

УДК 378.147 : 811.111 (075.8)

Английский язык для математиков / Сост. Т.В. Корнаухова, С.В. Кузнецова, В.Ю. Мурзина (Пензенский государственный университет). – Пенза, 2014

Данное учебное пособие предназначено для студентов I-II курсов математических специальностей неязыковых факультетов, прошедших начальный курс английского языка в вузе. Целью пособия является развитие навыков и умений чтения, двустороннего перевода, расширение лексического запаса студентов в области профессиональной терминологии. Кроме того, учебное пособие нацелено на развитие навыков говорения в профессионально-ориентированной устной речи.

Рецензенты:

кандидат педагогических наук, доцент 14 кафедры (иностранных языков) ПАИИ (Пензенского Артиллерийского Инженерного Института) Т.В. Ханжина

кандидат педагогических наук, доцент кафедры естественно-научных и гуманитарных дисциплин НОУ ВПО «Академия МНЭПУ» (Пензенский филиал) Ж.В. Ильина

Предисловие

Данное пособие ставит задачу научить студентов читать оригинальную литературу по специальности и вести беседу на профессиональные темы.

Необходимость появления такого пособия вызвана отсутствием систематизированного материала по профессиональной тематике для работы со студентами математических специальностей. Пособие составлено в соответствии с новыми программными требованиями ФГОС ВПО по дисциплине «Иностранный язык» (английский).

Учебное пособие имеет практическую направленность. Кроме навыка понимания и умения переводить профессиональные тексты, основной целью является развитие навыков устной речи.

Пособие содержит ряд текстов, объединенных общей тематикой. Тексты снабжены различными видами упражнений, направленных на усвоение и закрепление лексики по теме, пополнение словарного запаса профессиональной лексикой, развитие и совершенствование навыков изучающего и поискового чтения, перевод оригинальных материалов по заданной тематике, а также перевод с русского языка на английский. Кроме того, представлены упражнения на выполнение письменных заданий, вопросы для бесед, дискуссий, а также подготовки проектов по окончании изучения каждого раздела.

В пособии содержатся тексты для дополнительного чтения, которые предназначены для самостоятельной проработки студентами в качестве домашнего задания. В конце пособия даны приложения, которые содержат материал, необходимый для подготовки аннотаций и рефератов, функциональную лексику, предназначенную для ведения беседы, диспутов, дискуссий и выражения собственного мнения.

Материал ориентирован на активные и интенсивные методы обучения иностранным языкам. Рекомендуется использование технических средств, сети Интернет и других источников для подготовки к занятиям.

СОДЕРЖАНИЕ

Предисловие

Mathematics

Text 1: The Development of Mathematics

Text 2: The Real Number System

Text 3: *

Text 4: A Brief History of Algebra

Text 5: The Origins of the Word «Algebra»

Text 6: A Brief History of Geometry

Text 7: Euclidean Geometry

Text 8: Non-Euclidean Geometry

Text 9: The History of Arithmetics

Text 10: Greatest Mathematicians of All Time

Supplementary Reading

Text 1: Women in Math

Text 2: Florence Nightingale's Contribution to Mathematics

Text 3: About the Origin of '+' and '-' Signs in Arithmetic

Text 4: Arithmetic Operations

Text 5: The History of Negative Numbers

Text 6: Fractals: Useful Beauty (Fractal Geometry)

Text 7: Soap Films Help To Solve Mathematical Problems

Text 8: A Good Move to Master Maths

Text 9: A Brief History of Numbers And Counting

Приложение 1

Приложение 2

Приложение 3

Приложение 4

Приложение 5

Приложение 6

Приложение 7

Приложение 8

Приложение 9

Список использованных источников

TEXT 1

THE DEVELOPMENT OF MATHEMATICS

1. Прочитайте текст и выделите основные периоды формирования математики.



When asked about the major developments of mathematics, the average person would likely mention the calculator or the computer, or even the idea that we can consider "zero" an actual number. We learned mathematics from books and teachers; the ancients developed mathematics through tedious trial and error. Small steps by numerous people from

numerous cultures over thousands of years directed the development of mathematics. Under what circumstances did the first inquisitive minds begin to see a need to develop the basic mathematical principles?

As necessity is the mother of invention, so was necessity the mother of mathematics. This necessity expressed itself in numerous areas: in agriculture, business and industry. First and foremost, the need to accurately record transactions of goods and money forced the development of the early numeric notation. As advances to civilization progressed, other influences arose including navigation and complex architecture, astronomy, and with it the astrology of certain religious societies. From this grew the development of calendars based around the movements of the heavenly bodies.

Similar motivations (calendars, trade, astronomy etc.) applied to all people, and numerous cultures likewise developed similar mathematic ideas, regardless of their isolation from each other due to geographic barriers. When civilization began to trade, a need to count arose. There were prior civilizations in which the

beginnings or rudiments of mathematics were created. Scientists identify only a few cultures that directly affected the progression we can now trace backwards from modern mathematics: Mesopotamian/Babylonian, Greek, Indian, and Arabic/Islamic and finally European/American cultural group.

The Babylonian system of mathematics was [sexagesimal](#) (base 60) [numeral system](#). From this, we derive the modern day usage of 60 seconds in a minute, 60 minutes in an hour, and 360 degrees in a circle. Mathematics as an organized science did not exist before the classical Greeks of the period from 600 to 300 BC entered upon the scene. It is understood the Greeks diverged and began to delve into more theoretic and abstract ideas. Many scientific giants came from this Greek culture and with them their great discoveries. Among them are Pythagoras, Euclid, Hipparchus and many others.

Next in the line of significant discoveries came the Indian mathematicians to whose credit the current numerical system we have labeled "Arabic numerals". Finally came the Arabic/Islamic influence. The word "algebra" itself even originates from a single word ("al-jabr"— an ancient medical term meaning "the reunion of broken parts") from the title of a book written by the Arabic mathematician Muhammad ibn Musa al-Khwarizmi. All these developments finally arrived in Europe.

A ten-year-old child could easily master the mathematical exercises that ancient Babylonians could not even imagine. Nonetheless, this does not imply that these mathematic principles are obvious. On the contrary, these principles took years of painful experimentation and careful thought, which developed first numeric systems, then principles of simple arithmetic, the development of the number zero, geometric calculations, calendar and astronomic observations and measurements, and algebraic principles. These developed in numerous places around the globe due to similar or identical motivations such as record keeping and construction. Even now, mathematicians continue to expand our extent of

knowledge concerning mathematics, building upon those ideas that have been handed down to them from mathematicians of the past. We sometimes see the calculator and the computer as the most incredible discoveries in mathematics, and to some extent, this is true. Yet we must remember what these tools truly are: only a quicker way to do the exact same equations that took centuries for diligent men to discover.

2. Найдите в тексте предложения с данными словами и выражениями и письменно переведите их на русский язык.

Calculation, geometric calculations, painful experimentation, similar mathematic ideas, to delve, [sexagesimal numeral system](#), measurements, obvious, to diverge development.

3. Дайте английские эквиваленты следующим словам и выражениям:

Метод проб и ошибок, пытливые умы, точно вести запись, сделка, цифровая система, небесные тела, зачатки математики, повлиять на развитие, отследить, объём знаний, унаследовать, невероятные изобретения, в некоторой степени, решать уравнение.

4. Соотнесите слова с их определениями.

1. calculator	a. the process of learning something that was not known before, or of finding someone or something that was missing or hidden
2. computer	b. what someone knows about a particular subject
3. invention	c. a small piece of electronic equipment used for doing calculations

4. knowledge	d. a machine that stores programs and information in electronic form and can be used for a variety of processes, for example writing, calculating, and communicating on the Internet
5. discovery	e. a machine, tool, or system that someone has made, designed or thought of for the first time

5. Заполните пропуски в предложениях словами из рамки.

principles sexagesimal progression tedious trial and error scientific influence knowledge development areas discoveries

1. We learned mathematics from books and teachers; they developed mathematics through
2. Small steps by numerous people from numerous cultures over thousands of years directed the of mathematics.
3. This necessity expressed itself in numerous: in agriculture, business, and industry.
4. Only a few cultures directly affected the that we can now trace backwards from modern mathematics.
5. The Babylonian system of mathematics was (base 60) [numeral system](#)
6. Many giants came from this Greek culture and with them their great discoveries.
7. Next in the line of significant came the Indian mathematicians to whose credit the current numerical system we have labeled "Arabic numerals".
8. Finally came the Arabic/Islamic
9. Nonetheless, this does not imply that these mathematic are obvious.

10. Even now, mathematicians continue to expand our extent of concerning mathematics upon the ideas of the past.

6. Найдите логические ответы на вопросы (1-13) в правой колонке (А-М).

- | | |
|---|--|
| 1) How do modern people learn mathematics? | A. The Indian mathematicians discovered the current "Arabic numerals" numerical system. |
| 2) How did the ancients get knowledge in mathematics? | B. The Greeks diverged and began to delve into more theoretic and abstract ideas. |
| 3) What areas did the necessity of mathematics express itself? | C. We learned mathematics from books and teachers. |
| 4) What were the requirements of mathematics expressed in? | D. The word "algebra" originates from a single word meaning "the reunion of broken parts". |
| 5) What cultures created the rudiments of mathematics? | E. The ancients developed mathematics through tedious trial and error. |
| 6) Why did people develop similar mathematic ideas regardless of their isolation from each other? | F. The need to accurately record transactions of goods and money forced the development of the early numeric notation. |
| 7) How is sexagesimal numeral system used nowadays? | G. We derive the modern day usage of 60 seconds in a minute, 60 minutes in an hour, and 360 degrees in a circle. |
| 8) When did mathematics become to be considered as an organized science? | H. The necessity expressed itself in numerous areas: in agriculture, business, and industry. |
| 9) How did the Greeks affect the development of mathematics? | I. Modern mathematicians build their discoveries upon those ideas that have been handed down to them from |

- | | |
|--|---|
| <p>10) What is the most significant discovery that came from India?</p> <p>11) What does the word «algebra» mean?</p> <p>12) How far has mathematics progressed?</p> <p>13) What way do modern mathematicians expand their extent of knowledge in?</p> | <p>mathematicians of the past.</p> <p>J. When civilization began to trade, a need to count arose.</p> <p>K. Mathematics as an organized science did not exist before the classical Greeks of the period from 600 to 300 BC entered upon the scene.</p> <p>L. Scientists believe that Mesopotamian/Babylonian, Greek, Indian, Arabic/Islamic and finally European/American cultural group directly affected the progression of mathematics.</p> <p>M. A ten-year-old child can easily master the mathematical exercises that ancient Babylonians could not even imagine.</p> |
|--|---|

7. Сделайте краткое сообщение о развитии математики опираясь на текст урока и задания 5, 6.

8. Заполните таблицу краткой информацией о каждом периоде в развитии математики, основываясь на данные Интернет ресурсов и предложенные критерии. (См. Текст 8 в разделе "Supplementary Reading")

Примечание:

Invent vs. Discover

invent (v.) think up or mentally fabricate, esp. a new device or contrivance.

Ex. *The numeral zero (symbol) was invented.*

discover (v.) to be the first to find out, see or know about; to realize.

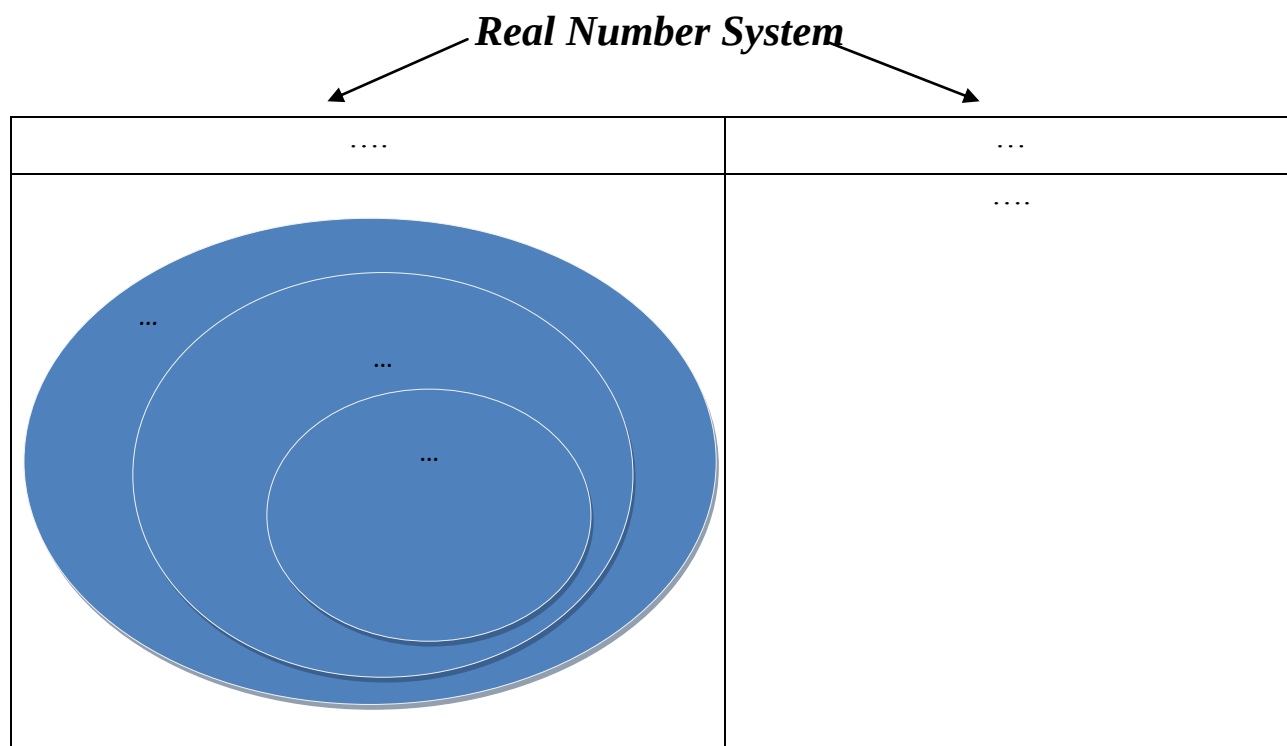
Ex. *The number zero (abstract) was discovered.*

	Period	inventions	discoveries
Mesopotamian/Babylonian			
Greek			
Indian			
Arabic/Islamic			
European/American			

TEXT 2

THE REAL NUMBER SYSTEM

1. Прочитайте текст и представьте систему действительных чисел в виде предложенной таблицы.



The real number system evolved over time by expanding the notion of what we mean by the word "number". At first, "number" meant something you could count. These are called the ***natural numbers***, or sometimes the ***counting numbers***.

Natural Numbers or "*Counting Numbers*" are 1, 2, 3, 4, 5 . . . (The use of three dots at the end of the list is ***a common mathematical notation*** to indicate that the list keeps going ad infinitum.)

At some point, the idea of "zero" came to be considered as a number. We call the set of natural numbers plus the number zero the ***whole numbers***.

Whole Numbers are natural numbers together with "zero", 1, 2, 3, 4, 5 . . . Even more abstract than zero is the idea of ***negative numbers***. It took longer for the idea of negative numbers to be accepted, but eventually they came to be seen as

something we could call "numbers". The expanded set of numbers that we get by including negative versions of the counting numbers is called the **integers**.

Integers – whole numbers plus negatives. Ex. . . . $-4, -3, -2, -1, 0, 1, 2, 3, 4$. . . How can you have less than zero? Well, do you have a checking account? Having less than zero means that you have to add some to it just to get it up to zero. And if you take more out of it, it will be even further less than zero, meaning that you will have to add even more just to get it up to zero.

The next generalization that we can make is to include the idea of **fractions**. While it is unlikely that a farmer owns a fractional number of sheep, many other things in real life are measured in fractions, like a half-cup of sugar. If we add fractions to the set of integers, we get the set of **rational numbers**.

Rational Numbers – all numbers of the form $\frac{a}{b}$, where a and b are integers (but b cannot be zero.)

Rational numbers include what we usually call *fractions*. (Notice that the word "rational" contains the word "**ratio**", which should remind you of fractions.)

The bottom of the fraction is called the **denominator**. (The denominator cannot be zero! But the numerator can.) Think of it as the **denomination** – it tells you what size fraction we are talking about: fourths, fifths, etc. The top of the fraction is called the **numerator**. It tells you how many fourths, fifths, or whatever.

Fractions can be numbers smaller than 1, like $\frac{1}{2}$ or $\frac{3}{4}$ (called **proper fractions**), or they can be numbers bigger than 1 (called **improper fractions**), like two-and-a-half, which we could also write as $\frac{5}{2}$. All integers can also be thought of as rational numbers, with a denominator of 1: $3 = \frac{3}{1}$. This means that all the previous sets of numbers (natural numbers, whole numbers, and integers) are **subsets of the rational numbers**.

Now it might seem as though the set of rational numbers would cover every possible case, but that is not so. There are numbers that cannot be expressed as a fraction, and these numbers are called ***irrational*** because they are not rational.

2. Прочитайте правильно дробные числа.

-- a (one) half, -- a (one) third, -- a (one) quarter or a (one) fourth, -- a (one) fifth, -- one sixth; -- two thirds, -- three quarters or three fourths, -- five sixths;
1 -- one and a half, 2 -- two and a (one) third;

0.1 -- nought point one or point one, 0.01 -- nought point nought one or point nought one, 2.35 -- two point three five, 32.305 -- three two (or thirty-two) point three nought five.

3. Переведите следующие предложения на русский язык, обращая внимание на выделенные курсивом слова.

- 1) Humans have been using numbers *to count* with for thousands of years.
- 2) Romans did all their *calculating* on a *counting board*, which was an early version of an abacus.
- 3) There are lots of different kinds of *numbers* that you'll come across in algebra, and a lot of these kinds of numbers are related to each other.
- 4) Numbers and counting didn't truly come into being until the rise of cities.
- 5) The ancient Greek mathematician Pythagoras believed that all numbers were *rational*, but one of his students Hippasus proved that you could not represent the square root of 2 as a *fraction*, and so it was *irrational*.
- 6) Rational number is any number that can be made by dividing one *integer* by another.
- 7) The most primitive method of representing a *natural number* is to put a dot for each object.
- 8) The ancient Egyptians developed a powerful *system of numerals*, with distinct hieroglyphs for 1, 10 up to over 1 million.

- 9) A much later advance was the development of the idea that 0 can be considered as a *number*, with its own *numeral*.
- 10) German mathematician Gottfried Leibnitz invented a system of counting that used only *ones and zeroes*; what would eventually be called the *binary system*.
- 11) In India, *negative numbers* did not appear until about 620 CE in the work of Brahmagupta (598 - 670) who used the ideas of 'fortunes' and 'debts' for positive and negative.

4. Соотнесите следующие эквиваленты с выделенными жирным курсивом словами в тексте.

Подмножества рациональных чисел, натуральные числа, отрицательные числа, целые числа (2), неправильные дроби, распространённое математическое обозначение, рациональные числа, дробь, правильные дроби, иррациональное число, знаменатель, числитель, достоинство (стоимость), пропорция.

5. Соедините термин с его определением.

1. the denominator	a. the expanded set of numbers that we get by including negative versions of the counting numbers
2. proper fractions	b. the number that is on the top of the fraction
3. whole numbers	c. the numbers that cannot be expressed as a fraction
4. rational numbers	d. the fractions that can be numbers smaller than 1, like $-\frac{1}{2}$ or $-\frac{3}{4}$
5. fractions	e. the number that is in the bottom of the fraction
6. the numerator	f. any of the numbers 0,1,2,3,4,... that can be used to count the members of a set; the non-negative

7. irrational numbers	integers
8. improper fractions	g. the fractions that can be numbers bigger than 1
9. integers	h. the set of natural numbers plus the number zero.
10. natural numbers	i. all numbers of the form $-\frac{a}{b}$, where a and b are integers (but b cannot be zero)
	j. a ratio of two expressions or numbers other than zero

6. Определите, является ли утверждение истинным или ложным

	True	False
1. At first, "number" meant something you could write.		
2. We call the set of natural numbers and the number zero whole numbers.		
3. Whole numbers together with negative numbers are called integers.		
4. Many things in real life are measured in fractions.		
5. We get the set of rational numbers if we add whole numbers to the set of integers.		
6. The numbers of the form $-\frac{a}{b}$ are called rational numbers.		
7. The bottom of the fraction is called the numerator.		
8. The top of the fraction is called the numerator.		
9. The denominator of the fraction can even be zero.		

10. Both parts of the fraction – are integers.		
11. Proper fractions can be represented by the numbers smaller than 1.		
12. – is an example of improper fractions.		
13. All integers can be thought of as rational numbers.		
14. Natural numbers, whole numbers, and integers are subsets of the irrational numbers.		

7. Ответьте на вопросы.

- 1) What were numbers initially used for?
- 2) What numbers were used for calculation?
- 3) What numbers are called whole numbers?
- 4) Why is the idea of negative numbers abstract?
- 5) What is a fraction?
- 6) What numbers does it contain?
- 7) What does the denominator mean?
- 8) What does the numerator tell us about?
- 9) What is the meaning of the word "rational"?
- 10) What numbers are called rational?
- 11) Why do you think fractions are necessary?
- 12) What do rational numbers consist of?
- 13) What kinds of fractions do you know?
- 14) How can all rational numbers be represented?
- 15) Why can we think of natural numbers, whole numbers, and integers as subsets of the rational numbers?
- 16) What numbers cannot be expressed as a fraction?

8. Расскажите о системе чисел, опираясь на информацию текста и вопросы задания 7.

9. Сделайте сообщение-презентацию на одну из предложенных тем.

Irrational numbers

The history of fractions

**The emergence and development of the concept
of number and number theory**

TEXT 3

1. Прочитайте текст и озаглавьте его, выбрав один из предложенных ниже вариантов. Обоснуйте своё мнение пользуясь Приложением 1.

- A. *A placeholder*
- B. *The inconceivable adventures of zero.*
- C. *Zero*
- D. *The idea of zero*



computers.

The story of zero is the story of an idea that has aroused the imagination of great minds across the globe. Understanding and working with zero is the basis of our world today; without zero, we would lack calculus, financial accounting, the ability to make arithmetic computations quickly, and especially in today's connected world,

Zero was independently invented only three times. The first recorded zero is attributed to the Babylonians, the 3rd century BC. A long period followed when no one else used a zero placeholder. Then the Mayans, halfway around the world in Central America, independently invented zero in the 4th century CE. The final independent invention of zero in India was long debated by scholars, but seems to be set around the middle of the 5th century. It spread to Cambodia around the end of the 7th century. From India it moved into China and then to the Islamic countries. Zero finally reached Western Europe in the 12th century.

About 3,000 years ago, when people started writing bigger numbers like "42" they had a problem: how to tell the difference between "4" and "40"? Without the zero, they look the same!

So they used a "placeholder", a space or special symbol, to show "there are no digits here". (So "5 2" meant "502" (5 hundreds, nothing for the tens, and 2 units.)

The idea of zero had begun, but it wasn't for another thousand years or so that people started thinking of it as an actual number. It was the Indians who began to understand zero both as a symbol and as an idea.

The Babylonians had a sexagesimal number system, that is, they counted in 60s, as we count in tens. They used two symbols to represent all the numbers from 1 to 59. The wedge was used for a one and the crescent equaled a 10. By grouping them together, they created symbols for all 59 numbers.

It was not until around 400 BC that the Babylonians put two wedge symbols into the place where we would put zero to indicate which was meant, 216 or 21 " 6. Babylonian mathematicians used the separator, a sort of sideways, superscript, double wedge (effectively the first zero) in the middle position only.

The Mayans had a very complex calendar system and needed a placeholder in their elaborate date system. It is the formal Long Count calendar that brought about the zero. The zero was often represented by a shell shape.

The final independent invention of the zero was in India. Math problems were written in verse and could be easily memorized, chanted or sung. Each word in the verse corresponded to a number. Brahmagupta, around 650 AD, was the first to formalize arithmetic operations using zero. He used dots underneath numbers to indicate a zero. These dots were alternately referred to as "sunya", which means empty, or "kha", which means place. Brahmagupta wrote standard rules for reaching zero through addition and subtraction as well as the results of operations with zero. The only error in his rules was division by zero, which would have to wait for Isaac Newton and G.W. Leibniz to tackle. It is recorded, that a dot or an open circle was used as zero before 628.

The Hindus influenced the numeration of nearby locales, and introduced the zero to the Chinese and to the Arabs who developed the modern day shape of numerals and passed them, along with zero, to the Europeans in the 12th century.

Zero reached Baghdad by 773 AD. In the 9th century, the Arabian mathematician Mohammed ibn-Musa al-Khwarizmi was the first to work on equations that equaled zero. He also developed quick methods for multiplying and dividing numbers known as algorithms (a corruption of his name). Al-Khwarizmi called zero "sifr", from which our cipher is derived. By 879 AD, zero was written almost, as we now know it, an oval but in this case smaller than the other numbers.

And thanks to the conquest of Spain by the Moors, zero finally reached Europe; by the middle of the 12th century, translations of al-Khwarizmi's work had weaved their way to England.

2. Найдите предложения со следующими словами и словосочетаниями в тексте и письменно переведите их на русский язык.

Calculus; wedge; crescent; actual number; superscript; the elaborate date system; to pass along; to equal; to weave; digit; to correspond; to derive; conquest; to attribute; to set; sort of sideways; shell shape; nearby locales; to chant.

3. Соотнесите русские и английские слова и выражения.

1. long count calendar	a. привести что-либо
2. financial accounting	b. заполнитель
3. CE (Common Era)	c. в стихах
4. numeration	d. обсуждать
5. actual number	e. уравнение
6. arithmetic computations	f. финансовый учет
7. elaborate date system	g. указывать, показать
8. placeholder	h. до нашей эры
9. to invent	i. исчисление; счёт
10. halfway	j. сложная система дат
11. equation	k. арифметические вычисления
12. BC (Before Christ)	l. сложный календарь (календарь длинного счета)
13. to debate	m. ноль; арабская цифра
14. to indicate	n. наша эра
15. separator	o. действительное число
16. to bring	p. разделитель
17. in verse	q. на полпути
18. cipher	r. изобретать

4. Переведите следующие предложения на русский язык.

- 1) The first thing to say about zero is that there are two uses of it: one – as an empty place *indicator* in our place-value number system and the other – as a number itself in the form we use it as 0.
- 2) Some historians favour the explanations that Greek astronomers began to use the *symbol* O (omicron), the first letter of the Greek word for nothing namely "ouden".

- 3) Fibonacci was one of the main people *to bring* these new ideas *about* the *number system* to Europe.
- 4) Cardan solved cubic and quartic *equations* without using zero.
- 5) Of course, on 1 January 2000, people celebrated the passing of only 1999 years since when the *calendar* was set up, no year zero was specified.
- 6) The final independent invention of zero in India *was* long *debated* by scholars.
- 7) The Babylonians used two symbols to represent all the numbers from 1 to 59: the wedge for a one, and crescent *equaled* a 10.
- 8) The Babylonian mathematicians used the *separator* (effectively the first zero) in the middle position only.
- 9) Despite the invention of zero as *a placeholder*, the Babylonians never quite discovered zero as a number.
- 10) Our name "zero" *derives* ultimately from the Arabic "sifr", which also gives us the word "cipher".

5. Найдите в тексте синонимы следующим словам и запишите их.

To devise, to denote, to transfer, concept, sign, digit.

6. Заполните пропуски подходящими по смыслу словами из задания 5. Не забывайте при необходимости менять форму слова и ставить глаголы в нужном времени.

- 1) The historical record shows quite a different path towards the
- 2) The were pressed into soft clay tablets with the slanted edge of a stylus and so had a wedge-shaped appearance.
- 3) Although we have evidence of zero from tablets in the Selucid era, it is possible that zero before that time.
- 4) The scene now to India where the numerals and number system was born.

- 5) The [classical Greeks](#) had a different system, with different letters for each from one to nine, and yet more for ten, twenty and so on.
- 6) The use of positional system fractions was introduced around 1579 AD by Francois Viete.

7. Найдите в тексте предложения, в которых говорится, что

- 1) zero has the fundamental significance for different fields of mathematics.
- 2) zero was independently invented by different civilizations.
- 3) zero has two meanings.
- 4) there were only two signs to represent numbers.
- 5) there were symbols to indicate zero.
- 6) the Mayans used a placeholder for their everyday needs.
- 7) the Indian mathematicians made an error in using zero in some arithmetic operations.
- 8) the Arabian mathematician was the first to operate on equations that equaled zero.

8. Ответьте на вопросы по содержанию текста.

- 1) Why is invention of zero so important?
- 2) What problem did the development of zero solve?
- 3) When does the history of zero go back to?
- 4) How can you explain the fact that zero was independently invented several times? Did the ancients use zero first as an idea or as a symbol?
- 5) Who began to understand zero both as an idea and as a symbol?
- 6) In what way did they indicate a placeholder (zero)?
- 7) Who wrote zero in the way it is known to us now?
- 8) What is Mohammed ibn-Musa al-Khwarizmi famous for?
- 9) What civilizations had taken part in the development of zero before it reached Europe?

9. Переведите текст на английский язык.

Первое, что нужно сказать о нуле, это то, что имеется два варианта его использования, оба очень важные, но немного различные. Первый – это указатель пустого разряда в нашей позиционной системе счисления. Так, в числе 2106 нуль служит для того, чтобы позиции 2 и 1 были верными. Очевидно, что 216 значит совершенно иное. Второй вариант использования нуля – это число, которое мы обозначаем «0».

Имеются также разные аспекты применения нуля, внутри каждого из которых понятие, обозначение и название.

TEXT 4

A BRIEF HISTORY OF ALGEBRA

1. Прочитайте текст. Расположите части текста в порядке логического следования.



The development of algebra can be represented as Egyptian algebra, Babylonian algebra, Greek geometric algebra, Diophantine algebra, Hindu algebra,



Arabic algebra, European algebra since 1500 and modern algebra. The development of algebraic notation progressed through three stages: the rhetorical (or verbal) stage, the syncopated stage (in which abbreviated words were used) and the symbolic

stage, with which we are all familiar. Since algebra grows out of arithmetic, recognition of new numbers – irrationals, zero, negative numbers and complex numbers – is an important part of its history.

Classical algebra was first developed by the ancient Babylonians, who had a system similar to our algebra. They were able to solve for unknown quantities (variables) and had formulas and equations. This may seem elementary, but many

advanced civilizations solved such problems geometrically because it was more visual. This is similar to the idea of graphing two linear equations to see where they intersect rather than directly solving for the solution. The Chinese began to publish their own algebra writings around 100 BC.

The history of algebra is split into two basic kinds of algebra. One is called *Classical Algebra* (equation solving or "find the unknown number" problems) and another is called Modern, or *Abstract Algebra* (the study of groups, rings and fields). Classical algebra has been developed over a period of 4000 years. Abstract algebra has only appeared in the last 20.



Modern Algebra has come into existence much more recently, emerging over the past 200 years. This is a very complicated study of abstract ideas that are useful for mathematicians and scientists. It also includes some more basic topics like Boolean algebra and matrix multiplication.



The word "Algebra" was first used around 800AD by the Arabic scholars and literally means the re-union of broken parts. While in ancient civilizations the basics of algebra were only studied by advanced mathematicians and scientists, now it is taught routinely to 7th and 8th graders. That is why it is important to know the history of algebra in order to identify the present status of modern day mathematics. Of course, you first need a good knowledge of arithmetic and logic to master algebra. However, algebra is the fundamental language of math that actually allows you to "do" anything.



The history of algebra is closely connected with such names as the Alexandrian mathematicians Hero of Alexandria and Diophantus, the Arab mathematician al-Khwarizmi, the Egyptian mathematician Abu Kamil, the Persian mathematician, astronomer and poet Omar Khayyam, the great Italian mathematician Leonardo Fibonacci, the Italian mathematicians Scipione del Ferro, Niccolò Tartaglia and Gerolamo Cardano, the Norwegian mathematician Niels

Abel and the French mathematician Evariste Galois, the French philosopher and mathematician René Descartes, the German mathematician Carl Friedrich Gauss.

2. Найдите предложения со следующими словами и словосочетаниями в тексте и письменно переведите их на русский язык.

Matrix multiplication; to be split into; basic topics; re-union of broken parts; variables; study of groups; rings and fields; to come into existence; fundamental language of math; to progress through; advanced civilizations; to intersect; solution.

3. Составьте словосочетания, используя слова левой и правой колонок. Найдите в тексте предложения с данными словосочетаниями и переведите их на русский язык.

1. algebraic	a. equations
2. abstract	b. notation
3. fundamental	c. algebra
4. linear	d. idea
5. symbolic	e. number
6. classical	f. language
7. unknown	g. stage

4. Дайте английские эквиваленты следующим словам и выражениям.

Ведущие математики; неизвестные величины; алгебраические вычисления; иррациональные числа; линейные уравнения; логическая алгебра; основы алгебры; сложные числа; знаковая стадия; научиться алгебре.

5. В каждой группе слов и словосочетаний найдите одно лишнее:

- a) irrationals, zero, negative numbers, complex numbers, equations;
- b) classical algebra, abstract algebra, modern algebra, Boolean algebra;
- c) to count, to calculate, to compute, to consider, to reckon;
- d) sexagesimal system, elaborate date system, decimal system, vigesimal system;

e) to discover, to invent, to contribute, to think up, devise.

6. В каждой группе слов найдите одно с наиболее общим значением.

- a) a separator, space, a superscript, zero, a dot, a placeholder, empty;
- b) addition, subtraction, algebraic notation, multiplication, division;
- c) re-union, restitution, algebra, resolution, comparison;
- d) arithmetic, logic, geometry, algebra, mathematics.

7. Переведите следующие предложения на английский язык, используя лексику заданий 3 и 4.

- 1) История развития алгебраических вычислений может быть разбита на три стадии.
- 2) Также как и индусы, арабы вплотную работали с иррациональными числами.
- 3) Никто не сможет перейти к изучению высшей математики без овладения основами алгебры.
- 4) Индусы рассматривали ноль как число и обсуждали математические операции с его использованием.
- 5) Решение квадратных уравнений выражалось и доказывалось в геометрической форме.
- 6) Важным в развитии алгебры 16 века было установление символов для неизвестных величин для алгебраических множеств и действий.
- 7) Арабское слово для обозначения "восстановления" – "al-jabru" – является корнем слова "алгебра".
- 8) История алгебры берёт начало в Древнем Египте и Древнем Вавилоне, где люди учились решать линейные и квадратные уравнения.

8. Соедините части предложений из левой и правой колонок так, чтобы получились утверждения, соответствующие содержанию текста.

1. It is important to know the history of algebra	a. literally means the re-union of broken parts.
---	--

2. Algebra is the fundamental	b. a system similar to our algebra.
3. The word “Algebra”	c. by the ancient Babylonians.
4. The development of algebra can be	d. study of abstract ideas that are useful for mathematicians and scientists.
5. Since algebra grows out of arithmetic,	e. language of math that actually allows you to "do" anything.
6. The history of algebra is split	f. connected with many outstanding mathematicians.
7. Classical algebra was first developed	g. in order to identify the present status of modern day mathematics.
8. The ancient Babylonians had	h. represented as Egyptian algebra, Babylonian algebra, Greek geometric algebra, Diophantine algebra, Hindu algebra, Arabic algebra, European algebra since 1500, and modern algebra.
9. Modern Algebra is a very complicated	i. into two basic kinds – <i>Classical Algebra</i> and Modern, or <i>Abstract Algebra</i> .
10. The history of algebra is closely	j. recognition of new numbers is an important part of its history.

9. Познакомьтесь с планом к тексту. Измените пункты плана в виде вопросов.

- 1) The word "Algebra" is of Arabic origin.
- 2) It is important to know the history of algebra in order to identify the present status of modern day mathematics.
- 3) Algebra went through some historical periods in its development.

- 4) The evolution of algebraic notation represents three stages.
- 5) The history of algebra is split into two basic kinds of algebra.
- 6) Classical algebra deals with equation solving.
- 7) Classical algebra has been developed over a period of 4000 years.
- 8) Modern algebra is a very complicated study of abstract ideas that are useful for mathematicians and scientists.
- 9) Modern Algebra has been developing for 200 years.
- 10) Many outstanding mathematicians of the past and present made great contribution to the development of mathematics.

10. Найдите и выпишите из дополнительных источников определение "алгебры" и расскажите о её становлении, опираясь на план задания 9 и текст.

TEXT 5

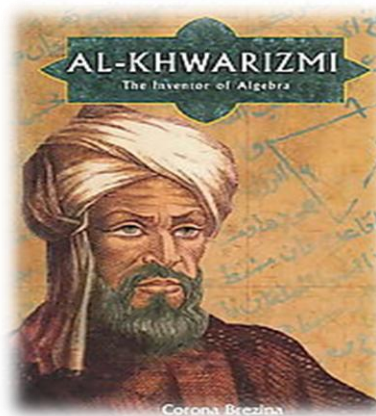
THE ORIGINS OF THE WORD «ALGEBRA»

1. Прочитайте текст и выпишите слова, объясняющие значение слова "алгебра".



Different writers have given various derivations of the word "algebra", which is of Arabian origin. The first mention of the word was found in the title of a work by Mahommed ben Musa al-Khwarizmi (Hovarezmi), who flourished about the beginning of the 9th century. The full title is *ilm al-jebr wa'l-muqabala*, which contains the ideas of restitution and comparison, or opposition and comparison, or resolution and equation, *jebr* being derived from the verb *jabara*, to reunite, and *muqabala*, from *gabala*, to make equal. (The root *jabara* is also met with in the word *algebrista*, which means a "bone-setter," and is still in common use in Spain.) The same derivation is given by Lucas Paciolus (Luca Pacioli), who reproduces the phrase in the transliterated form *alghebra e almucabala*, and ascribes the invention of the art to the Arabians.

Other writers have derived the word from the Arabic particle *al* (the definite article), and *gerber*, meaning "man." Since, however, Geber happened to be the name of a celebrated Moorish who flourished in about the 11th or 12th century, it has been supposed that he was the founder of algebra, which has since perpetuated his name. The evidence of Peter Ramus (1515-1572) on this point is interesting, but he gives no authority for his statements. In the preface to his *Arithmeticae libri duo et totidem Algebrae* (1560) he says: "The name Algebra is



philosopher of the 9th century, it has been supposed that he was the founder of algebra, which has since perpetuated his name. The evidence of Peter Ramus (1515-1572) on this point is interesting, but he gives no authority for his statements.

Syriac, signifying the art or doctrine of an excellent man. For Geber, in Syriac, is a name applied to men, and is sometimes a term of honour, as master or doctor among us. There was a certain learned mathematician who sent his algebra, written in the Syriac language, to Alexander the Great, and he named it *almucabala*, that is, the book of dark or mysterious things, which others would rather call the doctrine of algebra. To this day the same book is in great estimation among the learned in the oriental nations, and the Indians, who cultivate this art, it is called *aljabra* and *alboret*; though the name of the author himself is not known".

The uncertain authority of these statements, and the plausibility of the preceding explanation, have caused philologists to accept the derivation from *al* and *jabara*. Robert Recorde in his *Whetstone of Witte* (1557) uses the variant *algeber*, while John Dee (1527-1608) affirms that *algiebar*, and not *algebra*, is the correct form, and appeals to the authority of the Arabian Avicenna.

Although the term "algebra" is now in universal use, various other appellations were used by the Italian mathematicians during the Renaissance. Thus we find Pacioli calling it *l'Arte Magiore; ditta dal vulgo la Regula de la Cosa* over

Algebra e Almucabala. The name *l'arte maggiore*, the greater art, is designed to distinguish it from *l'arte minore*, the lesser art, a term which he applied to the modern arithmetic. His second variant, *la regola de la cosa*, the rule of the thing or unknown quantity, appears to have been in common use in Italy, and the word *cosa* was preserved for several centuries in the forms *coss* or *algebra*, *cossic* or *algebraic*, *cossist* or *algebraist*, &c. Other Italian writers termed it the *Regula rei et census*, the rule of the thing



and the product, or the root and the square. The principle underlying this expression is probably to be found in the fact that it measured the limits of their attainments in algebra, for they were unable to solve equations of a higher degree than the quadratic or square.

Franciscus Vieta (Francois Viète) named it *Specious Arithmetic*, on account of the species of the quantities involved, which he represented symbolically by the various letters of the alphabet. Sir Isaac Newton introduced the term Universal Arithmetic, since it is concerned with the doctrine of operations, not affected on numbers, but on general symbols.

Notwithstanding these and other idiosyncratic appellations, European mathematicians have adhered to the older name, by which the subject is now universally known.

2. Пользуясь словарём, выясните, какие ещё значения имеют слова из упражнения 1. Составьте список, иллюстрируя каждое значение примером.

word	Meaning	example
1) reunion – n.	1) воссоединение; 2) примирение, объединение; 3) встреча друзей, вечеринка;	College reunion – встреча старых однокашников.
2)	...	

3. Найдите в тексте предложения со следующими словами и словосочетаниями и письменно переведите их на русский язык. Gives no authority, the uncertain authority, preface, the learned, in common use, to make

equal, transliterated form, a term of honour, a book of dark or mysterious things, the doctrine of algebra.

4. Найдите в тексте и запишите словосочетания с предложенными ниже словами, распределив их в соответствующие графы таблицы.

Restitution; symbolically; comparison; higher; resolution; to reunite; several; bone-setter; derivation; probably; to ascribe; particle; modern; to perpetuate; plausibility; universally; to affirm; unable; appellations; general; to preserve; unknown; to term; attainments; universal; various; to adhere; idiosyncratic; to flourish; founder; oriental; however; uncertain; notwithstanding.

verb	noun	adjective	adverb
.....	The ideas of restitution – идеи восстановления		represented symbolically – представил символично

5. Дайте английские эквиваленты следующим словам и словосочетаниям.

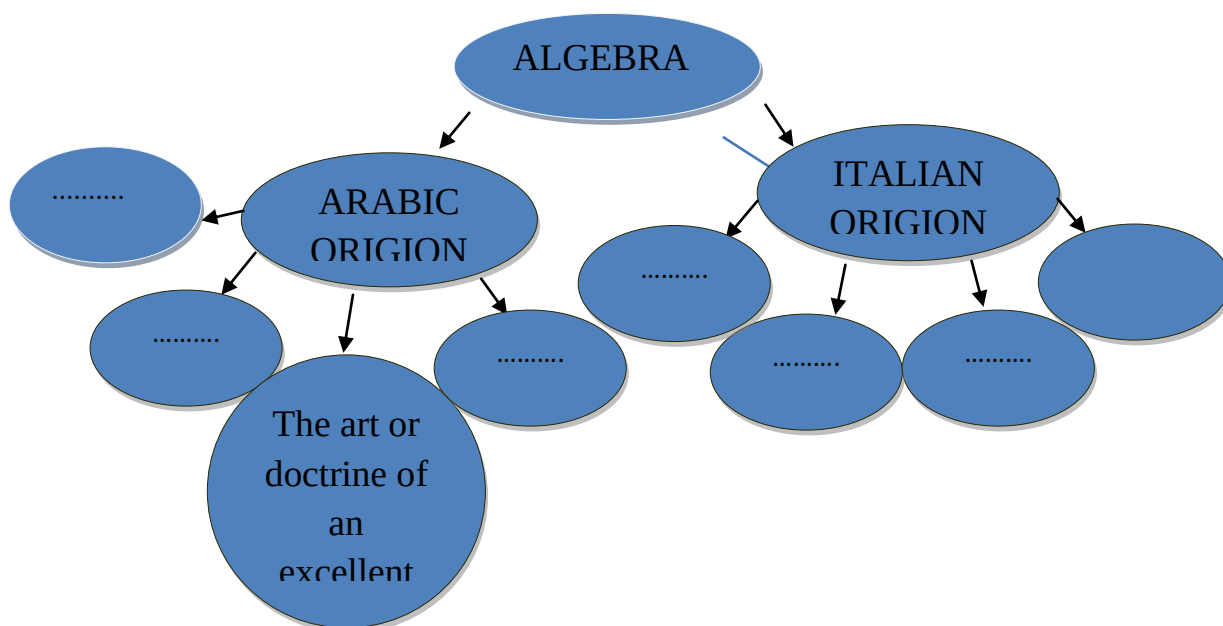
Решать уравнения; содержать идеи; восточные страны; увековечить своё имя; приписывать изобретение кому-либо; необычные высказывания; неизвестная величина; во всеобщем использовании; некий учёный-математик; идиосинкразические наименования; обращаться к источникам; пределы их достижений; низшая наука; высшая наука; первое упоминание; различное происхождение; правдоподобность предыдущего объяснения.

6. Соедините части предложений из правой и левой колонок так, чтобы получились утверждения, соответствующие содержанию текста.

1. The first mention of the word was found in the	a. sent his algebra, written in the Syriac language, to Alexander the Great.
2. Al-Khwarizmi's work contains the	b. the oriental nations, and the Indians,

ideas of	who cultivate this art, it is called <i>aljabra</i> and <i>alboret</i> .
3. It has been supposed that a celebrated Moorish philosopher Geber was	c. account of the species of the quantities involved.
4. There was a certain learned mathematician who	d. title of a work by Mahommed ben Musa al-Khwarizmi.
5. To this day the same book is in great estimation among the learned in	e. measured the limits of their attainments in algebra, for they were unable to solve equations of a higher degree than the quadratic or square.
6. The uncertain authority of these statements, and the plausibility of the preceding explanation, have caused	f. restitution and comparison, or opposition and comparison, or resolution and equation.
7. Although the term "algebra" is now in universal use, various	g. the founder of algebra, which has since perpetuated his name.
8. The principle underlying this expression is probably to be found in the fact that it	h. with the doctrine of operations, not affected on numbers, but on general symbols.
9. Franciscus Vieta (Francois Viète) named it <i>Specious Arithmetic</i> , on	i. philologists to accept the derivation from <i>al</i> and <i>jabara</i> .
10. Sir Isaac Newton introduced the term Universal Arithmetic, since it is concerned	j. other appellations were used by the Italian mathematicians during the Renaissance.

7. Создайте схему версий арабского и итальянского происхождений слова "алгебра".



8. Спросите одноклассников:

- what the origin of the word "algebra" is;
- if he/she can enumerate all derivations of the word "algebra";
- what opinion of European mathematicians on this subject he /she has;
- what idea he/she supports and why.

7. Сделайте доклад-презентацию об арабском учёном *Мухаммеде ибн Мусе ал-Хорезми* по предложенным темам.



The algebra of Mohammed ibn Musa Al-Khwarizmi

Al-Khwarizmi, the father of Algebra

Al-Khwarizmi's most important work

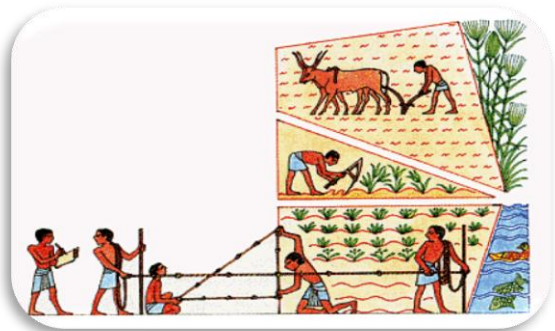
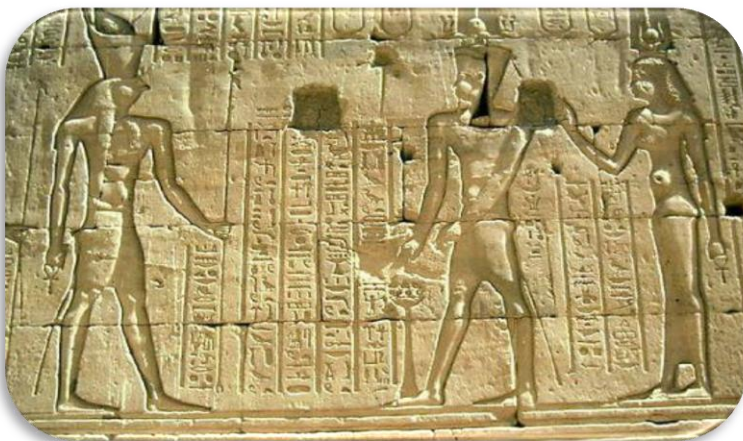
TEXT 6

A BRIEF HISTORY OF GEOMETRY

1. Прочитайте текст и ответьте на вопросы:

- a) *What are the branches of geometry?*
- b) *What do they deal with?*

Geometry began with a practical need to measure shapes. The word geometry means to "measure the earth" and is the science of shape and size of things. It is believed that geometry first became important when an Egyptian pharaoh wanted to tax farmers who raised crops along the Nile River. To compute the correct amount of tax the pharaoh's agents had to be able to measure the amount of land being cultivated.



Around 2900 BC the first Egyptian pyramid was constructed. Knowledge of geometry was essential for building pyramids, which consisted of a square base and triangular faces. The earliest record of a formula for calculating the area of a triangle dates back to 2000 BC. The Egyptians (5000-500

BC) and the Babylonians (4000-500 BC) developed practical geometry to solve everyday problems, but there is no evidence that they logically deduced geometric facts from basic principles.

It was the early Greeks (600 BC-400 AD) that developed the principles of modern geometry beginning with Thales of Miletus (624-547 BC). Thales is credited with bringing the science of geometry from Egypt to Greece. Thales studied similar triangles and wrote the proof that corresponding sides of similar triangles are in proportion.

The next great Greek geometer was Pythagoras (569-475 BC). Pythagoras is



regarded as the first pure mathematician to logically deduce geometric facts from basic principles. Pythagoras founded a brotherhood called the Pythagoreans, who pursued knowledge in mathematics, science and philosophy. Some people regard the Pythagorean School as the birthplace of reason and logical thought. The most famous and

useful contribution of the Pythagoreans was the Pythagorean Theorem. The theory states that the sum of the squares of the legs of a right triangle equals the square of the hypotenuse.

Euclid of Alexandria (325-265 BC) was one of the greatest of all the Greek geometers and is considered by many to be the "father of modern geometry". Euclid is best known for his 13-book treatise *The Elements*. *The Elements* is one of the most important works in history and had a profound impact on the development of Western civilization.

Euclid began *The Elements* with just a few basics, 23 definitions, 5 postulates and 5 common notions or general axioms. An axiom is a statement that is accepted as true. From these basics, he proved his first proposition. Once proof was established for his first proposition, it could then be used as part of the proof of a second proposition, then a third, and on it went. This process is known as the

axiomatic approach. Euclid's *Elements* form the basis of the modern geometry that is still taught in schools today.

Archimedes of Syracuse (287-212 BC) is regarded as the greatest of the Greek mathematicians and was also the inventor of many mechanical devices including the screw, the pulley and the lever. The Archimedean screw – a device for raising water from a low level to a higher one – is an invention that is still in use today. Archimedes works include his treatise *Measurement of a Circle*, which was an analysis of circular area, and his masterpiece *On the Sphere and the Cylinder*, in which he determined the volumes and surface areas of spheres and cylinders.

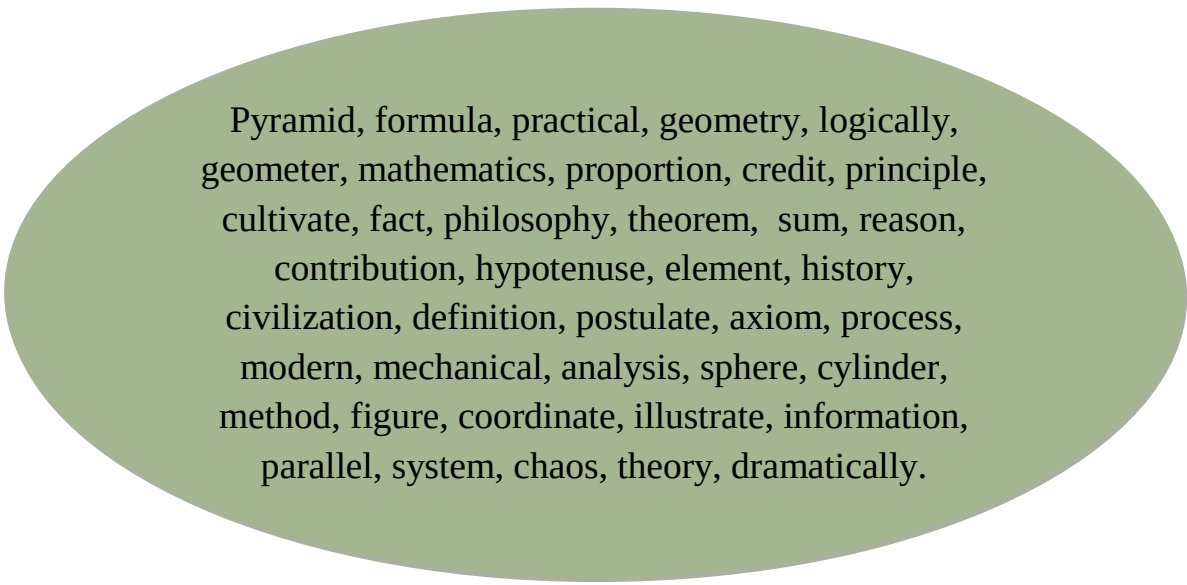
There were no major developments in geometry until the appearance of Rene Descartes (1596-1650). In his famous treatise *Discourse on the Method of Rightly Conducting the Reason in the Search for Truth in the Sciences*, Descartes combined algebra and geometry to create analytic geometry. Analytic geometry, also known as coordinate geometry, involves placing a geometric figure into a coordinate system to illustrate proofs and to obtain information using algebraic equations.

The next great development in geometry came with the development of non-Euclidean geometry. Carl Friedrich Gauss (1777-1855), who along with Archimedes and Newton is considered to be one of the three greatest mathematicians of all time, invented non-Euclidian geometry prior to the independent work of Janos Bolyai (1802-1860) and Nikolai Lobachevsky (1792-1856). Non-Euclidian geometry generally refers to any geometry not based on the postulates of Euclid, including geometries for which the parallel postulate is not satisfied. The parallel postulate states that through a given point not on a line, there is one and only one line parallel to that line. Non-Euclidian geometry provides the mathematical foundation for Einstein's Theory of Relativity.

The most recent development in geometry is fractal geometry. Fractal geometry was developed and popularized by Benoit Mandelbrot in his 1982 book *The Fractal Geometry of Nature*. A fractal is a geometric shape, which is self-

similar (invariance under a change of scale) and has fractional (fractal) dimensions. Similar to chaos theory, which is the study of non-linear systems, fractals are highly sensitive to initial conditions where a small change in the initial conditions of a system can lead to dramatically different outputs for that system.

2. Перепишите ниже приведённые интернациональные с фонетической транскрипцией и переводом на русский язык. Скажите, какие слова называются интернациональными?



Pyramid, formula, practical, geometry, logically, geometer, mathematics, proportion, credit, principle, cultivate, fact, philosophy, theorem, sum, reason, contribution, hypotenuse, element, history, civilization, definition, postulate, axiom, process, modern, mechanical, analysis, sphere, cylinder, method, figure, coordinate, illustrate, information, parallel, system, chaos, theory, dramatically.

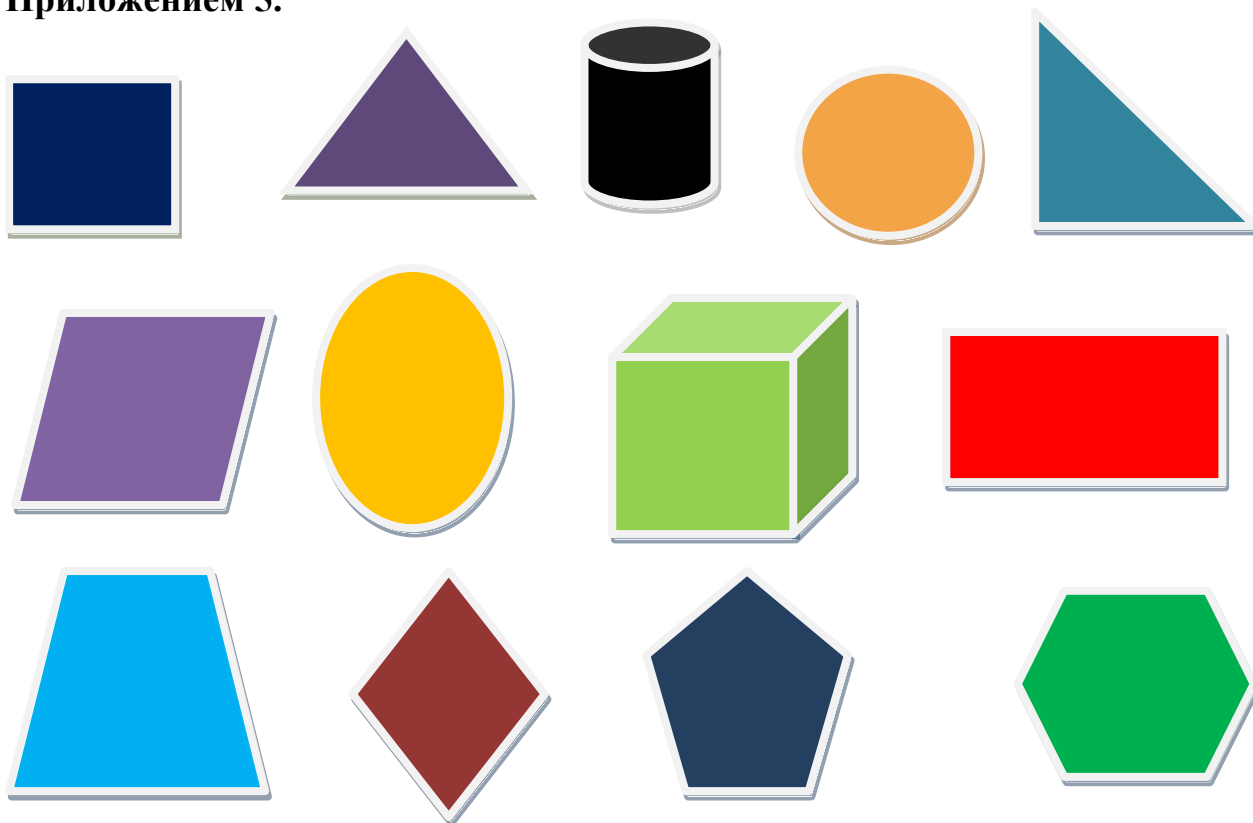
3. Найдите в тексте предложения с данными словами и словосочетаниями и письменно переведите их на русский язык.

The screw; the pulley; the lever; chaos theory; basic principles; scale; prior to; Einstein's Theory of Relativity; self-similar; non-linear systems; axiomatic approach; mathematical foundation.

4. Составьте словосочетания, используя слова двух колонок, и переведите их на русский язык.

1. Egyptian	a. theorem
2. the earliest record of	b. system
3. practical	c. civilization
4. analytic	d. approach
5. logical	e. axiom
6. Greek	f. devices
7. knowledge in	g. postulate
8. basic	h. fact
9. geometric	i. theory
10. the Pythagorean	j. principle
11. the development of Western	k. pyramid
12. general	l. mathematics
13. axiomatic	m. geometer
14. mechanical	n. need
15. coordinate	o. thought
16. parallel	p. geometry
17. chaos	q. formula

5. Назовите по-английски следующие фигуры пользуясь текстом и Приложением 5.



6. Дайте английские эквиваленты.

Измерять формы; облагать налогом; вычислить сумму налога; вычислить количество земли; привести к совершенно противоположным итогам; треугольные грани; вывести геометрические факты; квадратная основа; подобные треугольники; основать братство; стремиться к знаниям в области математики; место рождения разума и логического мышления; 13-ти томный трактат; глубокое воздействие; общие понятия; общие аксиомы; доказать утверждение (теорему); дробные размеры; механические устройства; получить информацию.

7. Выберите из скобок обобщающие понятия для следующих групп слов.

- a) Triangle, sphere, cylinder, square (shape, size, figure, form)
- b) Proof, theorem, postulate, general axiom, (proposition, basics, principles, problems)

c) Screw, pulley, lever, dividers, (tools, devices, forms, method)

8. Найдите в тексте и выпишите определение:

a) геометрии;

b) аксиомы;

c) аналитической геометрии;

d) геометрии координат;

e) фрактальной геометрии.

9. Составьте из данных слов и словосочетаний предложения и переведите их на русский язык.

A. to "measure the earth", and, the word, means, and, the science of shape , is, geometry, size of things.

B. determined, in, he, the volumes and surface areas, his, of spheres and cylinders, masterpiece *On the Sphere and the Cylinder*.

C. of the legs, the sum, of, a right triangle, of, the hypotenuse, of, the squares, of, equals, the square.

D. are, Thales, that, sides, wrote, the proof, corresponding, of, in, similar, proportion, triangles.

E. invented, along, Archimedes, geometry, Newton, Carl Friedrich Gauss, non-Euclidian, with, and.

10. Заполните пропуски подходящими словами из скобок. Расположите полученные предложения в порядке следования в тексте.

1) Who invented many mechanical including the screw, the pulley and the lever (tools, devices, tackles, engines)?

2) Why was knowledge of essential in 2900 BC (arithmetic, algebra, mathematics, geometry)?

3) What does the Pythagorean state (axiom, theorem, concept, algorithm)?

- 4) In what way did Thales of Miletus begin to develop of modern geometry (concepts, principles, ideas, doctrines)?
- 5) When did geometry first become (analytic, convenient, fractal, famous, important)?
- 6) What kind of geometry doesn't to Euclidean geometry (deal with, refer, represent, transfer)?
- 7) When does the earliest record of a formula for calculating the area of a date back (sphere, cylinder, triangle, square)?
- 8) What book by Euclid had a profound on the development of Western Civilization (changes, doctrines, impact, mathematical inquiry)?
- 9) What did Descartes combine to create geometry (fractal, algebraic, analytic, elliptic)?
- 10) What reason is Euclid's process of creation his postulates known as the axiomatic (idea, approach, algorithm, viewpoint)?
- 11) Why is Pythagoras regarded as the first pure (physicist, astronomer, mathematician, geographer)?

11. Используя полученные вопросы задания 10 в качестве плана, расскажите о развитии геометрии.

TEXT 7

EUCLIDEAN GEOMETRY

1. Прочитайте текст и соотнесите каждый абзац со следующими утверждениями, выражающими их основную мысль:

- A. A brief, simple, and self-evident system of postulates.
- B. Euclidean geometry was the basis for the emergence of various geometries.
- C. Euclid's main achievements.

"The Euclidean geometry is the true geometry of the universe and to contradict it is to contradict thought itself"

Immanuel Kant



1. Euclidean geometry is a mathematical system attributed to the Alexandrian Greek mathematician Euclid, which he described in his textbook on geometry *the Elements*. Euclid's method consists in assuming a small set of intuitively appealing axioms and deducing many other propositions (theorems) from these. Although earlier mathematicians had stated many of Euclid's

results, Euclid was the first to show how these propositions could fit into a comprehensive deductive and logical system. Euclidean geometry studies plane and solid figures based on axioms and theorems employed by Euclid. *The Elements* begins with plane geometry, the first axiomatic system and the first examples of formal proof, which still taught in schools. It goes on to the solid geometry of three dimensions. Much of *the Elements* states results of what are now called algebra and number theory, explained in geometrical language.

2. For more than two thousand years, the adjective "Euclidean" was unnecessary, *geometry* meant Euclidean geometry because no other sort of geometry had been conceived. It is the most typical expression of general mathematical thinking. Rather than the memorization of simple algorithms to solve equations by rote, it demands true insight into the subject, clever ideas for applying theorems in special situations, an ability to generalize from known facts and an insistence on the importance of proof. Euclid's axioms seemed so intuitively obvious (with the possible exception of the parallel postulate) that any theorem proved from them was deemed true in an absolute, often metaphysical, sense.

3. Euclidean geometry is an axiomatic system, in which all theorems ("true statements") are derived from a small number of axioms. Near the beginning of the first book of *the Elements*, Euclid gives five postulates (axioms) for plane geometry, stated in terms of constructions (as translated by Thomas Heath):

"Let the following be postulated"

- 1) "To draw a straight line from any point to any point."
- 2) "To produce [extend] a finite straight line continuously in a straight line."
- 3) "To describe a circle with any centre and distance [radius]."
- 4) "That all right angles are equal to one another."
- 5) *The parallel postulate*: "That, if a straight line falling on two straight lines make the interior angles on the same side less than two right angles, the two straight lines, if produced indefinitely, meet on that side on which are the angles less than the two right angles."

Today many other self-consistent non-Euclidean geometries are known, the first ones having been discovered in the early 19th century. *The Elements* remained the very model of scientific exposition until the end of the 19th century, when the German mathematician David Hilbert wrote his famous *Foundations of Geometry* (1899). The modern version of Euclidean geometry is the theory of Euclidean (coordinate) spaces of multiple dimensions. Thus, Euclid's statement of the postulates are also taken to be unique.

2. Найдите в текстах предложения с данными словами и словосочетаниями и письменно переведите их на русский язык.

Solid geometry; true in an absolute; three dimensions; model of scientific exposition; *the Elements*; self-consistent non-Euclidean geometries; Euclidean space; comprehensive deductive and logical system; stated in terms of constructions; interior angle.

3. Дайте английские эквиваленты следующим словам и выражениям.

Считаться истинным, представлять чего-л., метафизический смысл, прямой угол, выводить теорему, радиус, относить к чему-л., планиметрия, формулировка.

4. Определите, является ли утверждение истинным или ложным

	True	False
1. Plane geometry is still taught in schools.		
2. Euclid gives ten postulates for plane geometry.		
3. Euclid's postulates are stated in terms of theorems.		
4. All theorems are derived from a small number of axioms.		
5. Any theorem proved from Euclid's postulates was deemed true in an absolute, often metaphysical, sense.		
6. Many of Euclid's results had been stated by earlier mathematicians.		
7. Euclidean geometry studies plane and solid figures on the basis of axioms and theorems employed by Pythagoras.		

8. Euclidean geometry doesn't insist on the importance of proof.		
9. There is no other sort of geometry except Euclidean.		
10. Euclid's statement of the postulates are not taken to be unique.		

5. Восстановите постулаты Евклида и дайте их точную интерпретацию в современной геометрии. Представьте полученные аксиомы графически.

- a) ... any centre and any distance [radius]
- b) ... meet on that side on which are the angles less than the two right angles
- c) ... any point to any point
- d) ... equal to one another
- e) ... continuously in a straight line

1. "To draw a straight line from"
2. "To produce [extend] a finite straight line"
3. "To describe a circle with"
4. "That all right angle are"
5. The parallel postulate: "That, if a straight line falling on two straight lines make the interior angles on the same side less than two right angles, the two straight lines, if produced indefinitely... "

6. Переведите предложения, содержащие факты из биографии Евклида, на английский язык. Расположите полученные предложения в логическом порядке и используйте их в своём сообщении-презентации на тему "Жизнь и деятельность Евклида".

- 1) Многие люди полагают, что Евклид был основателем группы математиков в Египте.
 - 2) Возможно, Евклид был учеником Аристотеля.
 - 3) Он основал школу математики в большом университете Александрии.
 - 4) Не все исследователи считают, что Евклид – это один человек.
 - 5) Его полное имя Евклид Мегарский и Александрийский.
 - 6) Дата и место рождения и смерти Евклида неизвестны.
 - 7) Его научная деятельность относится к 322-275 годам до н.э.
 - 8) Его самым известным трудом считается собрание сочинений по геометрии «Начала».
 - 9) Некоторые предположения Евклида сейчас считаются ложными.
 - 10) Этот труд обобщил всё, что было известно по математике в то времена.
 - 11) Однако труды этого выдающегося математика оказали сильное влияние на умы того времени.
 - 12) В 13 томов вошли следующие темы: планиметрия, теория чисел, иррациональные числа, объём конуса.
- 7. Используйте фразы задания 6 и дополнительные источники для сообщений-презентаций на темы:**

Euclid life history

Euclidean geometry

Euclid's five postulates

The fifth postulate of Euclid

Plato – Euclid's teacher

TEXT 8

NON-EUCLIDEAN GEOMETRY

1. Прочитайте текст и выясните причину возникновения неевклидовой геометрии. Ответьте на вопросы.

- a) *What geometry is called "non-Euclidean"?*
- b) *Why did some critics argue on the subject of Parallel Postulate?*
- c) *Where is non-Euclidean geometry taught? Why?*

A non-Euclidean geometry is any geometry that contrasts the fundamental ideas of Euclidean geometry, especially with the nature of parallel lines. Any geometry that does not assume the parallel postulate or any of its alternatives is an absolute geometry (Euclid's own geometry, which does not use the parallel postulate until Proposition 28, can be called a neutral geometry). The first non-Euclidean geometries arose in the exploration of disputing Euclid's **notorious** Fifth Postulate, which states that if a straight line falling on two straight lines makes the interior angles on the same side less than two right angles, then the two straight lines, if produced indefinitely, meet on that side on which are the angles less than two right angles. Critics of the "parallel postulate" do not argue that it is a



mathematical fact. Instead, they do not find it as brief, simple, and self-evident as postulates are supposed to be. Furthermore, the converse of the parallel postulate, corresponding to Proposition 27, Book I, of Euclid's Elements, has a proof, which **fueled the argument** that the parallel postulate should be a theorem.

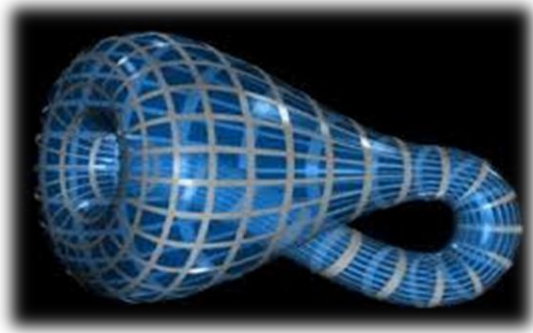
Many logically equivalent statements are included, but are not limited to the following:

- 1) Through a given point not on a given line, only one parallel can be drawn to the given line. (Playfair's Axiom)
- 2) A line that intersects one of two parallel lines intersects the other also.
- 3) There exists lines that are everywhere equidistant from one another.
- 4) The sum of the angles of a triangle is equal to two right angles.

- 5) For any triangle, there exists a similar noncongruent triangle.
- 6) Any two parallel lines have a common perpendicular.
- 7) There exists a circle passing through any three noncollinear points.

8) Two lines parallel to the same line are parallel to each other.

For two thousand years, geometers attempted to prove the parallel postulate,



but every proof failed due to an assumption made similar to the ones above or just **faulty thinking**. Probably the most interesting of these are the proofs of the 17th-18th century Italian geometer Girolamo Saccheri. He tried to prove it using a **reductio ad absurdum** argument. By proving that the sum of the

angles of a triangle cannot be greater than or less than 180 degrees, he would have achieved his goal. He successfully proved that they cannot be greater than 180 degrees, but could not find a **contradiction** of the latter case. He ended his proof and denied himself the opportunity to be history's first non-Euclidean geometer. This honour would be saved for two later mathematicians, Janos Bolyai and Nikolai Lobachevsky.



Both contemporaries of Carl Gauss, Lobachevsky and Bolyai did pioneering work in hyperbolic geometry, which keeps Euclid's other four postulates **intact**, but supposes that through any given point not on a given line, infinitely many lines can be drawn parallel to that given line. As opposed to Euclidean geometry, which asserts that the distance between any two lines is constant, hyperbolic geometry visually means that **lines curved** toward each other. They discovered this to be logically coherent and **feasible alternative** to Euclidean geometry. It is safe to assume that these facts were known to previous mathematicians such as Gauss and Adrien-Marie Legendre, both contributing much to elliptic functions. They conducted experiments that led them to conclude that the sum of the angles of a triangle can be less than 180 degrees. Sadly, Legendre did this in an attempt to prove the parallel postulate and Gauss never published his **findings** in order to avoid

controversy. Gauss, however, discovered much of differential geometry and ***potential theory***.

Bernhard Riemann, Gauss's student, in a famous lecture in 1854, established Riemannian geometry and discussed modern concepts such as ***curvature, manifolds*** and (Riemannian) metrics. By giving a formula for a family of Riemannian metrics on the unit ball in Euclidean space, Riemann constructed infinitely many possible non-Euclidean geometries and provided the logical foundation for elliptic geometry, which states that through a given point not on a given line, no parallel lines exist. Visually, we can interpret this as lines curving toward each other. We cannot call Riemann, however, ***the sole inventor*** of elliptic geometry since his theory extends to all geometries, including ***the default Euclidean n -space***. The ideas for elliptic and, mainly, hyperbolic geometry continued to be developed by mathematicians of the latter half of the century, such as Eugenio Beltrami, Felix Klein, and Henri Poincare. Such geometries have proven useful to the development of topology in the 20th century and to physics, notably in Albert Einstein's ***theory of general relativity***.



Though it is interesting, much of non-Euclidean geometry is ***far too advanced*** to be taught in high school (or even at the undergraduate level in college!) along with basic Euclidean geometry. In order to grasp it fully and do original work in it, one must have a good working knowledge of ***multivariable calculus***, linear and abstract algebra, real and complex analysis, and topology.

Other examples of a non-Euclidean geometry include affine geometry, the modern projective geometries of Girard Desargues, Blaise Pascal, Michel Chasles, Jean-Victor Poncelet and Jakob Steiner, the line geometry of Julius Plucker, the algebraic geometry of Frederigo Enriques and Francesco Severi, the enumerative geometry of Hermann Schubert, and the taxicab geometry of Hermann Minkowski.

2. Переведите на русский язык названия областей геометрии. Какая область не относится к неевклидовой?

Absolute geometry; neutral geometry; hyperbolic geometry; differential geometry; affine geometry; modern projective geometries; line geometry; algebraic geometry; enumerative geometry; taxicab geometry.

3. Соедините слова двух колонок так, чтобы получились словосочетания. Переведите полученные словосочетания на русский язык.

1. to achieve	a. the honor
2. to contrasts	b. the logical foundation
3. coherent	c. work
4. the converse	d. the opportunity
5. to save	e. postulate
6. to provide	f. work
7. to deny	g. the fundamental ideas
8. pioneering	h. alternative
9. original	i. of the parallel postulate
10.self-evident	j. one's goal

4. Найдите в тексте английские эквиваленты следующим словам и выражениям.

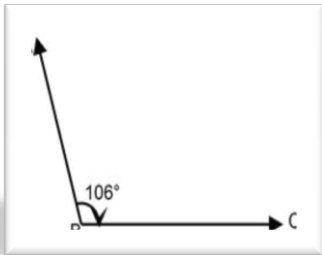
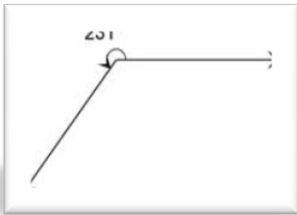
Общеизвестный; рассуждение от противного; кривые линии; вероятная альтернатива; теория потенциала; кривизна; многообразие; намного расширенный (углубленный); многомерный анализ; нетронутый; разжигать спор; единственный изобретатель; результаты изысканий; ложный ход мыслей; теория относительности; противоречие.

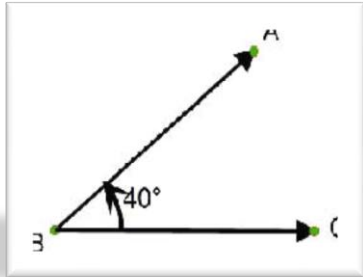
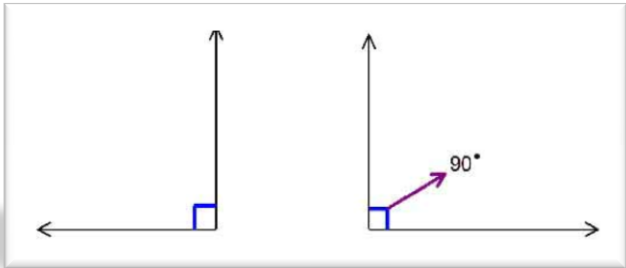
5. Заполните предложенную таблицу, опираясь на текст урока.

Non-Euclidean Geometries

Geometry	Hyperbolic	Riemannian		
Established by	Lobachevsky			
Concept	Lines curve toward each other			

6. Соедините термин с его определением и графическим изображением.

Type of Angle	Description	Graphics
A. Acute Angle	1. An angle that is less than 90° .	 <p>a.</p>
B. Right Angle	2. An angle that is greater than 90° but less than 180° .	 <p>b.</p>

C. Obtuse Angle	3. An angle that is greater than 180° .	c. 
D. Straight Angle	4. An angle that is exactly 90° .	d. 
E. Reflex Angle	5. An angle that is less than 90° .	e. 

7. Переведите предложения на русский язык, обращая внимание на подчёркнутые слова и словосочетания. Задайте вопросы к выделенным курсивом частям предложений.

- 1) The first non-Euclidean geometries arose in the exploration of disputing Euclid's notorious Fifth Postulate. (1)
- 2) The proof of the Fifth Euclidean Postulate fueled the argument that *the parallel postulate should be a theorem*. (1)
- 3) *The 17th-18th century Italian geometer* Girolamo Saccheri tried to prove Parallel Postulate using a reductio ad absurdum argument, but he stopped halfway. (2)

- 4) The honour to become the first non-Euclidean geometer was saved for *Janos Bolyai and Nikolai Lobachevsky*. (1)
- 5) Janos Bolyai and Nikolai Lobachevsky discovered that lines curved toward each other what is logically coherent and feasible alternative to Euclidean geometry, which asserts that *the distance between any two lines is constant*. (2)
- 6) Gauss and Adrien-Marie Legendre conducted experiments that *led them to conclude that the sum of the angles of a triangle can be less than 180 degrees*, but their attempts failed because of some reasons. (2)
- 7) Riemann constructed infinitely many *possible non-Euclidean geometries* and provided the logical foundation for elliptic geometry, which states that *through a given point not on a given line, no parallel lines exist*. (2)
- 8) Elliptic and, mainly, hyperbolic geometry were useful notably in *Albert Einstein's theory of general relativity*. (1)
- 9) In order to grasp non-Euclidean geometry fully and do original work in it, one must have *a good working knowledge in various fields of mathematics*. (1)
- 10) Other examples of a non-Euclidean geometry include *affine geometry, modern projective geometries, line geometry, algebraic geometry, enumerative geometry, taxicab geometry and so on*. (1)

8. Опираясь на упражнения к тексту и сам текст, составьте по памяти 10-15 предложений по теме "Non-Euclidian Geometry".

TEXT 9

THE HISTORY OF ARITHMETICS

- 1. Прочитайте текст и переведите его на русский язык. Сформулируйте определение арифметики.**

Arithmetics (from the Greek word ἀριθμός, *arithmos* "number") is the most ancient branch of mathematics, the science of numbers and operations on sets of numbers, used very popularly, for tasks ranging from simple day-to-day counting to advanced science and business calculations. It involves the study of quantity, especially as the result of operations that combine numbers. In common usage, it refers to the simpler properties when using the traditional operations of addition, subtraction, multiplication and division with smaller values of numbers. Arithmetic is closely connected with algebra, which includes the study of operations performed on numbers. Professional mathematicians sometimes use the term higher arithmetic when referring to more advanced results related to number theory, but this should not be confused with elementary arithmetic.



The art of computation arose and developed long before the times of the oldest written records extant. The prehistory of arithmetic is limited to a small number of artifacts which may indicate the conception of addition and subtraction, the best-known being the Ishango bone from central Africa, dating from somewhere between 20,000 and 18,000 BC, the Cahoon papyri and the famous Rhind papyrus (about 2000 BC).

The earliest written records indicate the Egyptians and Babylonians used all the elementary arithmetic operations as early as 2000 BC. The hieroglyphic system for Egyptian numerals, like the later Roman numerals, descended from tally marks used for counting. In both cases, this origin resulted in values that used a decimal base but did not include positional notation. Complex calculations with

Roman numerals required the assistance of a counting board or the Roman abacus to obtain the results.

Early number systems that included positional notation were not decimal, including the clumsy hexadecimal (sexagesimal) base 60 system for Babylonian numerals and the vigesimal (base 20) system that defined Maya numerals. Because



of this place-value concept, the ability to reuse the same digits for different values contributed to simpler and more efficient methods of calculation.

The continuous historical development of modern arithmetic starts with the Hellenistic civilization of ancient Greece, although it originated much later than the Babylonian and Egyptian examples. Prior to the works of Euclid around 300 BC, Greek studies in mathematics overlapped with philosophical and mystical beliefs. For example, Nicomachus summarized the viewpoint of the earlier Pythagorean approach to numbers and their relationships to each other in his *Introduction to Arithmetic*.

Greek numerals were used by Archimedes, Diophantus and others in a positional notation not very different from ours. Because the ancient Greeks lacked a symbol for zero (until the Hellenistic period), they used three separate sets of symbols. One set for the unit's place, one for the ten's place and one for the hundred's. Then for the thousand's place they would reuse the symbols for the unit's place, and so on. Their addition algorithm was identical to ours, and their multiplication algorithm was only very slightly different. Their long division algorithm was the same, and Archimedes, who may have invented it, knew the square root algorithm that was once taught in school. He preferred it to Hero's method of successive approximation because, once computed, a digit doesn't change, and the square roots of perfect squares, such as 7485696, terminate immediately as 2736. For numbers with a fractional part, such as 546.934, they used

negative powers of 60 instead of negative powers of 10 for the fractional part 0.934. The ancient Chinese used a similar positional notation. Because they also lacked a symbol for zero, they had one set of symbols for the unit's place and a second set for the ten's place. For the hundred's place they then reused the symbols for the unit's place, and so on. Their symbols were based on the ancient counting rods. It is a complicated question to determine exactly when the Chinese started calculating with positional representation, but it was definitely before 400 BC.

Very little is known about the initial development of arithmetic in India. The simplest fractions were utilized in India long before the Christian era. Our own decimal computation system is of Indian origin. The earliest written Indian mathematical records extant were compiled in the 5th century and indicate that the knowledge of arithmetic in India of that period was of a high standard. Indian mathematicians operated on integers and fractions using methods very similar to our own. They solved many problems on proportions and on the rule-of-three and could compute percentages. Studies on negative numbers began in India in the 7th century.

The gradual development of Hindu-Arabic numerals independently devised the place-value concept and positional notation, which combined the simpler methods for computations with a decimal base and the use of a digit representing 0. This allowed the system to represent both large and small integers. This approach eventually replaced all other systems. In the early 6th century AD, the Indian mathematician Aryabhata incorporated an existing version of this system in his work and experimented with different notations. In the 7th century, Brahmagupta established the use of 0 as a separate number and determined the results for multiplication, division, addition and subtraction of zero and all other numbers, except for the result of division by 0. His contemporary, the Syriac bishop Severus Sebokht described the excellence of this system as "...valuable methods of calculation which surpass description". The Arabs also learned this new method and called it *hesab*.



Leibniz's Stepped Reckoner was the first calculator that could perform all four arithmetic operations.

Although the Codex Vigilanus described an early form of Arabic numerals (omitting 0) by 976 AD, Fibonacci was primarily responsible for spreading their use throughout Europe after the publication of his book *Liber Abaci* in 1202. He considered the significance of this "new" representation of numbers, which he styled the "Method of the Indians" (Latin *Modus Indorum*), so fundamental that all related mathematical foundations including the results of Pythagoras and the algorism describing the methods for performing actual calculations, were "almost a mistake" in comparison.



In the Middle Ages, arithmetic was one of the seven liberal arts taught in universities.

The flourishing of algebra in the medieval Islamic world and in Renaissance Europe was an outgrowth of the enormous simplification of computation through decimals notation.

Various types of tools exist to assist in numeric calculations. Examples include slide rules (for multiplication, division and trigonometry) and monographs in addition to the electrical calculator.

2. Соотнесите русские и английские слова и выражения.

1. positional notation	1. гуманитарные науки
2. to perform operations	2. расчёты в бизнесе
3. prior to	3. сложные вычисления

4. to reuse	4. прогрессивная наука
5. negative powers	5. дробные числа
6. business calculation	6. источник (сведений)
7. contemporary	7. априори
8. complex calculations	8. азы арифметики
9. simpler properties	9. римские цифры
10.liberal arts	10.позиционная система счисления
11.elementary arithmetics	11.выполнять действия
12.slide rule	12.простейшие свойства
13.numbers with a fractional part	13.использовать повторно
14.origin	14.отрицательная степень
15.Roman numerals	15.современник
16.advanced science	16.логарифмическая линейка

3. Дайте английские эквиваленты.

Математические артефакты; теория чисел; квадраты простых чисел; объединять числа; преимущество; двадцатичная система счисления; изобретать; прогрессивные результаты; предъявление позиционного счисления; тройное правило; частично совпадать; Эллинистическая цивилизация; квадратный корень; родственные математические принципы; цифровой механический калькулятор; подход(метод); определить результат; счётные палочки; концепция замещения (место-значимости); десятичная система счисления; превосходить; шестидесятеричная система счисления; последовательное развитие; числовые метки; метод последовательных приближений.

4. Найдите лишнее слово в ряду:

a) equation, algorithm, addition, method of successive approximation;

- b) square roots, fractions, integers, percentages;
- c) concept, system, problem, method, doctrine.

5. Найдите слово или выражение с наиболее общим значением:

- a) zero, negative numbers, integers, positive numbers;
- b) square roots, fractions, real numbers, integers;
- c) viewpoint, approach, system, principle.

6. Выразите своё согласие/несогласие со следующими утверждениями, используя Приложение 1.

- 1) Arithmetics is the science of numerals and operations on sets of numbers.
- 2) Arithmetics includes the study of quantity, especially as the result of operations that combine numbers.
- 3) A small number of artifacts traces the art of computation.
- 4) Complex calculations with Roman numerals required the assistance of the Roman abacus to obtain the results.
- 5) The Babylonians used the clumsy sexagesimal system of notation.
- 6) The continuous historical development of modern arithmetic starts with the Mayan civilization.
- 7) Greek numerals included a universal symbol for zero.
- 8) Greek positional notation is not very different from ours.
- 9) Our own decimal computation system is of Chinese origin.
- 10) The place-value concept and positional notation is based on Hindu-Arabic numerals.
- 11) The Indian mathematicians made a great contribution to the operations with zero.
- 12) Brahmagupta invented the first calculator.
- 13) Fibonacci was primarily responsible for spreading Arabic numerals throughout Europe in 1202.

7. Ответьте на следующие вопросы и перескажите текст.

- 1) What traditional operations does arithmetics include?
- 2) When does the history of arithmetics go back to?
- 3) What is the prehistory of arithmetics limited to?
- 4) When do the first numerals descend from?
- 5) What tools did the ancients use?
- 6) What concept contributed to simpler and more efficient methods of calculation?
- 7) How did the ancient Greeks and Chinese operate with units, tens, hundreds when they lacked a symbol for zero?
- 8) What algorithms did the ancient Greeks know?
- 9) How did their notation look like?
- 10) What origin is our system of notation?
- 11) Who from the ancients came closer to the present-day system of notation?
- 12) What approach replaced all the systems of notations?
- 13) Who spread the new system of notation throughout Europe?
- 14) How did he evaluate the discovery of the Indians in his book?

8. Разработайте проект на одну из предложенных тем.

Notation systems of the future

Ancient artifacts of arithmetics

Calculator – a look from time immemorial

TEXT 10

GRETEST MATHEMATICIANS OF ALL TIME

1. Определите, кто из перечисленных учёных не принадлежит к плеяде математиков. Скажите, в какой области науки они известны.

Sir Isaac Newton, Galilei, Marie Curie, Albert Einstein, Charles Darwin, Archimedes of Syracuse, Nikola Tesla, Leonhard Euler, Stephen Hawking, Alan Turing, Thomas Edison, Alessandro Giuseppe Antonio Anastasio Volta, Carl Friedrich Gauss, Euclid.

	mathematicians	physicists	others
Sir Isaac Newton	✓	✓	
Galilei	...	...	...
...	...	...	...

2. Прочитайте предложенный *Top List* учёных-математиков. Согласны ли вы с приоритетом автора? Составьте свой вариант списка используя дополнительные источники и обсудите его с одноклассниками. Объясните свой выбор, используя фразы Приложения 1.

10. Pythagoras

Pythagoras of Samos was a well-known Ionian Greek mathematician, scientist, a religious teacher and a philosopher. He was born in Samos and is often hailed as the first great mathematician. He is often cherished as a great mystic and a scientist.



Living around 570 to 495 BC, in modern day Greece, he is known to have founded the Pythagorean cult. However, he is renowned for the Pythagorean Theorem that carries his name. The importance of this Theorem cannot be denied until now as it is the base of most

other theorems of Mathematics and his great theories lead to the development of geometry and therefore he is renowned as the Father of Modern Mathematics and a great mathematician.

According to Aristotle, the Pythagorean group was one of the first that widely studied advanced mathematics.

He believed that all relations could be expressed as numerical relations as in all things are numbers. He also observed that the vibrating strings create harmonious notes if the ratio of the length of the strings are whole numbers. The same ratio can be extended to other devices too.

He might have travelled widely in his youth, visiting [Egypt](#) and other places seeking knowledge.

Pythagoras also made important discoveries in music, astronomy and medicine. He set up a brotherhood with some of his followers who practiced his way of life and pursued his religious ideologies. He became one of the most distinguished teachers of religion in ancient Greece. Pythagoras's teachings were centered on the doctrine of metempsychosis. His doctrine later came to be known as "Pythagoreanism", which emphasized on esoteric and metaphysical ideologies. He might have travelled widely in his youth, visiting [Egypt](#) and other places seeking knowledge. He was intelligent and well-educated. Most of his works were lost throughout the history and very few survived.

9. Andrew Wiles

Andrew Wiles is still a living legend who made great contributions to the Mathematical Society. The British Mathematician Andrew John Wiles, was born on 11 April 1953 in Cambridge. Wiles is known to be quite an intelligent mathematician, due to the fact that he uncovered Fermat's Last



Theorem when he was only 10 years old. Wiles was educated at Merton College, Oxford where he gained his Bachelor's degree in Mathematics in 1974. He also carried out a research at Clare College, Cambridge and finally got his PhD in 1980. He stayed at The Institute for Advanced Studies at New Jersey in 1981 and later on became a Professor at Princeton University.

Wiles worked on a number of outstanding problems in number theory: the Birch and Swinnerton-Dyer conjectures, the principal conjecture of Iwasawa theory and the Shimura-Taniyama-Weil conjecture. But one of his greatest achievements includes his successful attempt to prove Fermat's Last Theorem. This proof resulted in him becoming quite popular and to suggest this he is a foreign member of the United States National Academy of Science, hence the man became an international mathematical legend. In recognition, he was awarded a special silver plaque – he was beyond the traditional age limit of 40 years for receiving the gold Fields Medal – by the International Mathematical Union in 1998. Many mathematicians had tried to solve it over the intervening centuries, but with no success. Wiles had been fascinated by the problem from the age of 10, when he first saw the conjecture. He spent 7 years of his life in isolation just to formulate his proof. It was later found out that there was an error in his proof. He isolated himself once again and reformulated the solution. Then, his proof was accepted.

His paper *Modular Elliptic Curves and Fermat's Last Theorem* was published in the *Annals of Mathematics*.

He is at present a Royal Society Research Professor at Oxford University.

8. Isaac Newton and Wilhelm Leibniz

These two genius are placed together as they are both often given the honour of being the "inventor" of modern infinitesimal calculus, and as such have both made monolithic contributions to the field.

Gottfried W. Leibniz was born at Leipzig on the first of July 1646.

He entered the University of Leipzig when he was fifteen as a law student.

In 1666, he applied for "Doctor of Law" degree in the University of Leipzig and aimed to obtain the post of assessor. Subsequently, Leibniz joined University of Altdorf.



In mathematics, his field of interest was theology but he then invented the calculus.

In 1674, he started working on calculus and by 1677. He had made a coherent system, which he published only in 1684. Later the publication of papers in a journal between 1682-1692 enhanced his mathematical and scientific reputation.

He is one of the most productive inventors of mechanical calculators and was the first who described a pinwheel calculator that was designed to perform the operations of multiplication, addition and subtraction, division and root extraction.

Leibniz's mathematical notation was used ever since it was published. The binary number system advanced by him laid down the foundation for the digital computers

Gottfried W. Leibniz died on 14 November 1716 because of deteriorated health.

Sir Isaac Newton was born on January 4, 1643 in the hamlet of Wools Thorpe, Lincolnshire, England.

He was enrolled at the King's School in Grantham, a town in Lincolnshire where he got his basic education.

He had innate intellectual abilities, Newton graduated Trinity College, at Cambridge. After getting his bachelor's degree in 1665, he studied mathematics,

physics, optics and astronomy on his own (Cambridge was closed for a couple years due to the Black Death plague). By 1666, he had completed his early work on his three laws of motion. Later he got his master's degree.

Among his biggest "inventions" was calculus.

Along with Gottfried Leibniz, Newton invented the infinitesimal calculus. His work helped in advancing every branch of mathematics. He is also appreciated for the generalized binomial theorem that is valid for any exponent. He is therefore one of the greatest mathematicians of all the time.

He was one of the inventors of calculus, built the first reflecting telescope and helped establish the field of classical mechanics with his seminal work, *Philosophiæ Naturalis Principia Mathematica*. He was the first to decompose white light into its component colors and gave us the three laws of motion, now known as Newton's laws.

7. Leonardo Pisano Bigollo



Living from 1170 to 1250, in the present-day Pisa, Italy, Leonardo Fibonacci is known by various names. Being of Pisa, he is called Leonardo of Pisa, which in Italian is Leonardo Pisano but he is better known by his nickname Fibonacci. His full name was Leonardo Pisano Bigollo. Historians are not sure what "bigollo" means. It could mean "traveller" or "good-for-nothing". Fibonacci was born in Italy but obtained his education in North Africa where his father held a diplomatic post. Fibonacci was taught mathematics in Bugia and travelled widely with his father, recognizing the enormous advantages of the mathematical systems used in the countries they visited.

Fibonacci ended his travels around the year 1200 and at that time he returned to Pisa. There he wrote a number of important texts which played an important role in reviving ancient mathematical skills and he made significant contributions of his own. Of his books we still have copies of *Liber abbaci* (1202), *Practica geometriae* (1220), *Flos* (1225), and *Liber quadratorum* (1225).

Fibonacci is considered to be one of the most talented mathematicians for the Middle Ages. He is renowned for introducing Fibonacci Series and the Arabic numbering system in Europe. Few people realise that it was Fibonacci that gave us our decimal number system (Hindu-Arabic numbering system) which replaced the Roman Numeral system. He shows how to use our current numbering system in his book *Liber abaci*. His work is still known as the major contribution in the development of the field of modern mathematics.

6. Alan Turing

Alan Turing is a British mathematician who has been called the father of computer science. During World War II, Turing bent his brain to the problem of breaking Nazi crypto-code and was the one to finally unravel messages protected by the infamous Enigma machine. He is known as the first true computer scientist and has also written outstanding papers on computing that are still affective and also formulated *the Turing test* which is still applicable for evaluation of computers "intelligence".



Alan Turing was instrumental in the development of the modern day computer. His design for a so-called "Turing machine" remains central to how computers operate today. The *Turing test* is an exercise in artificial intelligence that tests how well an AI (Artificial Intelligence) program operates.

English scientist Alan Turing was born Alan Mathison Turing on June 23, 1912, in Maida Vale, London, England. At a young age, he displayed signs of high intelligence. When Turing attended the well-known independent Sherborne School at the age of 13, he became particularly interested in math and science.

After Sherborne, Turing enrolled at King's College (University of Cambridge) in Cambridge, England, studying there from 1931 to 1934.

He received his PhD from Princeton University in 1938.

He made five major advances in the field of cryptanalysis including specifying the bomb, an electromechanical device used to help decipher German Enigma encrypted signals.

Alan Turing's career and life ended tragically when he was arrested and prosecuted for being gay. On June 8, 1954, Alan Turing was found dead of apparent suicide by his cleaning lady.

5. René Descartes

"I think; therefore I am."

René Descartes was a French philosopher, writer, mathematician and physicist. He was named as the "Father of Modern Philosophy", due to his well-known "Cogito Ergo Sum" philosophy.

He was born on March 31, 1596 in La Haye, a small town in central France, which has since been renamed after him to honour its most famous son.

He was extensively educated, first at a Jesuit college at the age of 8, then he earned a law degree at 22 at the University of Poitiers.



His investigations in theoretical physics led many scholars to consider him a mathematician first.

Descartes's influence in mathematics is equally apparent. One of his most lasting contribution is Cartesian coordinate system or analytical geometry. He invented the method of representing the unknowns in the equations by x , y and z or in the form of a , b and c . The introduction of Cartesian geometry has drastically changed the way distances are measured because points are now expressed as points on the graph. He also invented the standard notation that helps to show the exponents of powers. He is credited as the father of analytical geometry, the bridge between algebra and geometry, crucial to the discovery of infinitesimal calculus and analysis. Newton and Leibniz calculus were based on his work.

Descartes died of a bout of pneumonia in Stockholm, Sweden, on February 11, 1650.

4. Euclid

Euclid of "Alexandria" was born around 330 BC, presumably at Alexandria. Not much is even known about Euclid's appearance, and the sculptures or paintings seen today are mere products of the imagination of artists of how Euclid could have been. There have been certain documents that suggest that Euclid studied in Plato's ancient school in Athens, where only the opulent studied. He later shifted to Alexandria in Egypt, where he discovered a well-known division of mathematics, known as geometry.



Euclid was known as the "Father of Geometry" for a reason. He discovered the subject and gave it its value, making it one of the most complex forms of mathematics at the time.

He was known as the forerunner of geometrical knowledge and went on to contribute greatly in the field of

mathematics. Also known as, the "Father of Geometry", Euclid was known to have taught the subject of mathematics in Ancient Egypt during the reign of Ptolemy I. He was well-known, having written the most permanent mathematical works of all time, known as *the Elements* that comprised the 13 gigantic volumes filled with geometrical theories and knowledge. Euclid used the 'synthetic approach' towards producing his theorems, definitions and axioms in math.

The Elements sold more copies than the Bible and was used and printed countless times by mathematicians and publishers who have used the information even up to the 20th century. There was no end to Euclid's geometry, and he continued to develop theorems on various aspects of math such as "prime numbers" and other, basic "arithmetic". The system that Euclid went on to describe in *the Elements* was commonly known as the only form of geometry the world had witnessed and seen up until the 19th century. He concluded the principles of Euclidean geometry from a small set of axioms. Optics, ratios, data and conics are some of his other reputed works which are now lost with the mists of time.

Euclid logically and scientifically developed Mathematical formats of antiquity that are known to the world as *Euclidian Geometry* today.

He also wrote five other surviving works about spherical geometry, perspective number theory, conic sections and rigor. Very little information is known about his life and what he had written very earlier due to limited resources at that time.

The year and reason behind Euclid's death is unknown to mankind. However, there have been vague appropriations that suggest that he might have perished around 260 BC. The legacy he left behind after his death was far more profound than the impression he created when he was alive. His books and treatises were sold and used by personalities all over the world up until the 19th century.

3. Georg Friedrich Bernhard Riemann

Georg Friedrich Bernhard Riemann was a German scientist who was born to a poor family, in Breselenz, a village in the vicinity of Dannenberg in the Kingdom of Hanover (now known as the Federal Republic of Germany) but became an influential mathematician. At an early age, Riemann showcased extraordinary mathematical skills and unbelievable calculation abilities, but he was timid and underwent numerous nervous breakdowns. He also suffered from diffidence and a phobia of public speaking.



He made an outstanding contributions to number theory, differential geometry and analysis, and there are a number of theorems that bear his name like Riemannian Geometry, Riemann-Lowville differ integral, Riemann Integral and the Riemannian Surfaces. Riemann invented his theory of higher dimensions. In 1854, Riemann laid down the foundation for Einstein's General theory of Relativity.

He is widely known for his Riemann Hypothesis that indicates issues about the distribution of prime numbers and which was ignored on its first 50 years because of its legendary difficulties. The Clay Maths Institute has offered \$1 million for the proof of the theory and one will be a recipient of the Nobel Prize for mathematics for it.

In the spring of 1846 Riemann enrolled at the University of Göttingen. Gauss did lecture to Riemann, but he was only giving elementary courses. Riemann moved from Göttingen to Berlin University in the spring of 1847 to study under Steiner, Jacobi, Dirichlet and Eisenstein.

Riemann always suffered from health problems and that proved fatal for his life in the end.

In the autumn of 1862, Riemann caught a severe cold that eventually took form of the fatal tuberculosis. He died at the age of 39.

His everlasting contributions are still helping in the field of mathematics even after his death.

2. Carl Friedrich Gauss

Carl Friedrich Gauss was a German mathematician and a physicist who is also titled as "the Princeps mathematicorum", meaning "the Prince of Mathematicians" or "the foremost of mathematicians" and "greatest mathematician since antiquity" in Latin. He made great contribution to various fields like algebra, number theory, analysis, statistics, geophysics, differential geometry, optics, electrostatics and astronomy.



Carl Friedrich Gauss, born to a poor father and an illiterate mother, solved the puzzle of his own birth date and declared it to be 30 April 1777. Gauss was a genius since his childhood.

Carl Friedrich Gauss has proved his mathematical prowess and prodigy when he created his first major discovery at such a young age. When he was 21, he wrote his magnum opus entitled *Disquisitiones Arithmeticae* ("Arithmetical Investigations"), a foundational textbook that laid out the tenets of number theory (the study of whole numbers). This work was essential for building up number theory and has curved the field to the current period.



The local duke recognised his talent and sent him to the Collegium Carolinum before he went the most prestigious mathematical university across the globe, Göttingen. When he graduated at the age of 22 in 1798, he started developing his mathematical ideas especially on number theory, discussing the prime numbers. Without number theory, you could kiss computers goodbye. Computers operate, on the most basic level, using just two digits – 1 and 0, and

many of the advancements that we've made in using computers to solve problems are solved using number theory. Gauss was prolific, and his work on number theory was just a small part of his contribution to math; you can find his influence throughout algebra, statistics, geometry, optics, astronomy and many other subjects that underlie our modern world. He referred mathematics as Queen of all sciences and brought in the concept of Gaussian gravitational constant into physics, and proved Algebra's fundamental theorem before he was 24.

In the 18th century he proved the possibility of a 17 sided regular polygon with the help of a ruler and compass only.

He worked hard until his death, some of his students were very influenced by him such as Bernhard Riemann, Richard Dedekind and Friedrich Bessel, who themselves became great mathematicians in their lives.

In 1855, Gauss expired in Göttingen, Hannover (now part of Lower Saxony, Germany) and was cremated in Albanifriedhof. After a study of his brain by Rudolf Wagner, it was known that Gauss's brain had a mass of 1,492 grams and the cerebral area was 219,588 mm² (340.362 square inches), proving that Gauss was a real genius!

1. Leonhard Euler

While Gauss is considered as the Prince of Mathematics, Leonhard Euler is hailed as the King of Mathematics. This blind genius is regarded as the greatest mathematician of all time. After the time of Euler, all mathematical formulas were named after the mathematicians who have discovered them.

Born on April 15, 1707 in Basel, Switzerland, Leonhard Euler was one of math's most pioneering thinkers. He was considered to be on par with Albert Einstein in terms of intelligence level.



Though originally slated for a career as a rural clergyman, Euler showed an early aptitude and propensity for mathematics, and thus, after studying with Johan Bernoulli, he attended the University of Basel and earned his Master's during his teens. Moving to Russia in 1727, Euler served in the navy before joining the St. Petersburg Academy as a professor of physics and later heading its mathematics division.

Euler is known as an outstanding mathematician of the 18th century, the most prolific and great mathematician of all the time, with beauty in his theorems and concept he had done extraordinary work.

He made great discoveries in the fields of geometry, trigonometry, calculus (infinitesimal calculus), differential equations, number theory (graph theory) and notational systems – including the utilization of π and $f(x)$ – among a legion of other accomplishments.

He released hundreds of articles (over 900 publications) and publications during his lifetime and continued to publish after losing his sight. He suffered from a brain hemorrhage and died during the night of September 18, 1783 in St. Petersburg.

2. Соотнесите русские и английские слова и выражения.

1. doctrine	a. выдающееся произведение искусства
2. principle conjectures	b. 17-сторонний правильный многоугольник
3. intervening centuries	c. догматы теории чисел
4. infinitesimal calculus	d. искусственный интеллект

5. coherent system	e. конические сечения
6. pinwheel calculator	f. цифровой компьютер
7. digital computer	g. прошедшие столетия
8. innate intellectual abilities	h. учение, теория
9. binomial theorem	i. основные гипотезы
10. break crypto-code	j. исчисление бесконечно малых
11. artificial intelligence	k. арифмометр
12. conic sections	l. последовательная система
13. magnum opus	m. бином Ньютона
14. tenets of number theory	n. врождённые умственные способности
15. 17 sided regular polygon	o. взламывать шифр

3. Найдите в текстах предложения с данными словами и словосочетаниями и письменно переведите их на русский язык.

To carry out research; plaque; hamlet; to decompose light into its component colours; diffidence; major advances; exponents of powers; forerunner; to showcase extraordinary mathematical skills; higher dimensions; assessor; to be valid for any exponent; to bend smb's brain; unravel messages; to underlie.

4. Найдите в текстах английские эквиваленты для следующих слов и словосочетаний.

Возрождение древних математических навыков; одинаково очевидно; состоятельный человек; основательный; испытывать нервные срывы; ряд Фибоначчи; суицид; решающий; окрестности; склонность к математике; оценивать способности компьютера; стандартное понятие; простые числа; достижения; использование.

5. Заполните таблицу, опираясь на информацию из предложенных текстов.

Full Name	Date of birth and death	Education	Contribution to the development of Mathematics	Works & Achievements
Pythagoras of Samos	570 BC - 495 BC	Pythagoreanism	the Pythagoras Theorem	Most of his works were lost throughout the history and very few survived.
.....				

6. Прочитайте факты из жизни учёных. Определите, о ком из известных математиков в них говорится? Сравните свои предположения с предположениями одногруппников.

(1.Riemann, 2.Fibonacci, 3.Leibniz, 4.Wiles, 5. Pythagoras, 6. Euclid, 7. Gauss, 8. Turing, 9. Euler)

A. ... He went on a short trip to London before his arrival in Hanover in 1676. During this trip, Newton accused him of stealing his unpublished work on calculus. ... He met with the [Royal Society](#) where he demonstrated a calculating machine that

he had designed and had been building since 1670. The machine was able to execute all four basic operations (adding, subtracting, multiplying and dividing), and the Society quickly made him an external member.

B. ... *He could be called the founding Father of Modern Mathematics. His cult was considered by Aristotle as one of the first groups that have extensively studied advance mathematics. He accepted priesthood and performed the rites that were required in order to enter one of the temples in Egypt, known as Diospolis. He believed that a person's soul does not die and is destined to a cycle of rebirths. The soul is freed from the cycle of births only through the purity of its life.*

C. ... *When he was studying mathematics, he used the Hindu-Arabic (0-9) symbols instead of Roman symbols, which didn't have 0's and lacked place value. ... It was this problem that led him to the introduction of His Numbers and His Sequence which is what he remains famous for to this day. The sequence is 1, 1, 2, 3, 5, 8, 13, 21, 34, 55... This sequence, shows that each number is the sum of the two preceding numbers. It is a sequence that is seen and used in many different areas of mathematics and science. ...During his boyhood his father, Guglielmo, a Pisan merchant, was appointed consul over the community of Pisan merchants in the North African port of Bugia.*

D. ...*He is the only living mathematician today who is recognised for his development of the proof of Fermat's Last Theorem. His contributions may not be as grand as what have others have contributed, but he was able to formulate portions of new mathematics to support his theorem. He spent 7 years of his life in isolation just to formulate his proof.*

E. ...*Weber and he invented the first electromechanical telegraph in 1833, which linked the observatory with the Institute for physics in Göttingen.*

F. ... *Apart from being a tutor at the Alexandria library, he coined and structured the different elements of mathematics, such as Prisms, geometric systems, infinite values, factorizations, and the congruence of shapes that went on to contour His Geometry.*

G. ... Over the next two years, he studied mathematics and cryptology at the Institute for Advanced Study in Princeton, New Jersey. He returned to Cambridge, and then took a part-time position with the Government Code and Cypher School, a British code-breaking organization.

H. ... At 13, he was already attending lectures at the local university, and in 1723 gained his Master's degree, with a dissertation comparing the natural philosophy systems of Newton and Descartes. ... He wrote two articles on reverse trajectory, which were highly valued by his teacher Bernoulli.

I. ... Through the years, many mathematicians were able to understand his work, and it rose to be one of the greatest questions in the world of modern science, which confound and baffle other great mathematicians. There has been progress about his theory, but it is noted to be incredibly slow. It is believed that new mathematics can help in discovering the proof of such theory.

7. Обобщите информацию прочитанных текстов, выписав тезисные предложения обо всех учёных. Кто, из выше упомянутых учёных по вашему мнению, внёс наибольший вклад в развитие математики? Аргументируйте своё мнение. (См. приложение №1.)

Model:

Leonhard Euler is hailed as the King of Mathematics.

Leonhard Euler was one of math's most pioneering thinkers.

He attended the University of Basel.

He made great discoveries in the fields of geometry, trigonometry, calculus, differential equations, number theory and notational systems.

I think that Euler is an outstanding mathematician of the 18th century, the most prolific and great mathematician of all the time, because having earned his Master's during his teens he made great discoveries in different fields of mathematics.

9. Из приведённого списка прилагательных выберите наиболее подходящие для характеристики качеств, которыми, на ваш взгляд, должен обладать учёный-математик. Выразите свою точку зрения, используя Приложение №1.

Persistent, studious, well-read, honest, noble, gifted, genial, brainy, sharp-witted, erudite, enthusiastic, as sharp as a needle, self-determined, self-reliant, ambitious, persevering, energetic, industrious, patient, determined, frank, thoughtful, self-contained, focused, accurate, reasoned.

Model:

In my view, a true scientist must be self-reliant, persevering, and patient to achieve great results in the scientific work. ***E.g.***: Andrew Wiles spent 7 years of his life in isolation just to formulate his proof. It was later found out that there was an error in his proof. He isolated himself once again and reformulated the solution. Then, his proof was accepted.

10. Сделайте доклад-презентацию на одну из предложенных тем.

Mathematicians who changed the world

Muslim inventions that changed the world

Large Hadron Collider

Supplementary Reading

TEXT 1

WOMEN IN MATHS

Ever wondered why stories about mathematicians always seem to be about men? Is it because men are better at maths than women? Absolutely not, it's because until very recently society dictated that it wasn't very respectable for women to be mathematicians. Unfair as it was, it was very difficult for a woman to make herself heard and to be accepted by other mathematicians. It just wasn't the done thing in polite society. But there were a few women who dared to go against the flow, and their achievements demonstrate that women have as much to contribute to mathematics as any of their male counterparts. This article is about just a handful of the most famous women in the history of maths, but there are plenty more successful women out there.



Caroline Herschel was the sister of a very famous astronomer, William Herschel who was credited with discovering the planet Uranus. Caroline assisted her brother with his astronomical observations and did most of the complicated mathematical calculations that were involved in working out the position of stars and planets. Before long she was conducting observations of her own and discovered several new comets, which was a major achievement for any astronomer. When King George III gave her an annual salary for her astronomical work, Caroline became the first woman ever to be paid for doing a scientific job. The Royal Astronomical Society awarded her a Gold Medal in 1828, and she was honored throughout Europe.



Another famous woman in mathematics was Mary Somerville, who was born in 1780. She taught herself maths at home because at that time girls didn't learn maths at school. She was married twice, and her second husband was interested in maths and science. He introduced her to all kinds of famous mathematicians who were amazed to find that she understood their work extremely well, which was more than could be said for a lot of the men working in maths at the time. A friend asked her to translate a very important work by a French mathematician called Laplace, and she not only translated it, but added some original work and made it much easier for other people to understand. She wrote several other books that made maths and science accessible to a much wider audience.

Ada Lovelace was the daughter of the famous poet Lord Byron, though she never met her father. She was taught by Mary Somerville and through her family and friends she met several influential mathematicians and scientists, one of whom was Charles Babbage. Together, Lovelace and Babbage worked on the theoretical principles of the Analytical Engine, a machine which Babbage had designed, but which was never finished in their lifetime. The engine was designed to perform vast quantities of complex calculations, using a complicated mechanism of wheels and cogs, saving mathematicians a lot of time and effort. Lovelace contributed some highly original ideas to how it could be used to automate very difficult mathematical processes. Lovelace realized that a calculating machine could be programmed in the same way as a weaving machine, using cards with holes punched in them in a specific arrangement. She is now regarded as one of the earliest pioneers of computer programming.

Did you know that Florence Nightingale was a mathematician as well as a nurse? She developed systems of collecting, analysing, interpreting and displaying

data about diseases and patients' deaths, which are now considered to be quite advanced statistical methods. Because she presented her statistics so clearly and persuasively, civil servants could understand them and were more easily convinced by her arguments for improved healthcare and sanitation. She was the first woman to be elected a member of the Royal Statistical Society, and her work contributed to the improvement of medical care in India as well as Britain.

Many of the women featured in this article were still quite restricted in what they were allowed to do and often depended on male collaborators to make their work seem respectable. Thanks to their success and determination opinions have changed, although it happened very slowly. Today there are hundreds of thousands of women working in mathematics, pushing the boundaries of knowledge and doing award-winning research. Who knows what the next generation of female mathematicians will achieve?

TEXT 2

FLORENCE NIGHTINGALE'S CONTRIBUTION TO MATHEMATICS

The rare photograph of Florence Nightingale was taken by Lizzie Caswall Smith in 1910. The black and white image of the silver-haired nursing pioneer shows her in the imposing bedroom of her home just off London's Park Lane before her death in 1910 at the age of 90.

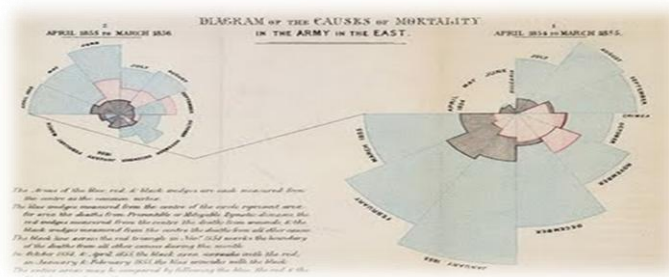


Florence Nightingale is most remembered as a pioneer of nursing and a reformer of hospital sanitation methods. For most of her ninety years, Nightingale pushed for reform of the British military health-care system and with that the profession of nursing started to gain the respect it deserved.

During the American Civil War, Nightingale was a consultant on army health to the United States government. She also responded to a British war office request for advice on army medical care in Canada. Her mathematical

activities included ascertaining "the average speed of transport by sledge" and calculating "the time required to transport the sick over the immense distances of Canada".

Unknown to many, Florence Nightingale is credited with developing a form



of the pie chart now known as the polar area diagram, or occasionally the Nightingale rose diagram, equivalent to a modern circular histogram to dramatize the needless deaths caused by

unsanitary conditions and the need for reform during the Crimean War.

The legend reads:

The Areas of the blue, red and black wedges are each measured from the centre as common vertex.

The blue wedges measured from the centre of the circle represent area for area the deaths from Preventable or Mitigable Zymotic diseases, the red wedges measured from the centre the deaths from wounds, and the black wedges measured from the centre the deaths from all other causes. The black line across the red triangle in Nov. 1854 marks the boundary of the deaths from all other causes during the month. In October 1854 and April 1855, the black area coincides with the red, in January and February 1855, the blue coincides with the black. The entire areas may be compared by following the blue, the red and the black lines enclosing them.

TEXT 3

ABOUT THE ORIGIN OF "+" AND "-" SIGNS IN ARITHMETIC

We can never think of mathematics without the "+" plus and "-" minus signs. While we do have a plethora of mathematical symbols for division ($\div$), multiplication ($\times$),



integral ($\int$) etc., at its core is

always the "+" and "-"

symbols. From our

elementary days, we've

been taught about these two

integral symbols. It could

be considered as the ABC's

of mathematics and things

wouldn't have been the same without them. The same symbols are used everywhere,

around the world. It wouldn't hurt to know how these forms originated and

evolved.

The signs as used in the earliest civilizations

The plus and minus signs (+ and -) are mathematical symbols used to represent operations of addition and subtraction as well as the notions of the positive and negative. Moreover, the Plus and Minus are Latin terms meaning "more" and "less" respectively. The origins of these two symbols date back to the Egyptian hieroglyphics where they used symbols which resembled "a pair of walking legs", either walking away or towards, representing addition or subtraction. Similarly, just like the Greeks, the Hindus too, did not have a particular sign for addition and subtraction. Many a times, they used "yu" to mark addition. "Yu" was used in the Bakhshali manuscript arithmetic, belonging to the period of 3rd or 4th century. In the early 15th century Europe, it was noted that "P" and "M" were used for the same.

Early recorded history of the signs

It has been recorded that the sign "+" has its origin from the Latin word "et" which meant "and". Nicole d'Oresme, astronomer and author of the book, *The Book of the Sky and the World* in 14th century, used the "+" sign as a shorthand for the word "et". The use of the "-" sign was first recorded in the year 1481, from a manuscript of German algebra located in Dresden Library. Johannes Widman, the famous German mathematician, published the first printed book named *Mercantile Arithmetic* in Leipzig in 1489, where he used the "+" and "-" signs. The beginning of 17th century also saw the usage of these two symbols by mathematicians Cavalieri and Gloriosi as well as astronomer Christopher Clavius.

But it was Robert Recorde, the acclaimed Welsh mathematician and designer of the equal (=) sign, who introduced to Britain in 1557 the same Plus and Minus that we've been using till now.

It seems there were different versions of these signs used by various people, but it was Robert Recorde who gave us the signs that we use till now, passed generations after generations before being accepted universally.

TEXT 4

ARITHMETIC OPERATIONS



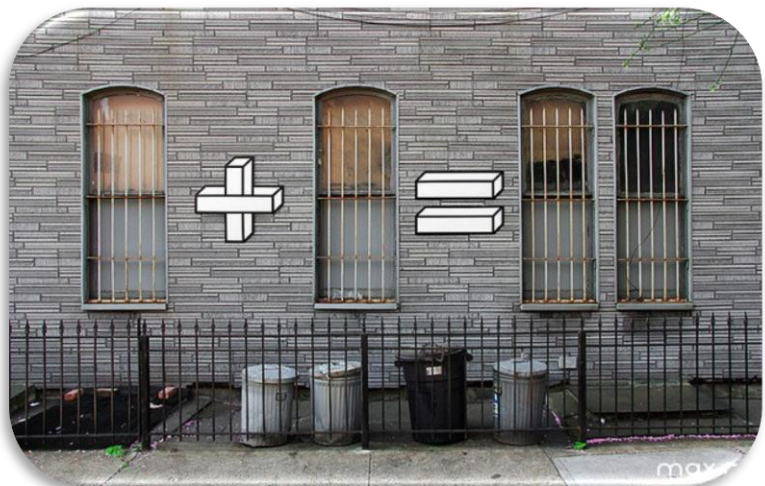
The basic arithmetic operations are addition, subtraction, multiplication and division, although this subject also includes more advanced operation, such as manipulations of percentages, square roots, exponentiation and logarithmic functions. Arithmetic is performed according to an order of operations.

Any set of objects upon which all four arithmetic operations (except division by 0) can be performed, and where these four operations obey the usual laws is called a field.

Addition (+) [\[edit\]](#)

Addition is the basic operation of arithmetic. In its simplest form, addition combines two numbers, the *addends* or terms, into a single number, the *sum* of the numbers. (Such as $2 + 2 = 4$ or $3 + 5 = 8$.)

Adding more than two numbers can be viewed as repeated addition; this procedure is known as summation and includes ways to add infinitely many numbers in an infinite series; repeated addition of the number 1 is the most basic form of counting.



Addition is **commutative** and **associative**, so the order the terms are added in does not matter. The **identity element** of addition (the **additive identity**) is 0, that is, adding 0 to any number yields that same number. Also, the **inverse element** of addition (the **additive inverse**) is the opposite of any number, that is, adding the opposite of any number to the number itself yields the additive identity, 0. For example, the opposite of 7 is -7 , so $7 + (-7) = 0$.

Addition can be given geometrically as in the following example.

If we have two sticks of lengths 2 and 5, then if we place the sticks one after the other, the length of the stick thus formed is $2 + 5 = 7$.

Subtraction (−)

Subtraction is the opposite of addition. Subtraction finds the *difference* between two numbers, the *minuend* minus the *subtrahend*. If the minuend is larger than the subtrahend, the difference is positive; if the minuend is smaller than the subtrahend, the difference is negative; if they are equal, the difference is 0.

Subtraction is neither **commutative** nor **associative**. For that reason, it is often helpful to look at subtraction as addition of the minuend and the opposite of the subtrahend, that is $a - b = a + (-b)$. When written as a sum, all the properties of addition hold.



There are several methods for calculating results, some of which are particularly advantageous to machine calculation. For example, digital computers employ the method of **two's complement**. Of great importance is the counting up method by which change is made. Suppose an amount P is given to pay the required

amount Q , with P greater than Q . Rather than performing the subtraction $P - Q$ and counting out that amount in change, money is counted out starting at Q and continuing until reaching P . Although the amount counted out must equal the result of the subtraction $-Q$, the subtraction was never really done and the value of $P - Q$ might still be unknown to the change-maker.

Multiplication ($\times$ or $\cdot$ or $*$)

Multiplication is the second basic operation of arithmetic. Multiplication also combines two numbers into a single number, the *product*. The two original numbers are called the *multiplier* and the *multiplicand*, sometimes both simply called *factors*.

Multiplication is best viewed as a scaling operation. If the numbers are imagined as lying in a line, multiplication by a number, say x , greater than 1 is the same as stretching everything away from 0 uniformly, in such a way that the number 1 itself is stretched to where x was. Similarly, multiplying by a number less than 1 can be imagined as squeezing towards 0. (Again, in such a way that 1 goes to the multiplicand.)

Multiplication is commutative and associative; further it is [distributive](#) over addition and subtraction. The [multiplicative identity](#) is 1, that is, multiplying any number by 1 yields that same number. Also, the [multiplicative inverse](#) is the [reciprocal](#) of any number (except 0; 0 is the only number without a multiplicative inverse), that is, multiplying the reciprocal of any number by the number itself yields the multiplicative identity.

The product of a and b is written as $a \times b$ or $a \cdot b$. When a or b are expressions not written simply with digits, it is also written by simple juxtaposition: ab . In computer programming languages and software packages in which one can only use characters normally found on a keyboard, it is often written with an asterisk: $a * b$.

Division ($\div$ or $/$)

Division is essentially the opposite of multiplication. Division finds the *quotient* of two numbers, the *dividend* divided by the *divisor*. Any dividend **divided by 0** is undefined. For positive numbers, if the dividend is larger than the divisor, the quotient is greater than 1, otherwise it is less than 1 (a similar rule applies for negative numbers). The quotient multiplied by the divisor always yields the dividend.

Division is neither commutative nor associative. As it is helpful to look at subtraction as addition, it is helpful to look at division as multiplication of the dividend times the **reciprocal** of the divisor, that is $a \div b = a \times \frac{1}{b}$. When written as a product, it obeys all the properties of multiplication

Basic arithmetic operations

The techniques used for compound unit arithmetic were developed over many centuries and are well-documented in many textbooks in many different languages. In addition to the basic arithmetic functions encountered in decimal arithmetic, compound unit arithmetic employs three more functions:

- **reduction** where a compound quantity is reduced to a single quantity, for example conversion of a distance expressed in yards, feet and inches to one expressed in inches.
- **expansion**, the **inverse function** to reduction, is the conversion of a quantity that is expressed as a single unit of measure to a compound unit, such as expanding 24 oz. to 1 lb., 8 oz.
- **normalization** is the conversion of a set of compound units to a standard form – for example rewriting "1 ft. 13 in" as "2 ft. 1 in".

Knowledge of the relationship between the various units of measure, their multiples and their submultiples forms an essential part of compound unit arithmetic.

TEXT 5

THE HISTORY OF NEGATIVE NUMBERS



Although the first set of rules for dealing with negative numbers was stated in the 7th century by the Indian mathematician Brahmagupta, it is surprising that in 1758 the British mathematician Francis Maseres was claiming that negative numbers

"... darken the very whole doctrines of the equations and make dark of the things which are in their nature excessively obvious and simple" .

Maseres and his contemporary, William Friend took the view that negative numbers did not exist. However, other mathematicians around the same time had decided that negative numbers could be used as long as they had been eliminated during the calculations where they appeared.

It was not until the 19th century when British mathematicians like De Morgan, Peacock, and others began to investigate the "laws of arithmetic" in terms of logical definitions that the problem of negative numbers was finally sorted out.

However, there were references to negative numbers far earlier...

In 200 BCE the Chinese number rod system represented positive numbers in Red and Negative numbers in black. These were used for commercial and tax calculations where the black cancelled out the red. The amount sold was positive (because of receiving money) and the amount spent in purchasing something was negative (because of paying out); so a money balance was positive, and a deficit negative.

132			≡	
5089	≡		⊥	≡
-704		⊥		
-6027	⊥		=	⊥
-8053	⊥		=	⊥

The concept also appeared in Astronomy where the ideas of "strong" and "weak" were used for approximating a number from above or below. For example approaching 5 from above means for example, starting with 5.2 you can find better approximations 5.1, 5.05, 5.025. Thus 5.025 was called a "strong" approximation and a number like 4.9 "weak". So "strong" numbers were called positive and "weak" numbers negative.

In **India** , negative numbers did not appear until about 620 CE in the work of Brahmagupta (598-670) who used the ideas of "fortunes" and "debts" for positive and negative. By this time a system based on place-value was established in India, with zero being used in the Indian number system. Brahmagupta used a special sign for negatives and stated the rules for dealing with positive and negative quantities as follows.



A debt minus zero is a debt.

A fortune minus zero is a fortune.

Zero minus zero is a zero.

A debt subtracted from zero is a fortune.

A fortune subtracted from zero is a debt.

The product of zero multiplied by a debt or fortune is zero.

The product of zero multiplied by zero is zero.

The product or quotient of two fortunes is one fortune.

The product or quotient of two debts is one fortune.

The product or quotient of a debt and a fortune is a debt.

The product or quotient of a fortune and a debt is a debt.

The conflict between geometry and algebra

The ancient **Greeks** did not really address the problem of negative numbers, because their mathematics was founded on geometrical ideas. Lengths, areas and volumes resulting from geometrical constructions necessarily all had to be positive. Their proofs consisted of logical arguments based on the idea of magnitude. Magnitudes were represented by a line or an area, and not by a number (like 4.3 metres or 26.5 cubic centimetres). In this way, they could deal with "awkward" numbers like square roots by representing them as a line. For example, you can draw the diagonal of a square without having to measure it.

About 300 CE, the Alexandrian mathematician Diophantus (200-c.284 CE) wrote his *Arithmetica*, a collection of problems where he developed a series of symbols to represent the "unknown" in a problem and powers of numbers. He dealt with what we now call linear and quadratic equations. In one problem Diophantus wrote the equivalent of $4 = 4x + 20$ which would give a negative result, and he called this result "absurd".

In the 9th century in **Baghdad** Al-Khwarizmi (c.780-c.850 CE) presented six standard forms for linear or quadratic equations and produced solutions using algebraic methods and geometrical diagrams. In his algebraic methods he acknowledged that he derived ideas from the work of Brahmagupta and therefore was happy with the notion of negative numbers. However, his geometrical models (based on the work of Greek mathematicians) persuaded him that negative results were meaningless (how can you have a negative square?). In a separate treatise on the laws of inheritance, Al-Khwarizmi represents negative quantities as debts.

In the 10th century Abul-Wafa (940-998 CE) used negative numbers to represent a debt in his work on "what is necessary from the science of arithmetic for

scribes and businessmen". This seems to be the only place where negative numbers have been found in medieval Arabic mathematics. Abul-Wafa gives a general rule and gives a special case where subtraction of 5 from 3 gives a "debt" of 2. He then multiplies this by 10 to obtain a "debt" of 20, which when added to a "fortune" of 35 gives 15.

In the 12th century Al-Samawal (1130-1180) produced an algebra where he stated that:

- if we subtract a positive number from an "empty power", the same negative number remains,
- if we subtract the negative number from an "empty power", the same positive number remains,
- the product of a negative number by a positive number is negative, and by a negative number is positive.

Negative numbers did not begin to appear in Europe until the 15th century when scholars began to study and translate the ancient texts that had been recovered from Islamic and Byzantine sources. This began a process of building on ideas that had gone before, and the major spur to the development in mathematics was the problem of solving quadratic and cubic equations.

As we have seen, practical applications of mathematics often motivate new ideas and the negative number concept was kept alive as a useful device by the Franciscan friar Luca Pacioli (1445-1517) in his *Summa* published in 1494, where he is credited with inventing double entry book-keeping.

TEXT 6

FRACTALS: USEFUL BEAUTY

(FRACTAL GEOMETRY)



Fractals is a new branch of mathematics and art. Perhaps this is the reason why most people recognise fractals only as pretty pictures useful as backgrounds on the computer screen or original postcard patterns. But what are they really?

Most physical systems of nature and many human artifacts are not regular geometric shapes of the standard geometry derived from Euclid. Fractal geometry offers almost unlimited ways of describing, measuring and predicting these natural phenomena. But is it possible to define the whole world using mathematical equations?

This article describes how the four most famous fractals were created and explains the most important fractal properties, which make fractals useful for different domain of science.

Many people are fascinated by the beautiful images termed fractals. Extending beyond the typical perception of mathematics as a body of complicated, boring formulas, fractal geometry mixes art with mathematics to demonstrate that equations are more than just a collection of numbers. What makes fractals even more interesting is that they are the best existing mathematical descriptions of many natural forms such as coastlines, mountains or parts of living organisms.

Although fractal geometry is closely connected with computer techniques, some people had worked on fractals long before the invention of computers. Those people were British cartographers, who encountered the problem in measuring the length of Britain coast. The coastline measured on a large scale map was

approximately half the length of coastline measured on a detailed map. The closer they looked, the more detailed and longer the coastline became. They did not realise that they had discovered one of the main properties of fractals.

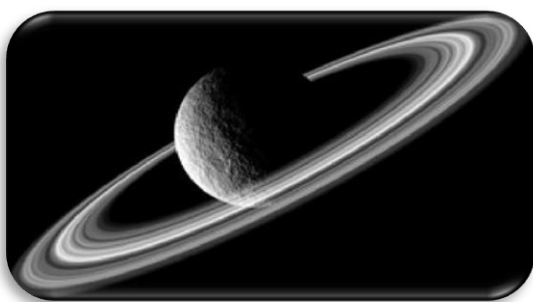
Fractals' properties

Two of the most important properties of fractals are self-similarity and non-integer dimension.



What does self-similarity mean? If you look carefully at a fern leaf, you will notice that every little leaf – part of the bigger one – has the same shape as the whole fern leaf. You can say that the fern leaf is self-similar. The same is with fractals: you can magnify them many times and after every step you will see the same shape, which is characteristic of that particular fractal.

The non-integer dimension is more difficult to explain. Classical geometry deals with objects of integer dimensions: zero dimensional points, one dimensional lines and curves, two dimensional plane figures such as squares and circles and



three dimensional solids such as cubes and spheres. However, many natural phenomena are better described using a dimension between two whole numbers. So while a straight line has a dimension of one, a fractal curve will have a dimension between one and two, depending on how much space it takes up as it twists and curves. The more the flat fractal fills a plane, the closer it approaches two dimensions. Likewise, a "hilly fractal scene" will reach a dimension somewhere between two and three. So a fractal landscape made up of a large hill covered with tiny mounds would be close to the second dimension, while a

rough surface composed of many medium-sized hills would be close to the third dimension.

TEXT 7

SOAP FILMS HELP TO SOLVE MATHEMATICAL PROBLEMS

Soap bubbles and films have always fascinated children and adults, but they can also serve to solve complex mathematical calculations. This is shown by a study carried out by two professors at the University of Málaga, who have succeeded in solving classic problems using just such an innovative procedure.

"With the aid of soap films we have solved variational mathematical problems, which appear in the formulation of many physical problems," explains Carlos Criado, professor at the University of Málaga. Together with his colleague Nieves Álamo, he has just published his work in the *American Journal of Physics*.

Soap films always adopt the shape which minimizes their elastic energy, and therefore their area, so that they turn out to be ideal in the calculus of variations, "where we look for a function that minimizes a certain quantity (depending on the function)," adds the researcher.

"Of course there are other ways to solve variational problems, but it turns out to be surprising, fun and educative to obtain soap films in the shape of brachistochrones, catenaries and semicircles," Criado emphasizes.

The professor offers the example of the famous problem of the brachistochrone curve. What shape must a wire be in order that a ball travels down it from one end to the other (at a different height) as rapidly as possible? The answer is the brachistochrone (from the Greek brachistos, the shortest, and cronos, time), the curve of fastest descent.

New methods for old problems

The mathematician Johann Bernoulli found the answer centuries ago when he realised that it was a cycloid (the curve described by a point on a circle rolling along a line). That was the origin of the calculus of variations, which was also used in other classic problems, like that of the catenary (the shape of a chain suspended by its endpoints) and the isoperimetric curve (a curve that maximizes the area it encloses).

The study shows that these calculations may be related to Plateau's problem, that is, to find the shape adopted by a soap film under certain boundary restrictions. Besides, the researchers show how to design the experiments constraining the soap films between two surfaces in such a way as to obtain the appropriate curves.

Other Spanish researchers, like Isabel Fernandez, of the University of Seville, and Pablo Mira, of the Polytechnic University of Cartagena, have succeeded in finding for the first time the solution to specific mathematical problems (the Bernstein problem in the Heisenberg space) with the help of soap films.

TEXT 8

A GOOD MOVE TO MASTER MATHS

In the spirit of the current world championship bout between Norwegian



grandmaster Magnus Carlsen and Indian grandmaster Viswanathan Anand, we should seriously consider the role of chess in how young students learn mathematics.

The two activities have plenty in common. In either, one's success relies strongly on the ability to be creative under some set of rules.

Beginners in both maths and chess seem to play only for the rules, for they don't really understand much else yet. In maths, this means swinging the algebraic sword blindly in the hope of making progress. In chess, making any legal move is enough for a beginner, so long as their piece can't be immediately taken.

Playing either game this way seems fine at first, for if the teacher has the right experience then the newbie will be punished or rewarded accordingly, and will shape their ideas and strategy for the next time around.

However, while chess has maintained huge popularity worldwide, the allure of doing maths seems lower than ever.



And if we think about the reasons for which we bellow the importance of maths – critical thinking, decision making, mental agility – it seems surprising that chess isn't routinely taught in maths classrooms across the country.

Learning chess could actually have a two-fold effect. Not only could we impart the aforementioned skills through something, which more people seem to enjoy, but also we might able to transition students to maths through chess.

Students of chess use symbolic notation to record their moves, arithmetic to add up their points and creativity to win position and pieces. And plenty of new ideas in maths could be first taught under the framework of chess.

TEXT 9

A BRIEF HISTORY OF NUMBERS AND COUNTING



The origins of numbers are cloaked in mystery. It's safe to say that as civilization advanced, numbers advanced with it; and it is equally safe to say that

civilization could not have advanced without it.

Common intuition, and recently discovered evidence, indicates that numbers and counting began with the number one. (Even though in the beginning, they likely didn't have a name for it.) The first solid evidence of the existence of the number one, and that someone was using it to count, appears about 20,000 years ago. It was just a unified series of unified lines cut into a bone. It's called the Ishango Bone.

The Ishango Bone (it's a fibula of a baboon) was found in the Congo region of Africa in 1960. The lines cut into the bone are too uniform to be accidental. Archaeologists believe the lines were tally marks to keep track of something, but what that was – isn't clear.

However, numbers, and counting, didn't truly come into being until the rise of cities. Indeed, numbers and counting weren't really needed until then. Numbers, and counting, began about 4,000 BC in Sumeria, one of the earliest civilizations. With so many people, livestock, crops and artisan goods located in the same place, cities needed a way to organize and keep track of it all, as it was used up, added to or traded.

Their method of counting began as a series of tokens. Each token a man held, represented something tangible, say five chickens. If a man had five chickens he was given five tokens. When he traded or killed one of his chickens, one of his tokens was removed. This was a big step in the history of numbers and counting because with that step subtraction – and thus the invention of arithmetic – was invented.

In the beginning, Sumerians kept a group of clay cones inside clay pouches. The pouches were then sealed up and secured. Then the number of cones that were inside the clay pouch was stamped on the outside of the pouch, one stamp for each cone inside. Someone soon hit upon the idea that cones weren't needed at all. Instead of having a pouch filled with five cones with five marks written on the

outside of the pouch, why not just write those five marks on a clay tablet and do away with the cones altogether? This is exactly what happened.

This development of keeping track on clay tablets had ramifications beyond arithmetic, for with it, the idea of writing was also born.

But, if you're keeping track of your wealth with marks made on a clay tablet, what's to stop you from making your own clay tablet, stamping in 50 marks, and trading those 50 marks on a clay tablet for grain?

To prevent this from happening, the Sumerians needed an official method of keeping track and an official group of people, who kept track. A select few were allowed to enter this group. They essentially became the world's first accountants. So a farmer may have made his own clay tablet with 50 marks on it and claimed that this proved that he was the owner of 50 chickens, but if that tablet didn't have an official seal from the accountants it was worthless.

It was the Egyptians, who transformed the number one from a unit of counting things to a unit of measuring things. In Egypt, around 3,000 BC, the number one became to be used as a unit of measurement to measure length. If you're going to build pyramids, temples, canals and obelisks, you'll need a standard unit of measurement and an accurate method of applying it to real objects. What they invented was the cubit, which they considered to be a sacred measurement. A cubit is the length of a man's forearm, from elbow to fingertips, plus the width of his palm. Considered sacred as they were, they had officially ordained sticks, which they kept in the temples. If copy cubits were needed, they were made from one of the original cubits kept in the temple. The Egyptians were able to create colossal buildings and monuments with wondrous accuracy due to this very official, very guarded and very precise unit of measurement.

The Egyptians were the first civilization to invent different symbols for different numbers. They had a symbol for one, which was just a line. The symbol for ten was a rope. The symbol for a hundred was a coil of rope. They also had

numbers for a thousand and ten thousand. The Egyptians were the first to dream up the number one million, and its symbol was a prisoner begging for forgiveness, which was a person on its knees, hands upraised in the air, in a posture of humility.

Greece made further contributions to the world of numbers and counting, much of it under the guidance of Pythagoras. He studied in Egypt and upon returning to Greece established a school of math, introducing Greece to mathematical concepts already prevalent in Egypt. Pythagoras was the first man to come up with the idea of odd and even numbers. To him, the odd numbers were male and the evens were female. He is most famous for his Pythagorean Theorem, but perhaps, his greatest contribution to math was laying the groundwork for Greek mathematicians who would follow him.

Pythagoras was one of the world's first theoretical mathematicians, but it was another famous Greek mathematician, Archimedes, who took theoretical mathematics to a level no one had ever taken it to before. Archimedes enjoyed doing experiments with numbers and playing games with numbers.

But as trivial as his math games may have seemed to outsiders, they often led to results that proved practical in the real world, some of which we still benefit from today. One example: Archimedes wondered if you could turn the surface of a sphere into a cylinder, and if you did that, what would be the difference in area covered. Archimedes successfully worked this problem out, and to him that was the end of it. But thanks to the formulas he left behind, later mapmakers were able to turn the surface of the globe into a flat map.

Archimedes is also famous for his Archimedes' screw, which is a circular inclined plane (a screw) inside a tube that pumps water from one level to a higher level. He is equally famous for inventing a method of determining the volume of an object with an irregular shape. The answer came to him while he was bathing. He was so excited he leapt from his tub and ran naked through the streets screaming "Eureka!", which is Greek for "I have found it".

But, the Greek's role in mathematics ended, quite literally, with Archimedes, who was killed by a Roman soldier during the Siege of Syracuse in 212 BC. Under the rule of Rome, mathematics entered a dark age, and for a couple different reasons.

The main reason was that Romans simply weren't interested in mathematics (they were more concerned with world domination), and secondly, because Roman numerals were so unwieldy, they couldn't be used for anything more complicated than recording the results of calculations. Romans did all their calculating on a counting board, which was an early version of an abacus. And because of that Roman mathematics couldn't, and didn't, go far beyond adding and subtracting. Their use of numbers was good for nothing more than a simple counting system. The Romans' use of numbers was no more advanced than the notches on the Ishango Bone. There are no famous Roman mathematicians.

The next big advance (and it was a huge advance) in the world of numbers and mathematics came around 500 AD in India. It would be the most revolutionary advance in numbers since the Sumerians invented math. The Indians invented an entirely new number: zero.

The Indians needed a way to express very large numbers, and so they created a method of counting that could deal with very large numbers. It was they who created a different symbol for every number from one to nine. They are known today as Arabic numerals, but they would more properly be called Indian numbers, since it was the Indians who invented them. The Indians have been using "Arabic" numbers them since about 500 BC.

Once zero was invented, it transformed counting and mathematics in a way that would change the world. Zero is still considered India's greatest contribution to the world. For the first time in human history, the concept of nothing had a number.

Zero, by itself, wasn't necessarily all that special. The magic happened when you paired it with other numbers. With the invention of zero, the Indians gained the

ability to make numbers infinitely large or infinitely small. And that enabled Indian scientists to advance far ahead of other civilizations that didn't have zero, due to the extraordinary calculations that could be made with it. For example, Indian astronomers were centuries ahead of the Christian world. With the help of the very plastic and fluid Arabic numbers, Indian scientists worked out that the Earth spins on its axis, and that it moves around the Sun, something that Copernicus wouldn't figure out for another thousand years.

The next big advance in numbers, the invention of fractions, came in 762 AD in what is now Baghdad – and what was then Persia.

The Koran taught that possessions of the deceased had to be divided among their descendants. Unlike Christianity at the time, Islam, which was scarcely 100 years old at the time, divided belongings among women as well as men. But women got a lesser share. Working all of that out, required fractions. But prior to 762 AD they didn't have a system of mathematics sophisticated enough to do a very proper job. Enter Arabic numbers.

It's not known for certain, how Arabic numbers came to the Islamic world, but the most prevalent theory states that one day an ambassador from India arrived in Baghdad and presented the Caliph with the greatest gift he could think of: Arabic numbers.

Using Arabic numbers, Muslim mathematicians invented entirely new methods of mathematics. Beside just simple fractions, they turned Arabic numbers into quadratic equations, and algebra, and these numeric breakthroughs enabled science, mathematics and astronomy to reach new levels in the Middle East.

By 1200 AD, Arabic numerals made their way to North Africa, and from there, thanks to the curious son of an Italian merchant, they would soon make their way to Europe.

Leonardo Pisano Bigollo, who would later be known as Fibonacci, had been raised using Roman numerals. While traveling with his merchant father, he was first introduced to Arabic numbers in Algeria. Fibonacci became enthralled with this new method of counting, and its very practical and plastic abilities. He introduced Arabic numbers to Europe when he returned to Italy. In 1202 he published a book of mathematics called "Liber Abaci" and it was through that book that Europe was introduced to Arabic numbers.

The Roman numeral system was deeply entrenched in Europe, and it took a while for the Arabic system to catch on. The name for zero in Italian was *cipha*, and it was regarded with such suspicion that it became the word for secret code: *cipher*. What finally caused the Arabic number system to catch on was good old-fashioned human greed, and a merchant class that could use it quickly, easily and more precisely calculate interest on their goods and properties.

Prior to the Catholic Reformation, Christians weren't allowed to charge interest on loans because the Catholic Church said it was a sin to do so. But after the Catholic Reformation charging interest was allowed. The merchant class quickly adopted the new Arabic system because interest could be calculated out to 12 decimal points, which worked to the advantage of the merchants. An abacus, the old system of counting under the Romans, could only calculate interest out to two decimal points.

From there, use of Arabic numbers spread to conquer the world.

The next big evolution in numbers came in Germany in 1679. German mathematician Gottfried Leibnitz invented a system of counting that used only ones and zeros; what would eventually be called the binary system. In the binary system ones stand for *something*, and zeros stand for *nothing*.

Leibnitz even went so far as to design a machine that would count in binary. The digital age, it seemed, had arrived. Though he designed his binary machine he

never built it, and the world would have to wait another 265 years before one and zero would usher in the modern world.

The machine that would usher in the digital age was named Colossus and was built in England in 1944, during World War II, as a code-breaking apparatus. Colossus was able to perform millions of rapid calculations, and with its help, the Allies cracked numerous Nazi codes. Thanks to Colossus, Ally code-breakers often knew what the Germans had said even before Hitler did. Some experts believe that Colossus may have shortened the war by as much as two years.

From there the binary system was adopted and used in every computer ever built. Computer code has literally made possible the Internet, space exploration and indeed modern life.

ПРИЛОЖЕНИЕ 1

Оформительская лексика, предназначенная для ведения бесед, дискуссий, выступлений.

Начало беседы

Well... – Ну (и так)...

First of all... – Прежде всего...

To begin with... – Начнем с...

I say... – Послушайте...

Look here... – Послушайте...

Let me see... – Дайте подумать...

Just a minute (moment)... – Одну минуту (момент)...

May I have my say?... – Можно мне сказать?...

The fact is that... – Дело в том, что...

On the one hand..., on the other hand... – С одной стороны, с другой стороны...

As far as I know... – Насколько я знаю...

To tell the truth... – По правде говоря...

To sum it up... – Подводя итог...

On the whole... – В целом...

In short... – Короче...

To make (cut) a long story short... – Короче говоря...

That's all... – Это все...

And so... – Итак...

Let's round off... – Давайте закругляться...

I should like to know... – Мне бы хотелось знать...

I would like to ask you about (whether)... – Мне бы хотелось спросить о...

I have (got) some (several) questions... – У меня есть несколько вопросов...

Одобрение, согласие

I agree that... – Я согласен, что...

I (quite) agree with you... – Я совершенно с вами согласен...

I think so to. – Я думаю также.

That's just what I was going to say... – Это как раз то, что я хотел сказать...

That's right. – Это правильно.

That's true. – Это верно.

Quite right. – Совершенно верно.

I believe so. – Думаю, что так.

You are right. – Вы правы.

I think you are right. – Я думаю, что вы правы.

Absolutely right (certain). – Абсолютно верно.

Exactly so. – Именно так.

A fine idea! – Прекрасная идея!

Not a bad idea! – Не плохая идея!

Wonderful! – Замечательно!

Excellent! – Отлично!

Splendid! – Великолепно!

Точка зрения или мнения

I think (believe, suppose, maintain, feel, hope) that... – Я думаю (полагаю, предполагаю, утверждаю, чувствую, надеюсь), что...

To my mind ... – По-моему...

It's my opinion that... – Мое мнение, что...

In any case... – Во всяком случае...

I dare say... – Осмелюсь сказать...

I mean to say... – Я подразумеваю (я хочу сказать)...

Do you mean (to say)...? – Вы имеете в виду, что...?

Don you mean (to say)...? – Вы имеете ввиду, что...?

What do you think of ...? – Что вы думаете...?

In my view/opinion... – По моему мнению...

The way I see it... – Я считаю...

If you want my honest opinion... – Если вы хотите услышать мое мнение...

As far as I'm concerned, as far as I can see, to my knowledge, for all I know... – Насколько знаю...

If you ask me... – Если вы спросите меня...

I think, I believe, I feel, I tend to think, to my way of thinking, personally, I prefer to think that... – Я думаю...

It seems to me... – Мне кажется...

From my point of view / viewpoint... – С моей точки зрения...

As I see it, at my best guess... – Как я это вижу...

I guess... – Мне кажется...

I'm convinced... – Я убежден...

I'm sure... – Я уверен...

I have no doubt... – Я не сомневаюсь...

I don't think... – Я не думаю...

Well, it sounds logical but I imagine there are some [counterarguments] too. – Звучит логично, но я думаю, что есть и [другие мнения] тоже.

As for me, I tend to assume that... – Что касается меня, я полагаю, что...

That's my view exactly. – Вот мое мнение.

Незнание фактов

Sorry, I don't know. – Извините, я не знаю.

I'm very sorry, I really don't know. – Мне очень жаль, я действительно не знаю.

I must confess, I don't know. – Я должен признаться, я не знаю.

I've no idea. – Не имею представления.

Заполнение пауз

Oh..., Well..., Just..., You see..., You know...

Несогласие, сомнение

I cannot agree (that)... – Я не могу с вами согласиться (что)...

I don't quite agree (with you). – Я не совсем согласен (с вами).

I doubt (it). – Я сомневаюсь.

I don't think you are right. – Я не думаю, что вы правы.

I am afraid you are wrong (mistaken). – Я боюсь, что вы не правы (ошибаетесь).

I am sorry but (that)... – Я сожалею, но (что).... Мне жаль, но...

Nothing of the kind. – Ничего подобного.

That's wrong. – Это неверно.

I am not sure... – Я не уверен...

I see what you mean, but... – Я знаю, что вы имеете в виду, но...

I find that hard to believe... – Я считаю, что в это трудно поверить...

ПРИЛОЖЕНИЕ 2

Рекомендации по составлению реферата и аннотации

Реферат – это сжатое изложение содержания статьи с основными фактическими данными, выводами и рекомендациями.

1. Реферат строится на основе ключевых фрагментов, выделенных из текста подлинника.
2. Реферат должен быть написан литературным языком с соблюдением сокращений широко употребляемых слов, обозначений и единиц физических величин.
3. В реферате должна быть использована научная терминология, принятая в научной литературе по той или иной отрасли науки и техники.
4. Реферат должен объективно и точно отражать содержание первоисточника; нельзя вносить какие-либо изменения или дополнения по существу реферируемой работы; нельзя излагать собственную точку зрения или критические замечания, вступать в полемику с автором.
5. Начало реферата не должно повторять заглавие работы. Не следует прибегать к неясным формулировкам, а также к различного рода повторениям.
6. Текст реферата рекомендуется делить на абзацы.
7. Главная мысль в реферате должна быть конкретизирована и выделена.

Аннотация – это краткая характеристика работы с изложением наиболее важных положений.

1. Аннотация пишется своими словами, просто и кратко. Следует избегать сложных конструкций и предложений.
2. Изложение аннотируемой части рекомендуется начинать с существа вопроса, избегая повторения заголовка.
3. Не следует нагружать аннотируемую часть дополнительными фразами типа: «Целью данной статьи является...», «В данной статье автор рассматривает...», «По мнению автора...». Для обобщения информации

рекомендуется использовать такие слова, как «предлагается, описывается, излагается, сообщается...» и т.п.

4. Рекомендуется названия фирм, исследовательских центров, институтов, компаний давать в их оригинальном написании.
5. Следует использовать аббревиатуры и различные сокращения в соответствии с общепринятыми в справочной литературе.
6. Объем реферата определяется степенью важности реферируемого материала, хотя практически средний объем реферата не превышает 2000 печатных знаков, объем аннотации обычно не превышает 600 печатных знаков.

ПРИЛОЖЕНИЕ 3

Список выражений, рекомендуемых для написания реферата

1. The article (text) is headlined...
The headline of the article (I have read) is...
I have read the article under the title of...
2. The author of the article (text) is...
The article is written by...
3. It is (was) published in...
It is (was) printed in...
4. The main idea of the article (text) is...
The article is about...
The article is devoted to...
The article deals with...
The article touches upon...
The article presents some results which illustrate...
5. The purpose of the article (text) is to give the reader some information on...; is to compare (to determine)...
The aim of the article is to provide the reader with some materials (data) on...
6. The author starts by telling the readers (about, that)...
The author writes (states, stresses, thinks, points out) that...
The article describes...
According to the article (text)...
Further the author reports (says) that...
The article goes on to say that...
7. The article is (can be) divided into 3 (4-7) parts.
The first part deals with...
The second part is about...
The third part touches upon...
The fourth part of the article includes the fact on...

8. In conclusion the article reads...

The author comes to the conclusion that...

9. I found the article (text) interesting (important, dull, of no value, easy, (too) hard to understand...).

ПРИЛОЖЕНИЕ 4

Список выражений, рекомендуемых для написания аннотации

кратко описывается ...	it is described in short ...
... вводится	... is introduced
показано, что ...	it is shown that ...
... дается (предлагается)	... is given
рассматривается ...	it is dealt with ...
обеспечивается ...	... is provided for
... предназначен для	... is designated for
... исследуется	... is examined, is investigated
... анализируется	... is analyzed
подчеркивается необходимость	the need is stressed to employ...
использования ...	
обращается внимание на ...	attention is drawn to ...
приведены данные о ...	data are given about ...
делаются попытки проанализировать	attempts are made to analyze, to
(сформулировать) ...	formulate ...
делаются выводы ...	conclusions are drawn ...
даны рекомендации ...	recommendations are given ...

ПРИЛОЖЕНИЕ 5

Геометрические фигуры

Circle. A circle is a closed curve with constant curvature. The distance from the center to the border is constant, no matter where the point is on the border. Technically speaking, a "circle" refers to the curved boundary, while a "disk" is a circle plus its interior. In everyday life, the two terms can be used interchangeably.

Ellipse. An [ellipse](#) is a circle squished (or stretched) in one direction. If you cut a cone or a cylinder at an angle, the cross-section is an ellipse. An ellipse has two foci with the following property. For any triangle you draw that connects the two foci and an arbitrary point on the ellipse's border, the perimeter of the triangle is constant. A circle is a special type of ellipse in which the two foci coincide at the same point.

Stadium. A stadium is an oblong figure formed by joining semicircles to opposite ends of a rectangle. It gets its name from the shape of sport fields.

Oval. An oval is a non-specific term for any sort of closed oblong or egg-shaped curve without points. It includes ellipses, stadiums and more irregular egg-shaped curves.

Arch. An arch is a shape with one curved arc opposite a straight edge. It may have more than one straight side.

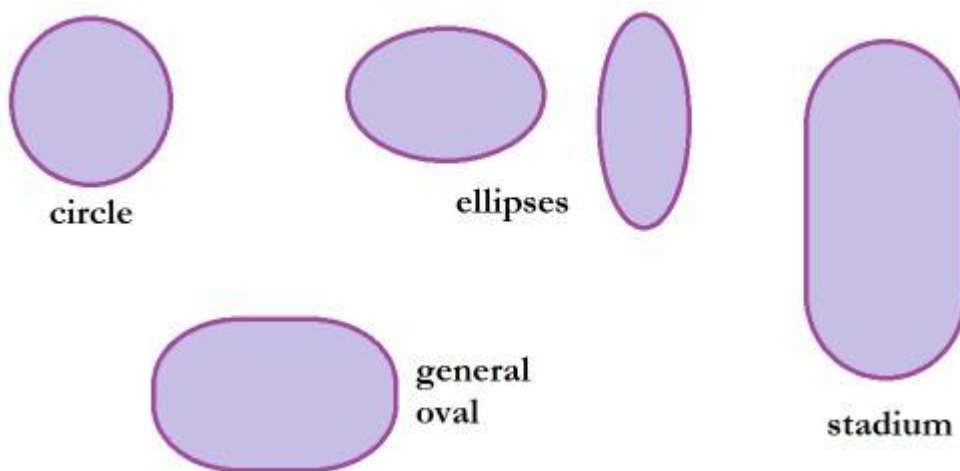
Circular Sector. A [circular sector](#) is a wedge or pie slice cut from a circle. The vertex of a circular sector is the center of the circle from which it is cut.

Circular Segment. A circular segment is formed by cutting a circle along a chord. It is a two-sided shape, with one side curved and the other side straight. Arches can be shaped like circular segments

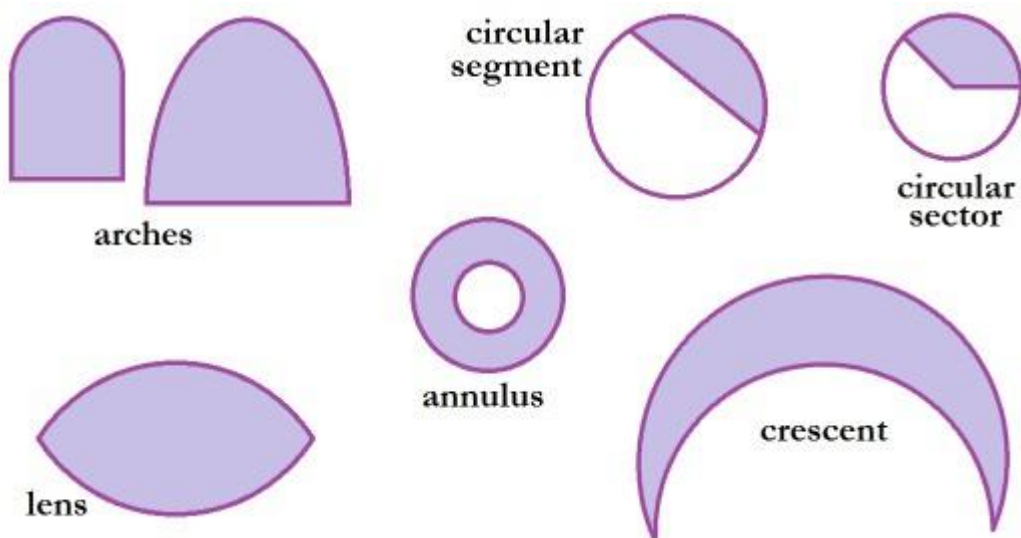
Lens. A lens is a two-sided figure formed from two arcs; both arcs are convex with respect to the interior of the figure. It has two vertices where the arcs meet.

Crescent. A crescent is a two-sided figure formed from two arcs; one curved side is convex with respect to the interior and the other is concave. It can be formed by taking a disk and removing a smaller disk along the edge.

Annulus. An annulus is a ring. It is formed by taking a disk and removing a smaller disk from the center.



Circles, ellipses, stadiums, and ovals.



Arches, sectors, segments, lenses, annuluses, and crescents.

Triangles

A [triangle](#) is a three-sided figure. One property of triangles is that all three angles add up to 180 degrees. The longest side is opposite the largest angle, and the shortest side is opposite the smallest angle.

Scalene Triangle. A scalene triangle has three sides of unequal length. All three angles are also unequal.

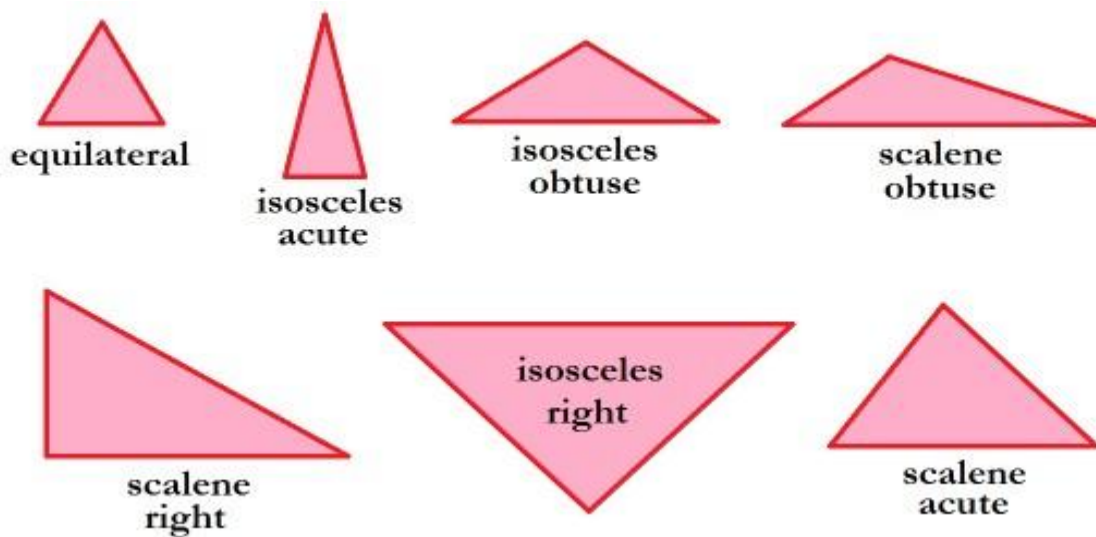
Isosceles Triangle. A triangle with two sides of equal length and a third side that is either longer or shorter than the other two. Because two sides are equal, the angles opposite these sides are also equal.

Equilateral Triangle. A triangle with three equal sides and three equal angles. Also called an equiangular triangle, each of the angles is 60 degrees.

Obtuse Triangle. A triangle that has one angle with a measure greater than 90 degrees, aka an obtuse angle. The other two angles are necessarily less than 90 degrees.

Right Triangle. A triangle with one angle that is exactly 90 degrees, aka a right angle. The other two angles add up to 90 degrees.

Acute Triangle. A triangle whose three angles are all less than 90 degrees, aka acute angles.



Quadrilaterals

Any four-sided figure with straight edges.

Parallelogram – a four-sided figure that has two pairs of parallel sides. Opposite sides are equal in length, and opposite angles are equal as well.

Rectangle – a parallelogram with four right angles.

Rhombus – a parallelogram with four equal sides. See also, Rhombus Area Formula.

Trapezoid – a quadrilateral with one pair of parallel sides.

Kite – a quadrilateral with two pairs of sides that have equal length. The sides with equal length are adjacent to one another, rather than opposite as with a parallelogram.

Square – a rectangle that is also a rhombus. It has four equal sides and four equal angles with a measure of 90 degrees.

Pentagon – a pentagon is a five-sided polygon. A regular pentagon has five equal sides and five equal angles.

Hexagon – a hexagon is a six-sided polygon. See also, Regular Hexagon Area Formula.

Heptagon – a heptagon is a seven-sided polygon.

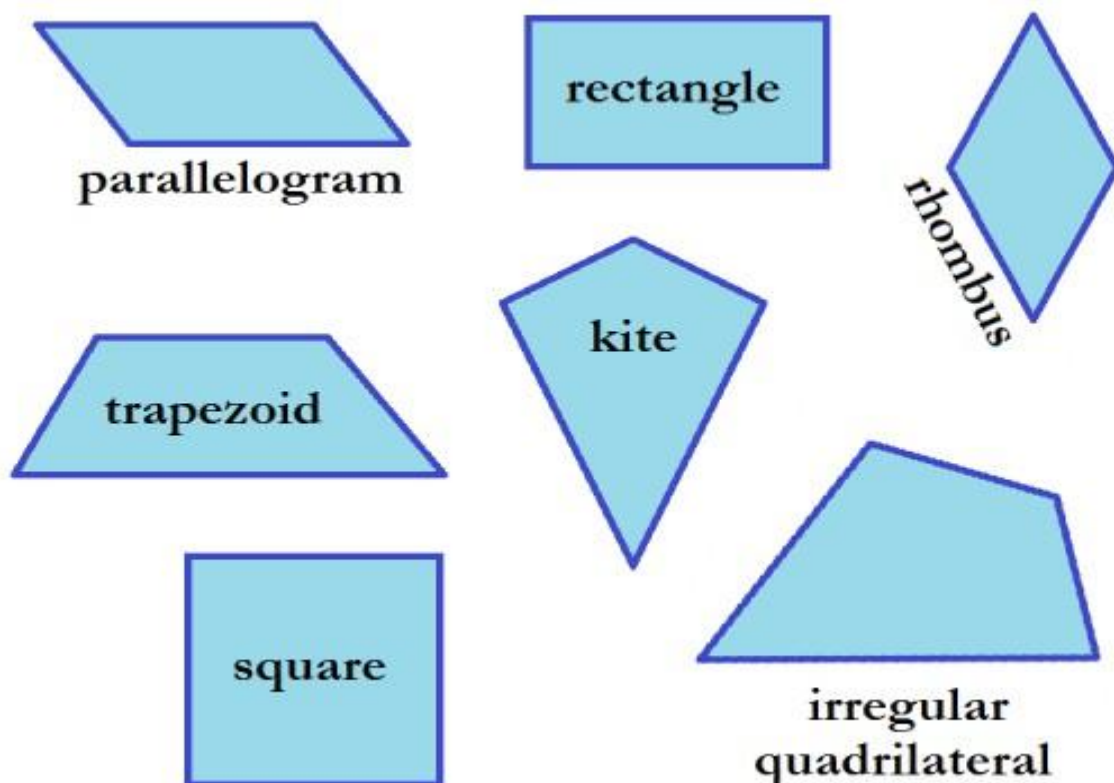
Octagon – an octagon is an eight-sided polygon. A stop sign is in the shape of a regular octagon since it has eight equal sides and eight equal angles.

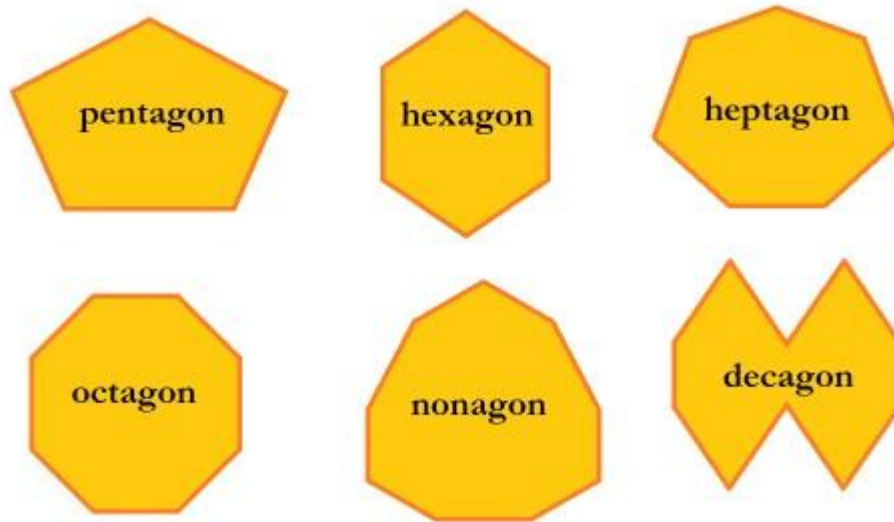
Nonagon – a nonagon is a nine-sided polygon.

Decagon – a decagon is a ten-sided polygon.

Regular Polygon – having equal side lengths and equal angles at the vertices.

Convex Polygon – all vertex angles as measured from the interior are less than 180 degrees. Equivalently, all vertex angles measured from the exterior or greater than 180 degrees.





Solid Shapes with Curved Surfaces

Sphere – a sphere is a three-dimensional analogue of a disk. The boundary of a sphere is a three-dimensional closed curved surface such that every point on the surface is equidistant from the center

Ellipsoid – the three-dimensional analogue of an ellipse, it can be thought of as a sphere that has been squished or stretched in one or two directions. If two of the three axes have equal length it is called a spheroid. See Ellipsoid Surface Area Formula.

Cone – a cone has a circular base that tapers linearly to a point, called the apex. If the tip is sliced off, the resulting shape is called a conical frustum.

Cylinder – a cylinder has two circular bases of equal size at the ends, and a middle section that can be formed by rolling a rectangle into a tube. It is the standard shape for canned foods. A conical frustum is like a cylinder except that the circular ends are different sizes.

Barrel – like a cylinder, both ends of a barrel are circles of equal size. But unlike a cylinder, its sides do not go straight up and down, but rather bulge outward in the middle.

Torus – a torus is the technical mathematical term for a doughnut or bagel shape.

Dome – a dome is any solid shape that has a flat base and a curved surface connecting the boundary of the base. A hemisphere (sphere cut in two) is a type of dome, as is a spherical cap.

Spheres, cones, and ellipsoids.



Cylinder, barrel, torus, and dome.



Polyhedra

Triangular Prism – a solid shape with two equal triangular faces on opposite ends oriented in the same direction and parallel. Three parallelograms connect the matching triangular edges. If the parallelograms are rectangles, it is called a right prism. Otherwise it is called an oblique prism.

Rectangular Prism – a rectangular prism is a solid shape with six rectangular faces. Opposite faces have the same shape, size, and orientation and are parallel.

Cube – a regular rectangular prism; all faces are squares of equal size. It has six faces, eight vertices, 12 edges, and is one of the five Platonic solids.

Parallelepiped – a generalization of a rectangular prism in which all the faces are parallelograms, but not necessarily rectangles. A parallelepiped has six faces that come in parallel pairs.

Pentagonal Prism – a pentagonal prism has two equal pentagonal faces on opposite ends oriented in the same direction and parallel to one another. Five parallelogram faces connect the matching pentagonal edges.

Hexagonal Prism – a solid shape with two equal hexagonal faces on opposite ends oriented in the same direction and parallel. Six parallelogram faces connect the matching hexagonal edges.

Tetrahedron – also called a triangular prism, this shape has four triangular faces, four vertices, and six edges. If the triangles are equilateral, it is a Platonic solid,

Square Pyramid – a pyramid with a square base and four triangular faces that meet at a point opposite to the square base.

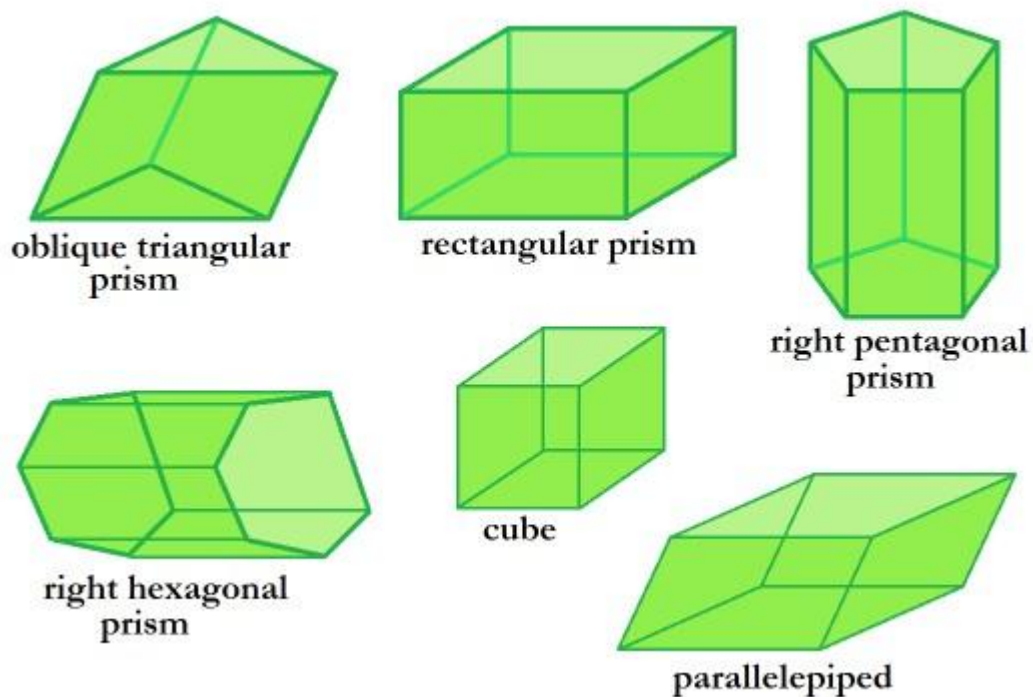
Pentagonal Pyramid – a pyramid with a pentagonal base and five triangular faces that meet at a point opposite to the base.

Hexagonal Pyramid – a pyramid with a hexagonal base and six triangular faces that meet at a point opposite to the base.

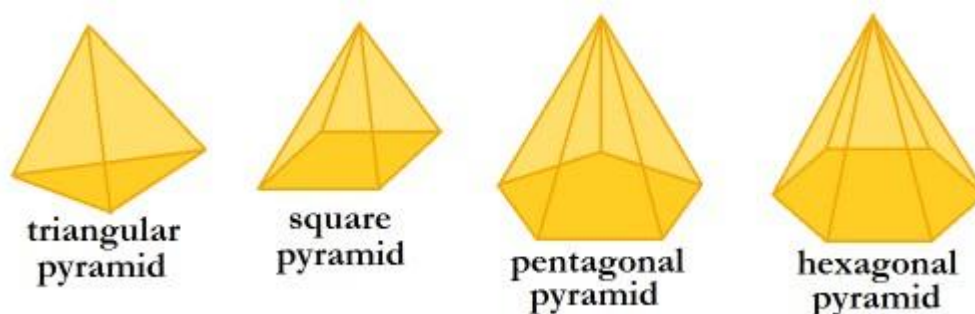
Octahedron – a solid shape with eight triangular faces, six vertices and 12 edges. Each vertex is the meeting point of four triangles. If the triangles are equilateral, it is one of the Platonic solids

Dodecahedron – any solid shape with 12 faces. A pentagonal dodecahedron is a Platonic solid with 12 regular pentagonal faces, 20 vertices and 30 edges, where each vertex is the meeting point of three pentagons. Not all dodecahedrons have pentagonal faces, for example, a rhombic dodecahedron's 12 faces are rhombuses.

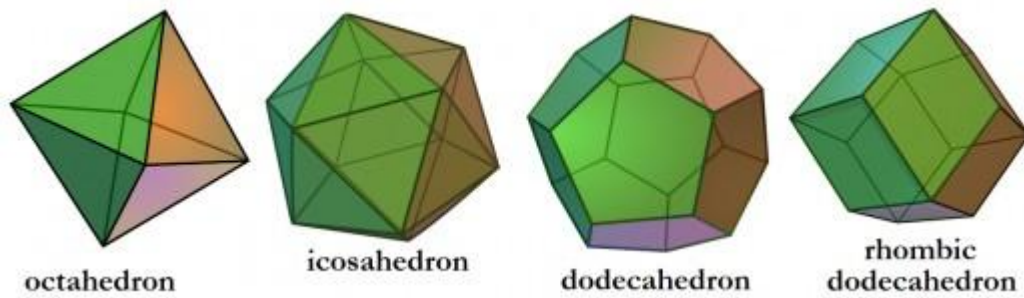
Icosahedron – a solid shape with 20 triangular faces, 12 vertices and 30 edges. Each vertex is the meeting point of five triangles. If the triangles are equilateral, it is one of the Platonic solids.



Types of prisms.



Types of pyramids



ПРИЛОЖЕНИЕ 6

Углы и линии

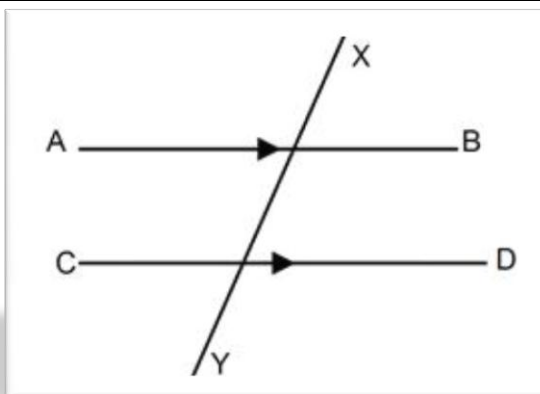
Names of Angles

Type of Angle	Description
Acute Angle	an angle that is less than 90°
Right Angle	an angle that is 90° exactly
Obtuse Angle	an angle that is greater than 90° but less than 180°
Straight Angle	an angle that is 180° exactly
Reflex Angle	an angle that is greater than 180°
Revolution Or full rotation	a complete turn – it is exactly 360° . When turned, it turns one full circle.



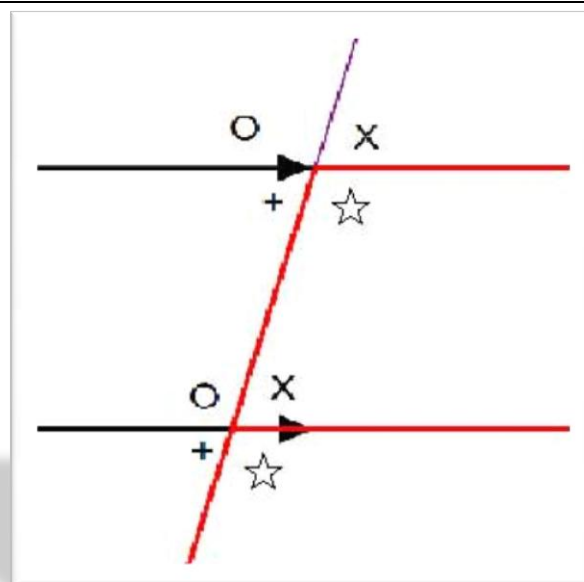
In addition to these basic angles, there are some special types of angles formed when a transversal intersects two parallel lines.

The line XY forms 8 angles, and they are corresponding angles, alternate angles, and co-interior angles.



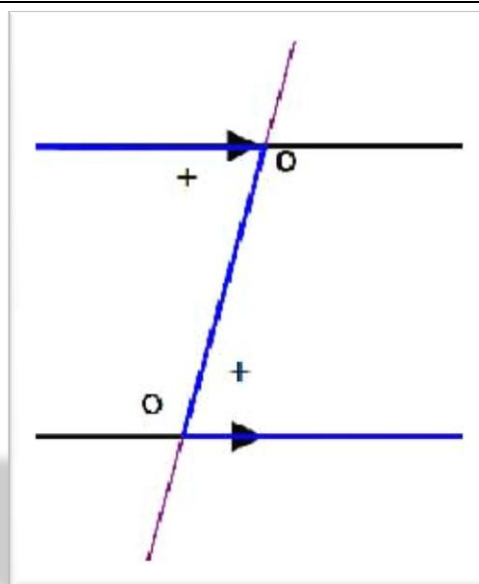
Corresponding angles

They are on the same side of the transversal, and in the same position on both the parallel lines. They are equal in size, and form a 'F' shape on the parallel lines.



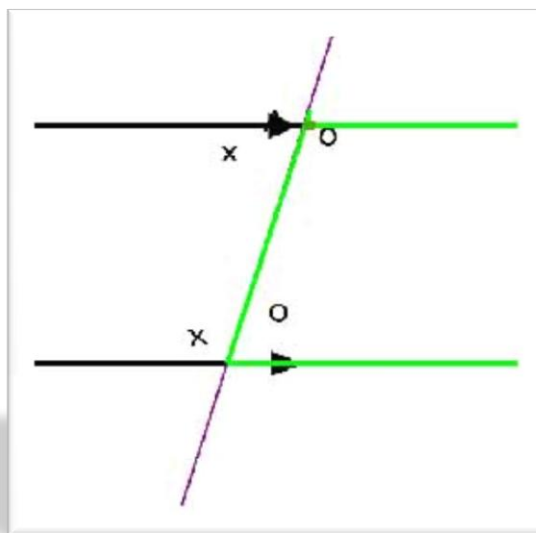
Alternate angles

These angles are on opposite sides of the transversal, and lie in between the parallel lines. They are equal in size and form a 'Z' shape.



Co-interior angles

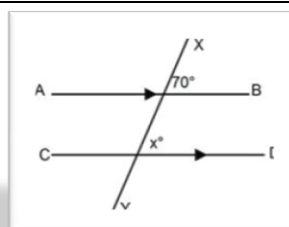
They are on the same side of the transversal, and between the parallel lines. These angles will add up to 180° and form a 'C' shape.

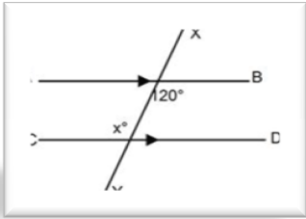
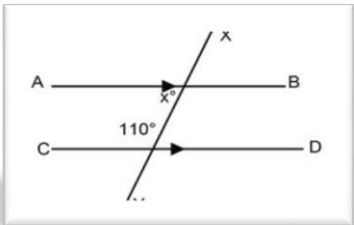
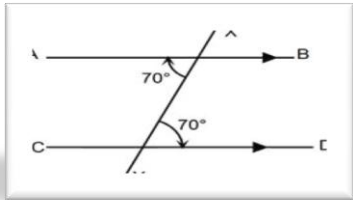


Практические задания

In the figure, what is x ?

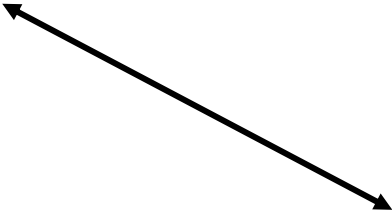
Since they are corresponding angles, $x = 70^\circ$

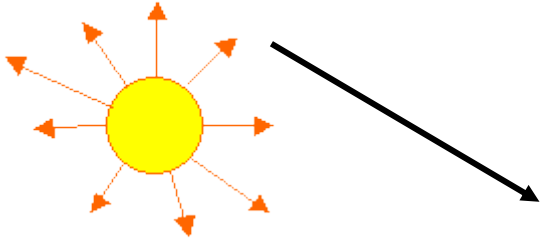
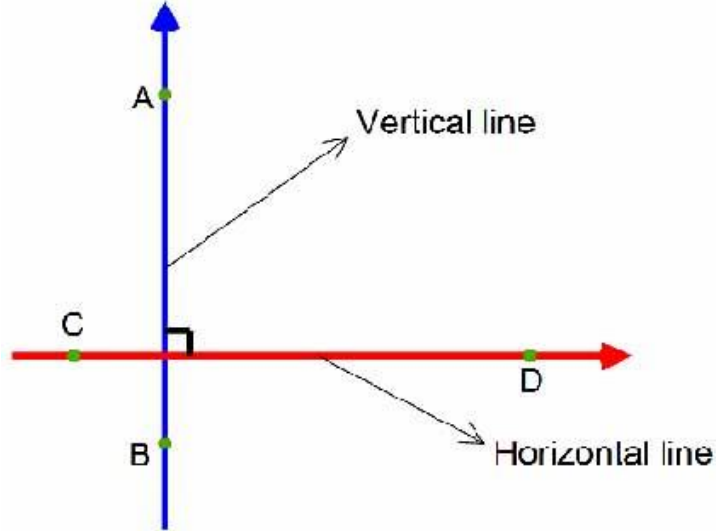


Since the two angles are alternate angles, $x = 120^\circ$.	
x and 110° are co-interior angles, and will add up to 180° . So $x = 180^\circ - 110^\circ$ $= 70^\circ$	
In order to show that $AB \parallel CD$, we need to prove that the alternate angles are equal to each other. Here they are both 70° , so AB and CD are parallel lines.	

Types of Lines

There are four types of lines: horizontal line, vertical line, perpendicular, and parallel lines. They are defined based on their orientation, and the angles if any, formed between them. Let's look at each one of them.

A line has no beginning point or end point. Imagine it continuing indefinitely to both directions. We can illustrate that by little arrows on both ends.	
A line segment has a beginning point and an end	

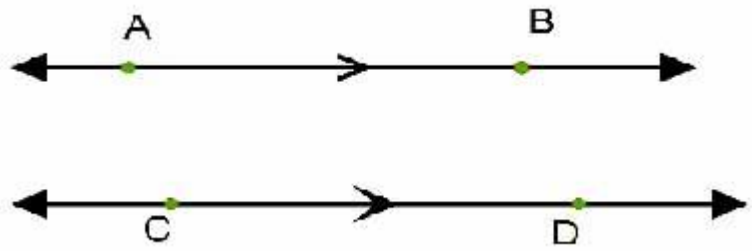
point.	
<p>A ray has a beginning point but no end point. Think of sun's rays: they start at sun and go on forever...</p>	 <p>The diagram shows a yellow circle representing the sun on the left. Multiple orange arrows radiate outwards from the sun, representing rays. To the right of the sun, a single black arrow points away from the sun, representing a ray with a starting point (the sun) and no end point.</p>
<p>Horizontal line A line that runs from left to right in a straight line is called a horizontal line.</p> <p>Vertical line A line that runs from top to bottom in a straight line is called a vertical line.</p> <p>Perpendicular When two straight lines intersect (i.e.cross) each other at right angles (= 90°), then these two lines are said to be perpendicular to each other.</p> <p><i>Here AB and CD are the two perpendicular lines, and they are represented as $AB \perp CD$.</i></p>	 <p>The diagram shows two intersecting lines. A vertical blue line has points A at the top and B at the bottom. A horizontal red line has points C on the left and D on the right. The two lines intersect at a right angle, indicated by a small square symbol at the intersection point. Labels 'Vertical line' and 'Horizontal line' with arrows point to their respective lines.</p>

Parallel lines

When two lines never meet each other, no matter how much you extend them, then these two lines are said to be parallel to each other.

Lines AB and CD are parallel lines, and are always the same distance apart from each other.

Parallel lines are represented by the two large arrows on the lines, and are represented as $AB \parallel CD$



ПРИЛОЖЕНИЕ 7

GREEK ALPHABET

A α	alpha ['ælfə]	альфа
B β	beta ['bi:tə]	бета
Γ γ	gamma ['gæmə]	гамма
Δ δ	delta ['deltə]	дельта
Ε ε	epsilon ['epsilɒ n]	эпсилон
Z ζ (d)	zeta ['zeɪ tə], ['zi:tə]	дзета
Η η	eta ['eitə], ['i:tə]	эта
Θ θ	theta ['θeɪ tə], ['θi:tə]	тета
Ι ι	iota [aɪ 'outə]	йота
Κ κ	kapra ['kæpə]	каппа
Λ λ	lambda ['læmdə]	лямбда
Μ μ	mu [mju:], [mu:]	ми (мю)
Ν ν	nu [nju:], [nu:]	ни (ню)
Ξ ξ	xi [ksi:]	кси
Ο ο	omicron	
	['ɒ mɪ krɒ n] , ['oumɪ krɒ n]	
	омикрон	
Π π	pi [pɪ :]	пи
Ρ ρ	rho [rou]	ро
Σ σ	sigma ['sɪ gmə]	сигма
Τ τ	tau [tau]	тау
Υ υ	upsilon ['ju:psəlɒ n]	ипсилон
Φ φ	phi [fɪ :]	фи
Χ χ	chi [hɪ :]	хи
Ψ ψ	psi [psi:]	пси
Ω ω	omega ['oumɪ gə], [ou'meɪ gə]	
	омега	

Математические символы и знаки

plus

minus

plus or minus

multiplication sign

point (1.5 – one point five)

division sign; ratio sign

sign of equality (equals, (is) equal to)

(is) not equal to

difference

approximately equal; approaches

greater than

less than

equal or greater than

equal or less than

infinity

—

the square root (out) of

—

the cube root (out) of

—

the n -th root (out) of

brackets, square brackets (pl)

parentheses, round brackets (pl)

braces (pl)

empty set

tends to, corresponds to

belongs to

is contained in

is not contained in

integral of

integral between limits a and b

integral from n to m

—

A barred

—

a vector; the mean value of a

a tilded

a star

a prime

a double prime

b sub, b first

x sub m , x m -th

x to the power n

N sub v prime

limit (of)

the limit as v becomes infinite

maximum

maximum over x belongs to k

minimum

minimum over y belongs to L of f

the first derivative of Z

function

function of x

increment of x

summation

the sum from x belongs to S

the sum from I equals 0 to i equals r

differential

the first derivative of y with respect to x

the second derivative of y with respect to x

the first derivative of y with respect to x

R of s

(where) V is equal to 1, 2 and so on

(where) i runs from zero to r

Laplacian

union of sets C and D

intersection of sets C and D

B is a subset of A

K is equal to the maximum over i of the sum from j equals one to j equals n of the modulus of s , where s lies in the closed interval ab and where i runs from one to n .

gradient of the function $f(x)$

modulus of a

a plus b over a minus b is equal to c plus d over c minus d .

a cubed is equal to the logarithm of d to the base c .

ПРИЛОЖЕНИЕ 8

Числительные

Простые дроби

Десятичные дроби

(Common Fractions)

(Decimal Fractions)

– a (one) half

0.1 – читается: nought point one или point one

– a (one) third

– two thirds

0.01 – читается: nought point nought one или point nought one

–

2.35 – читается: two point three five

–

– a (one) fifth

32.305 – читается: three two (или thirty-two) point three nought five

– two fifth

– one sixth

– five sixth

– one and a half

– two and a (one) third

1. В простых дробях числитель выражается количественным числительным, а знаменатель – порядковым числительным: – – a (one) third, – – a (one) fifth, – – an (one) eighth. Однако – читается: a (one) half (а не: one second), – a (one) quarter (реже: a fourth).

Когда числитель больше единицы, знаменатель принимает окончание –s: – – two thirds; – – three fifths; – – five sixths.

2. Существительное, следующее за дробью, стоит в единственном числе: – ton (читается: two thirds of a ton); – kilometer (читается: three quarters of a kilometer); – ton (читается: half a ton).

3. Существительное, к которому относится смешанное число, употребляется во множественном числе: – tons (читается: two and a half tons или two tons and a half); – tons (читается: four and a third tons или four tons and a third).

При чтении смешанного числа, целое число которого равно единице, существительное употребляется во множественном числе, когда оно читается после смешанного числа. Когда же существительное читается между единицей и дробью, оно употребляется в единственном числе: – hours (читается: one and a half hours или one (an) hour and a half); – pounds (читается: one and a third pounds или one (a) pound and a third).

4. В десятичных дробях целое число отделяется от дроби точкой. При чтении десятичных дробей каждая цифра читается отдельно. Точка, отделяющая целое число от дроби, читается **point**. Нуль читается **nought**. Если целое число равно нулю, то оно часто не читается: 0.25 – nought point two five или point two five; 14.105 – one four (или fourteen) point one nought five.

Существительное, следующее за десятичной дробью, стоит в единственном числе, когда целое число равно нулю: 0.25 ton (читается: nought point two five of a ton). В других случаях существительное стоит во множественном числе: 1.25 tons (читается: one point two five tons); 23.76 tons (читается: two three point seven six tons или twenty-three point seven six tons).

5. Проценты обозначаются следующим образом: 2% или 2 per cent., или 2 p.c. (читается: two per cent.). Дробным доли одного процента обозначаются следующим образом: $\frac{3}{8}$, или $\frac{3}{8}$ per cent., или $\frac{3}{8}$ p.c. (читается: three eighths per cent. или three eighths of one per cent.); $\frac{1}{2}$, или $\frac{1}{2}$ per cent., или $\frac{1}{2}$ p.c. (читается: a half per cent. или a half of one per cent.); 0.2%, или 0.2 per cent., или 0.2 p.c. (читается: nought point two per cent. или nought point two of one per cent.).

ПРИЛОЖЕНИЕ 9

Практическая часть

Задание 1

Прочитайте и запишите следующие количественные числительные:

5, 100, 73, 14, 31, 46, 88, 97, 123, 678, 779, 1050, 384, 2134, 1, 207, 641, 425, 712, 2, 032, 75, 137.

Задание 2

Прочитайте и запишите следующие числительные:

3, 4, 14, 40, 15, 18, 80, 12, 100, 226, 705, 1000, 4568, 6008, 75, 137, 425, 712, 1306527, 2032678, 3453, 696, $\frac{1}{7}$, $\frac{2}{19}$, $1\frac{1}{5}$, $8\frac{3}{8}$, 0.8, 1.35, 2. 07, 2.386, 3.14.

Задание 3

Образуйте, прочитайте и запишите, порядковые числительные из следующих количественных:

1, 12, 2, 20, 7, 14, 40, 15, 6, 16, 60, 18, 80, 9, 19, 90, 100, 103, 300, 425, 705, 1000, 1015.

Задание 4

Образуйте, прочитайте и запишите порядковые числительные из следующих количественных:

5, 11, 21, 62, 100, 690, 3, 8, 13, 30, 76, 108, 1, 701, 4, 9, 22, 50.

Задание 5

Прочитайте и запишите следующие:

а) даты

6/VI.1995 8/XII.1939 12/IV.2001 2/VIII.1940

7/XI.1917 6/III.1987 31/VII.2003 22/VI.1941

б) простые дроби:

2/3, 3/5, 5/8, 7/16, 9/32, 1/4, 3/4

с) десятичные дроби:

2,5; 25,16; 31,75; 49,165; 0,36; 0, 105

Задание 6

Дайте соответствующие количественные и порядковые числительные:

Пример:

Seven – seventh – seventeen – seventeenth – seventy – seventieth

One, nine, four, five, three, eight, two, six.

Задание 7

Переведите на английский язык:

- 1) Две тысячи рублей. 2) Тысячи людей. 3) Триста сорок метров. 4) Сотни лет.
- 5) Тысяча четыреста километров. 6) Двенадцать студентов. 7) Пятьдесят автомобилей. 8) Три с половиной килограмма. 9) Три четверти часа. 10) 16 процентов. 11) 3/4 тонны. 12) 1/2 сантиметра. 13) 265 метра. 14) 0,75 процента. 15) 2 1/2 часа.

Задание 8

Переведите на английский язык:

1/4 километра; 1 1/2 часа; 1/3 фунта; 2 3/4 процента; 0, 105 метра; 2,18 фунта; 17, 562 тонны; 5 процентов; 23 сантиметра; 1/2 процента; 1 1/3 фунта; 2 1/2 тонны; 35 долларов; 2 500 рублей; 3/4 километра; 0,2 процента, 6,8 метра; 3 1/2 часа; 3445 рублей.

Задание 9

Переведите на английский язык:

- 1) Пятьдесят килограммов. 2) Триста автомобилей. 3) Шестьдесят один грамм.
- 4) Два миллиона тонн. 5) Сотни ящиков. 6) Тысячи книг. 7) Двести восемьдесят один доллар. 8) Три тысячи рублей. 9) Сорок фунтов. 10) Тридцать четыре доллара и десять центов. 11) Сотня велосипедов. 12) Триста лет.

Задание 10

Напишите следующие числа словами.

7 902, 310 064, 739 361, 3 000, 8 651, 300 152.

Задание 11

Заполните таблицу приведёнными ниже числами в цифровой форме.

Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Ones

1. Five thousand ninety-three
2. One thousand three hundred twenty-three
3. Nine hundred thousand nine hundred twenty-one
4. Two thousand nine hundred twenty-three

5. Seven thousand five
6. One hundred sixty-four thousand ninety two

Word problem (задачи)

Math expressions (examples):

after you review the keywords, test yourself

addition: $5+x$	subtraction: $5-x$
multiplication: $5*x$; $5x$	division: $5 \div x$; $5/x$
Exercise: ("mouse over" the block for answer)	
Key words for addition + <i>increased by; more than; combined together; total of; sum; added to</i>	
What is the sum of 8 and y?	$8 + y$
Express the number (x) of apples increased by two	$x + 2$
Express the total weight of Alphie the dog (x) and Cyrus the cat (y)	$x + y$
Key words for Subtraction - <i>less than, fewer than, reduced by, decreased by, difference of</i>	
What is four less than y	$y - 4$
What is nine less than a number (y)	$y - 9$
What if the number (x) of pizzas was reduced by 6?	$x - 6$

What is the difference of my weight (x) and your weight (y)	$x - y$
Key words for multiplication * x or integers next to each other (5y, xy): <i>of, times, multiplied by</i>	
What is y multiplied by 13	$13y$ or $13 * y$
Three runners averaged "y" minutes. Express their total running time:	$3y$
I drive my car at 55 miles per hour. How far will I go in "x" hours?	$55x$
Key words for division $\div$ / <i>per, a; out of; ratio of, quotient of; percent (divide by 100)</i>	
What is the quotient of y and 3	$y/3$ or $y \div 3$
Three students rent an apartment for \$ "x" /month. What will each have to pay?	$x/3$ or $x \div 3$
"y" items cost a total of \$25.00. Express their average cost:	$25/y$ or $25 \div y$

More vocabulary and key words:

- "Per" means "divided by"

as "I drove 90 miles on three gallons of gas, so I got 30 miles per gallon."
(Also 30 miles/gallon)

- "a" sometimes means "divided by"

as in "When I filled up, I paid \$10.50 for three gallons of gasoline,
so the gas was 3.50 a gallon, or \$3.50/gallon"

- **"less than"**

If you need to translate "1.5 less than x", the temptation is to write " $1.5 - x$ ". DON'T! Put a "real world" situation in, and you'll see how this is wrong: "He makes \$1.50 an hour less than me." You do NOT figure his wage by subtracting your wage from \$1.50.

Instead, you subtract \$1.50 from your wage

- **"quotient/ratio of" constructions**

If a problems says "the ratio of x and y", it means "**x divided by y**" or x/y or $x \div y$

- **"difference between/of" constructions**

If the problem says "the difference of x and y", it means " $x - y$ "

What if the number (x) of children was reduced by six, and then they had to share twenty dollars? How much would each get?	$20/(x - 6)$
What is 9 more than y?	$y + 9$
What is the ratio of 9 more than y to y?	$(y + 9)/y$
What is nine less than the total of a number (y) and two	$(y + 2) - 9$ or $y - 7$
The length of a football field is 30 yards more than its width "y". Express the length of the field in terms of its width y	$y + 30$

In January of the year 2000, I was one more than eleven times as old as my son William. In January of 2009, I was seven more than three times as old as him. How old was my son in January of 2000?

Obviously, in "real life" you'd have walked up to my kid and asked him how old he was, and he'd have proudly held up three grubby fingers, but that won't help you on your homework. Here's how you'd figure out his age for class:

First, name things and translate the English into math: Let " E " stand for my age in 2000, and let " W " stand for William's age. Then $E = 11W + 1$ in the year 2000 (from "eleven times as much, plus another one"). In the year 2009 (nine years after the year 2000), William and I will each be nine years older, so our ages will be $E + 9$ and $W + 9$. Also, I was seven more than three times as old as William was, so $E + 9 = 3(W + 9) + 7 = 3W + 27 + 7 = 3W + 34$. This gives you two equations, each having two variables:

$$E = 11W + 1$$

$$E + 9 = 3W + 34$$

If you know how to solve systems of equations, you can proceed with those techniques. Otherwise, you can use the first equation to simplify the second: since $E = 11W + 1$, plug " $11W + 1$ " in for " E " in the second equation:

$$E + 9 = 3W + 34$$

$$(11W + 1) + 9 = 3W + 34$$

$$11W - 3W = 34 - 9 - 1$$

$$8W = 24$$

$$W = 3$$

Remember that the problem did not ask for the value of the variable W ; it asked for the age of a person. So the answer is: ***William was three years old in January of 2000.***

In three more years, Miguel's grandfather will be six times as old as Miguel was last year. When Miguel's present age is added to his grandfather's present age, the total is 68. How old is each one now?

One-half of Heather's age two years from now plus one-third of her age three years ago is twenty years. How old is she now?

*"Here lies Diophantus," the wonder behold . . .
Through art algebraic, the stone tells how old:
"God gave him his boyhood one-sixth of his life,
One twelfth more as youth while whiskers grew rife;
And then yet one-seventh ere marriage begun;
In five years there came a bouncing new son.
Alas, the dear child of master and sage
After attaining half the measure of his fathers life
chill fate took him.
After consoling his fate by this science of numbers
for four years, he ended his life."*

Find Diophantus' age at death.

In order to solve geometric word problems, you will need to have memorized some geometric formulas for at least the basic shapes (circles, squares, right triangles, etc). You will usually need to figure out from the word problem which formula to use, and many times you will need more than one formula for one exercise. So make sure you have memorized any formulas that are used in the homework, because you may be expected to know them on the test.

Some problems are just straightforward applications of basic geometric formulae.

The radius of a circle is 3 centimeters. What is the circle's circumference?

The formula for the circumference C of a circle with radius r is:

$$C = 2(\pi)r$$

...where " π " (above) is of course the number approximately equal to 22 / 7 or 3.14159. They gave me the value of r and asked me for the value of C , so I'll just "plug-n-chug":

$$C = 2(\pi)(3) = 6\pi$$

Then, after re-checking the original exercise for the required units (so my answer will be complete):

the circumference is 6π cm.

Note: Unless you are told to use one of the approximations for π , or are told to round to some number of decimal places (from having used the " π " button on your calculator), you are generally supposed to keep your answer in "exact" form, as shown above. If you're not sure if you should use the " π " form or the decimal form, use both: " 6π cm, or about 18.85 cm".

A square has an area of sixteen square centimeters. What is the length of each of its sides?

The formula for the area A of a square with side-length s is:

$$A = s^2$$

They gave me the area, so I'll plug this value into the area formula, and see where this leads:

$$16 = s^2$$

$$4 = s$$

After re-reading the exercise to find the correct units, my answer is:

The length of each side is 4 centimeters.

A cube has a surface area of fifty-four square centimeters. What is the volume of the cube?

Work" problems involve situations such as two people working together to paint a house. You are usually told how long each person takes to paint a similarly-sized house, and you are asked how long it will take the two of them to paint the house when they work together. Many of these problems are not terribly realistic (since when do two laser printers work together on printing one report?), but it's the technique that they want you to learn, not the applicability to "real life".

The method of solution for work problems is not obvious, so don't feel bad if you're totally lost at the moment. There is a "trick" to doing work problems: you have to think of the problem in terms of how much each person / machine / whatever does *in a given unit of time*. For instance:

Suppose one painter can paint the entire house in twelve hours, and the second painter takes eight hours. How long would it take the two painters together to paint the house?

If the first painter can do the entire job in twelve hours and the second painter can do it in eight hours, then (this here is the trick!) the first guy can do $\frac{1}{12}$ of the job *per hour*, and the second guy can do $\frac{1}{8}$ *per hour*. How much then can they do *per hour* if they work together?

To find out how much they can do together *per hour*, I add together what they can do individually *per hour*: $\frac{1}{12} + \frac{1}{8} = \frac{5}{24}$. They can do $\frac{5}{24}$ of the job *per hour*. Now I'll let " t " stand for how long they take to do the job together. Then they can do $\frac{1}{t}$ *per hour*, so $\frac{5}{24} = \frac{1}{t}$. Flip the equation, and you get that $t = \frac{24}{5} = 4.8$ hours. That is:

hours to complete job:

first painter: 12

second painter: 8

together: t

completed per hour:

first painter: $\frac{1}{12}$

second painter: $\frac{1}{8}$

together: $\frac{1}{t}$

adding their labor:

$$\frac{1}{12} + \frac{1}{8} = \frac{1}{t}$$

$$\frac{5}{24} = \frac{1}{t}$$

$$\frac{24}{5} = t$$

They can complete the job together in just under five hours.

One pipe can fill a pool 1.25 times faster than a second pipe. When both pipes are opened, they fill the pool in five hours. How long would it take to fill the pool if only the slower pipe is used?

Convert to rates:

hours to complete job:

fast pipe: f

slow pipe: $1.25f$

together: 5

completed per hour:

fast pipe: $\frac{1}{f}$

slow pipe: $\frac{1}{1.25f}$

together: $\frac{1}{5}$

adding their labor:

$$\frac{1}{f} + \frac{1}{1.25f} = \frac{1}{5}$$

multiplying through by $5f$:

$$5 + 5/1.25 = f$$

$$5 + 4 = f = 9$$

Then $1.25f = 11.25$, so ***the slower pipe takes 11.25 hours.***

If you're not sure how I derived the rate for the slow pipe, think about it this way: If someone goes twice as fast as you, then you take twice as long as he does; if he goes three times as fast, then you take three times as long. In this case, if he goes 1.25 times as fast, then you take 1.25 times as long.

Two mechanics were working on your car. One can complete the given job in six hours, but the new guy takes eight hours. They worked together for the first two hours, but then the first guy left to help another mechanic on a different job. How long will it take the new guy to finish your car?

Working alone, Maria can complete a task in 100 minutes. Shaniqua can complete the same task in two hours. They work together for 30 minutes when Liu, the new employee, joins and begins helping. They finish the task 20 minutes later. How long would it take Liu to complete the task alone?

References

<http://fabpedigree.com/james/grmatm2.htm>

<http://www.kidsmathgamesonline.com/pictures/mathematicians.html>

<http://www.mscs.dal.ca/~kgardner/History.html>

<http://www.britannica.com/EBchecked/topic/194901/Euclidean-geometry>

<http://listverse.com/2010/12/07/top-10-greatest-mathematicians/>

http://en.wikipedia.org/wiki/Ren%C3%A9_Descartes

http://en.wikiquote.org/wiki/Carl_Friedrich_Gauss

<http://www.mnn.com/green-tech/research-innovations/blogs/5-brilliant-mathematicians-and-their-impact-on-the-modern#http://www.therichest.com/rich-list/most-influential/greatest-mathematicians/>

<http://math.about.com/od/mathematicians/a/fibonacci.htm>

<http://www2.stetson.edu/~efriedma/periodictable/html/F.html>

<http://www.britannica.com/EBchecked/topic/643734/Andrew-John-Wiles>

<http://www.biography.com/people/alan-turing-9512017?page=3>

<http://www.livescience.com/20296-isaac-newton.html>

<http://www.sunshinemaths.com/topics/geometry/types-of-lines/>

<http://www.mathsisfun.com/angles.html>

<http://www.sunshinemaths.com/topics/geometry/types-of-angles/>

<http://listtoptens.com/top-10-greatest-mathematicians/#sth.jK769GdA.dpuf>

<http://ru.wikipedia.org/wiki/%D0%90%D0%BB%D0%B3%D0%BE%D1%80%D0%http://www.sunshinemaths.com/topics/geometry/types-of-lines/B8%D1%82%D0%BC>

<http://www.mathsisfun.com/angles.html>

<http://www.agnesscott.edu/lriddle/women/women.htm>

<http://nrich.maths.org/5748>

<http://www.sciencedaily.com/releases/2010/07/100708111324.htm>

<http://theconversation.com/a-good-move-to-master-maths-check-out-these-chess-puzzles-20200>

<http://www.studygs.net/mathproblems.htm>

<http://www.deseretnews.com/article/865560133/A-brief-history-of-numbers-and-counting-Part-2-Indian-invention-of-zero-was-huge-in-development-of.html?pg=2>