capital pi	product - product of all values in range of series	$\prod x_i = x_1 \cdot x_2 \cdot ... \cdot x_n$
e	e constant / Euler's number	$e = 2.718281828...$	$e = \lim (1+1/x)^x$, $x \to \infty$
γ	Euler-Mascheroni constant	γ = 0.527721566...	
φ	golden ratio	golden ratio constant	

A.3. Linear Algebra Symbols

Symbol	Symbol Name	Meaning / definition
$\cdot$	dot	scalar product
$\times$	cross	vector product
$A \otimes B$	tensor product	tensor product of A and B
$\langle x, y \rangle$	inner product	
[ ]	brackets	matrix of numbers
( )	parentheses	matrix of numbers
$\vert A \vert$	determinant	determinant of matrix A
$\det(A)$	determinant	determinant of matrix A
$\Vert x \Vert$	double vertical bars	norm
A^T	transpose	matrix transpose
$A^\dagger$	Hermitian matrix	matrix conjugate transpose
A^*	Hermitian matrix	matrix conjugate transpose
A^{-1}	inverse matrix	$A A^{-1} = I$
$\mathrm{rank}(A)$	matrix rank	rank of matrix A
$\dim(U)$	dimension	dimension of matrix A

A.4. Probability and Statistics Symbols

Symbol	Symbol Name	Meaning
$P(A)$	probability function	probability of event A
$P(A \cap B)$	probability of events intersection	probability that of events A and B
$P(A \cup B)$	probability of events union	probability that of events A or B
$P(A \mid B)$	conditional probability function	probability of event A given event B occured

Symbol	Symbol Name	Meaning
$f(x)$	probability density function (pdf)	$P(a \le x \le b) = \int f(x)\, dx$
$F(x)$	cumulative distribution function (cdf)	$F(x) = P(X \le x)$
μ	population mean	mean of population values
$E(X)$	expectation value	expected value of random variable X
$E(X \mid Y)$	conditional expectation	expected value of random variable X given Y
$var(X)$	variance	variance of random variable X
σ^2	variance	variance of population values
$std(X)$	standard deviation	standard deviation of random variable X
σ_X	standard deviation	standard deviation value of random variable X
$\tilde{x}$	median	middle value of random variable x
$cov(X,Y)$	covariance	covariance of random variables X and Y
$corr(X,Y)$	correlation	correlation of random variables X and Y
$\rho_{X,Y}$	correlation	correlation of random variables X and Y
$\sum$	summation	summation - sum of all values in range of series
$\sum\sum$	double summation	double summation

Symbol	Symbol Name	Meaning
Mo	mode	value that occurs most frequently in population
MR	mid-range	$MR = (x_{max}+x_{min})/2$
Md	sample median	half the population is below this value
Q_1	lower / first quartile	25% of population are below this value
Q_2	median / second quartile	50% of population are below this value = median of samples
Q_3	upper / third quartile	75% of population are below this value
x	sample mean	average / arithmetic mean
s^2	sample variance	population samples variance estimator
s	sample standard deviation	population samples standard deviation estimator
z_x	standard score	$z_x = (x-x) / s_x$
$X\sim$	distribution of X	distribution of random variable X
$N(\mu,\sigma^2)$	normal distribution	gaussian distribution
$U(a,b)$	uniform distribution	equal probability in range a,b
$exp(\lambda)$	exponential distribution	$f(x) = \lambda e^{-\lambda x}$, $x\geq0$
$gamma(c, \lambda)$	gamma distribution	$f(x) = \lambda c x^{c-1}e^{-\lambda x} / \Gamma(c)$, $x\geq0$
$\chi^2(k)$	chi-square distribution	$f(x) = x^{k/2-1}e^{-x/2} / (2^{k/2} \Gamma(k/2))$

A.5. Combinatorics Symbols

Symbol	Symbol Name	Meaning / definition
$n!$	factorial	$n! = 1\cdot2\cdot3\cdot\ldots\cdot n$
$_nP_k$	permutation	$_nP_k = \frac{n!}{(n-k)!}$
$_nC_k$ $\binom{n}{k}$	combination	$_nC_k = \binom{n}{k} = \frac{n!}{k!(n-k)!}$

A.6. Set Theory Symbols

Symbol	Symbol Name	Meaning / definition
{ }	set	a collection of elements
$A \cap B$	intersection	objects that belong to set A and set B
$A \cup B$	union	objects that belong to set A or set B
$A \subseteq B$	subset	subset has less elements or equal to the set
$A \subset B$	proper subset / strict subset	subset has less elements than the set
$A \not\subset B$	not subset	left set not a subset of right set
$A \supseteq B$	superset	set A has more elements or equal to the set B
$A \supset B$	proper superset / strict superset	set A has more elements than set B
$A \not\supset B$	not superset	set A is not a superset of set B
2^A	power set	all subsets of A

Symbol	Symbol Name	Meaning / definition
$\mathcal{P}(A)$	power set	all subsets of A
A = B	equality	both sets have the same members
A^c	complement	all the objects that do not belong to set A
A \ B	relative complement	objects that belong to A and not to B
A - B	relative complement	objects that belong to A and not to B
A ∆ B	symmetric difference	objects that belong to A or B but not to their intersection
A ⊖ B	symmetric difference	objects that belong to A or B but not to their intersection
$a \in A$	element of	set membership
$x \notin A$	not element of	no set membership
(a,b)	ordered pair	collection of 2 elements
A×B	cartesian product	set of all ordered pairs from A and B
|A|	cardinality	the number of elements of set A
#A	cardinality	the number of elements of set A
$\aleph_0$	aleph-null	infinite cardinality of natural numbers set
$\aleph_1$	aleph-one	cardinality of countable ordinal numbers set
Ø	empty set	Ø = { }

Symbol	Symbol Name	Meaning / definition
U	universal set	set of all possible values
$\mathbb{N}_0$	natural numbers / whole numbers set (with zero)	$\mathbb{N}_0 = \{0,1,2,3,4,...\}$
$\mathbb{N}_1$	natural numbers / whole numbers set (without zero)	$\mathbb{N}_1 = \{1,2,3,4,5,...\}$
$\mathbb{Z}$	integer numbers set	$\mathbb{Z} = \{...-3,-2,-1,0,1,2,3,...\}$
$\mathbb{Q}$	rational numbers set	$\mathbb{Q} = \{x \mid x=a/b, a,b\in\mathbb{N}\}$
$\mathbb{R}$	real numbers set	$\mathbb{R} = \{x \mid -\infty < x < \infty\}$
$\mathbb{C}$	complex numbers set	$\mathbb{C} = \{z \mid z=a+bi, -\infty<a<\infty, -\infty<b<\infty\}$

A.7. Logic Symbols

Symbol	Symbol Name	Meaning / definition
·	and	and
^	caret / circumflex	and
&	ampersand	and
+	plus	or
∨	reversed caret	or
|	vertical line	or
x'	single quote	not - negation
x	bar	not - negation
¬	not	not - negation
!	exclamation mark	not - negation

Symbol	Symbol Name	Meaning / definition
$\oplus$	circled plus / oplus	exclusive or - xor
~	tilde	negation
$\Rightarrow$	implies	
$\Leftrightarrow$	equivalent	if and only if
$\forall$	for all	
$\exists$	there exists	
$\nexists$	there does not exists	
$\therefore$	therefore	
$\because$	because / since	

A.8. Calculus & Analysis Symbols

Symbol	Symbol Name	Meaning / definition
$\lim_{x\to x0} f(x)$	limit	limit value of a function
ε	epsilon	represents a very small number, near zero
e	e constant / Euler's number	$e = 2.718281828...$
y'	derivative	derivative - Leibniz's notation
y''	second derivative	derivative of derivative
$y^{(n)}$	nth derivative	n times derivation
$\frac{dy}{dx}$	derivative	derivative - Lagrange's notation

Symbol	Symbol Name	Meaning / definition
$\frac{d^2y}{dx^2}$	second derivative	derivative of derivative
$\frac{d^ny}{dx^n}$	nth derivative	n times derivation
$\dot{y}$	time derivative	derivative by time - Newton notation
$\ddot{y}$	time second derivative	derivative of derivative
$\frac{\partial f(x,y)}{\partial x}$	partial derivative	
$\int$	integral	opposite to derivation
$\iint$	double integral	integration of function of 2 variables
$\iiint$	triple integral	integration of function of 3 variables
$\oint$	closed contour / line integral	
$\oiint$	closed surface integral	
$\oiiint$	closed volume integral	
$[a,b]$	closed interval	$[a,b] = \{x \mid a \le x \le b\}$
(a,b)	open interval	$(a,b) = \{x \mid a < x < b\}$
i	imaginary Unit	$i \equiv \sqrt{-1}$
z^*	complex conjugate	$z = a+bi \rightarrow z^*=a-bi$

Symbol	Symbol Name	Meaning / definition
z	complex conjugate	$z = a+bi \rightarrow z = a-bi$
∇	nabla / del	gradient / divergence operator
$x * y$	convolution	$y(t) = x(t) * h(t)$
$\mathcal{L}$	Laplace transform	$F(s) = \mathcal{L}\{f(t)\}$
$\mathcal{F}$	Fourier transform	$X(\omega) = \mathcal{F}\{f(t)\}$
δ	delta function	

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