

UNIT 1

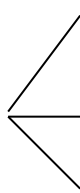
*“Mathematics is the science that
draws necessary conclusions.”*

Benjamin Pierce

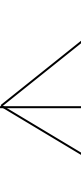
Grammar: Sequence of Tenses. Reported Speech.

Согласование времен (Sequence of Tenses)

1. Если сказуемое главного предложения выражено глаголом **в настоящем времени** (Present Simple, Present Perfect) или **в будущем времени** (Future Simple), то глагол в придаточном предложении употребляется в **любом времени**, которое требуется по смыслу:

| | | | |
|--------|--|---------------------------------|-------------------|
| I know |  | he works there | работает |
| | | he is working there | |
| | | he worked there | работал |
| | | he was working there | |
| | | he will work there | будет работать |
| | | he will be working there | |

2. Если сказуемое главного предложения выражено глаголом **в прошедшем времени** (обычно Past Simple), то глагол придаточного предложения употребляется в одной из форм **прошедшего времени** или **будущего в прошедшем** (Future in the Past).

| | | | |
|--------|---|----------------------------------|-------------------|
| I knew |  | he worked there | работает |
| | | he was working there | |
| | | he had worked there | работал |
| | | he had been working there | |
| | | he would work there | будет работать |
| | | he would be working there | |

3. Изменение **модальных глаголов** при согласовании времен.

can → **could**

shall → **should** (совет)

may → **might**

must → **had to** (пришлось, был вынужден)

will → **would**

**would, could, might, ought to, must (обязан)/mustn't НЕ
МЕНЯЮТСЯ.**

She **reminded** me that I **ought** to be more careful. Она напомнила мне, что я должен быть осторожнее.

I **didn't understand** why it was I who **should** do it. Я не понимал, почему именно я должен все это делать.

Косвенная речь (Reported Speech)

Правило согласования времен действует и при обращении предложения в косвенную речь.

1. **Повествовательные предложения** в косвенной речи вводятся глаголами **to say, to tell** + косвенное дополнение без предлога **to**: **he said that ..., he said to me that ..., he told me that ...** .

Глагол в главном предложении, вводящий прямую речь, стоит в **настоящем времени**.

Direct Speech

Jack says, "She **knows** the answer."
Anna says, "We **are leaving** tonight."

Bob says, "I **have read** the story."
Sue says, "They **told** the truth."
Jim says, "I **was thinking** about it."

Greg says, "Dad **will speak** to you."
Paul says, "He **can swim** here."

Reported Speech

Jack says (that) she **knows** the answer.
Anna says (that) they **are leaving** tonight.

Bob says (that) he **has read** the story.
Sue says (that) they **told** the truth.
Jim says (that) he **was thinking** about it.

Greg says (that) dad **will speak** to me.
Paul says (that) he **can swim** here.

Глагол, вводящий прямую речь, стоит в **прошедшем времени**.

Direct Speech

Present Simple

Jack said, "She **knows** the answer."

Present Continuous

Anna said, "We **are leaving** soon."

Present Perfect

Bob said, "I **have read** the story."

Reported Speech

Past Simple

Jack said (that) she **knew** the answer.

Past Continuous

Anna said (that) they **were leaving** soon.

Past Perfect

Bob said (that) he **had** read the story.

Past Simple

Sue said, "They **told** the truth."

Past Continuous

I said, "**I was thinking** about it."

Past Perfect

Matt said, "I **had read** this book."

Past Perfect Continuous

Ted said, "**I had been doing** it all day."

Future Simple

Greg said, "Dad **will speak** to you."

Past Simple/Past Perfect

Sue said (that) they (**had**) **told** the truth.

Past Continuous/Past Perfect

Continuous

I said (that) I **was /had been thinking** about it.

Past Perfect (no change!)

Matt said (that) he **had read** this book.

Past Perfect Continuous (no change!)

Ted said (that) he **had been doing** it all day.

Future in the Past

Greg said (that) dad **would speak** to me.

Для передачи косвенной речи используется ряд других глаголов:

а) для сообщения информации: **remark** (отмечать), **explain** (объяснять), **mention** (упоминать), **insist** (настаивать), **declare** (объявлять), **announce** (объявлять), **state** (заявлять), **promise** (обещать)

б) следующие глаголы показывают, что далее последует ответ на уже высказанную реплику: **answer** (отвечать), **confirm** (убеждать), **reply** (говорить в ответ), **object** (возражать), **agree** (соглашаться), **deny** (отрицать), **assert** (утверждать), **protest** (выражать протест)

2. **Общие вопросы** вводятся в косвенной речи союзами **if** или **whether**, которые помещаются перед косвенным общим вопросом. Сам косвенный вопрос приобретает структуру утвердительного предложения.

Direct speech

The dean asked Lucie, "**Do you live** far from the university?"

My brother asked, "**Can you answer** the phone?"

Reported Speech

The dean asked Lucie **if she lived** far from the university.

My brother asked me **if I could answer** the phone.

Вместо глагола **ask** могут употребляться другие вводящие глаголы: **want to know** (хотеть знать), **inquire** (узнавать), **wonder** (интересоваться).

3. **Специальные вопросы** в косвенной речи вводятся вопросительными местоимениями, которые становятся союзными словами.

Direct speech

He asks me, "What book **has she read** since Monday?"

He asked me, "What places **have you visited**?"

Reported Speech

He asks me what book she **has read** since Monday.

He asked me what places **I had visited**.

4. **Повелительное предложение.** Если прямая речь выражает **приказание**, то глагол **to say** заменяется глаголом **to tell** (велеть, сказать) или **to order** (приказывать). Если прямая речь выражает **просьбу**, то глагол **to say** заменяется глаголом **to ask** (просить).

Следует иметь в виду, что после глаголов **to ask, to tell, to order** в английском языке всегда следует **косвенное дополнение**, обозначающее лицо, к которому обращена просьба или приказание, а само содержание просьбы или приказа передается глаголом в форме **инфинитива** с частицей **to**.

Здесь также возможно употребление таких глаголов, как **to invite** (приглашать), **to advise** (советовать), **to recommend** (рекомендовать), **to warn** (предупреждать).

Direct speech

She **said** to him, "**Come** at five o'clock."

The teacher **said** to me, "**Don't sit down**."

I **said** to her, "Please, **bring** me a glass of water."

Reported speech

She **told him to come** at five o'clock.

The teacher **told me not to sit down**.

I **asked her to bring** me a glass of water.

5. **Отступления от правил согласования времен.**

- A. Правило согласования времен **не соблюдается**, если придаточное предложение содержит **универсальную** (всеобщую) **истину**.

They **didn't even know** that life **has been developing** on our planet for billions of years.

Они не знали даже того, что жизнь на нашей планете развивается миллиарды лет.

- B. Если придаточное предложение содержит **высказывание**, которое говорящий считает **истинным**, безотносительно ко времени (поговорки, пословицы).

When he **returned** from France he **said** that East or West home **is** best.

Когда он вернулся из Франции, он сказал, что в гостях хорошо, а дома лучше.

С. Если предложение в косвенной речи употребляется во II или III типе условных предложений.

He **said** that if he **were** me, he **would attend** that conference. Он сказал, что если бы он был на моем месте, он принял бы участие в той конференции.

6. Дополнительные изменения в косвенной речи. Личные, притяжательные и указательные местоимения, а также наречия места и времени претерпевают следующие изменения при изменении предложений в косвенную речь.

| Direct speech | Reported speech |
|---|---|
| I, you, he, she we, you, they | he or she they |
| my, your, his, her our, your, their | his or her their |
| this, these | that, those |
| now today tonight yesterday tomorrow the day after tomorrow in an hour last week next week next Friday two days ago | then, at that time that day that night the day before, the previous day the next day, the following day two days later an hour later the week before, the previous week the week after, the following week the following Friday two days before |

Ex. 1. Answer the questions according to the model. Don't forget to make the necessary changes in the reported speech.

a) A. What does he say? (I am a first-year student).

B. He says he is a first-year student.

1. What does he say? (I live in the students' hall of residence).
2. What does he promise? (As soon as my exams are over I shall go to Brest for a short vacation).
3. What do the students say? (We had two tests last week).
4. What does mother know? (My son is afraid of dogs).

5. What does the reporter mention? (There have been two accidents on the road).
6. What has the Prime Minister declared? (I am going to London next week).
7. What does the child say? (We have been reading this book for three days, Mom).
8. What will you tell her? (We need some help).

b) A. What did he say? (My sister learnt French).
B. He said his sister had learnt French.

1. What didn't you know? (She can speak Polish).
2. What did you decide last week? (We all will go to the Canaries Islands).
3. What did she know? (Her boyfriend has already come back to Minsk).
4. What did the administrator announce? (The press conference is taking place in the main hall now).
5. What did the student say? (I have been writing my term paper since Friday).
6. What did Bill say? (I took my dog out for a walk in the morning).
7. What did mother remind you about? (I ought to be more careful when doing my homework).

c) A. What did she ask you about? (Has anybody read the book?).
B. She asked me if somebody had read the book.

1. What did your friend ask you about? (Do you know the password for the computer?)
2. What did the policeman ask you about? (Does the car belong to you?)
3. What did the interviewer want to know? (Do you watch TV every evening, Chris?)
4. What did your father ask you about? (Do you know what you have done?)
5. What did your sister want to know? (Are they getting married this weekend?)
6. What did you say to her? (Can a correct solution be found?)
7. What did he want to know? (Has the situation changed recently?)

d) A. What did he say? (What field of maths are you concerned with?).
B. He asked what field of maths I was concerned with.

1. What did the scientist say? (When will it be possible to introduce a new method?)

- c) following
 - d) the following
2. They have said that their new computer _____ tomorrow.
a) would deliver b) will deliver
c) would be delivered d) will be delivered
 3. The driver said that he _____ be there at 8:40.
a) has to b) had to
c) ought d) will have to
 4. He _____ why I had been standing at the bus stop the night before.
a) asked to me b) asked me
c) told me d) had told me
 5. She asked me if I _____ time to help him two hours later.
a) have b) will have
c) would have d) am having
 6. The manager wondered when _____ them the goods they had ordered.
a) would they send b) will they send
c) they would send d) they will send
 7. They complained that the coffee machine they had bought in that store _____.
a) didn't work b) don't work
c) hasn't worked d) isn't working
 8. He said that actions _____ louder than words.
a) speaks b) speak
c) will speak d) had spoken
 9. Jane _____ there was nothing she could do.
a) said me b) told me
c) told to me d) say to me
 10. The customer wanted to know _____.
a) how much that book is b) how much is this book
c) how much that book was d) how much was this book

Pre-Reading Activity

Guess the meaning of the following words

| | |
|-----------------------------|------------------------|
| geometry [dʒi'ɒmɪtri] (n) | process ['prəʊses] (n) |
| geometric [dʒi'ɒmɪtrɪk] (a) | axiom ['æksɪəm] (n) |
| postulate ['pɒstjʊleɪt] (n) | theorem ['θiərəm] (n) |
| vertical ['vɜːtɪkəl] (a) | figure ['fɪɡə] (n) |
| form [fɔːm] (n) | |

Read and learn the basic vocabulary terms.

| | |
|--------------------------------|--|
| reasoning ['riːsɒnɪŋ] (n) | – 1. рассуждение; 2. обоснование |
| principal ['prɪnsɪpəl] (a) | – главный |
| discover [dɪs'kʌvə] (v) | – обнаружить, открыть, находить |
| acquaint [ə'kweɪnt] (v) | – познакомить |
| establish [ɪs'tæblɪʃ] (v) | – устанавливать |
| proposition [ˌprɒpə'zɪʃən] (n) | – 1. предложение, утверждение (требующее доказательства), высказывание, суждение; 2. теорема |
| definition [defɪ'nɪʃən] (n) | – определение |
| meaning ['miːnɪŋ] (n) | – значение; смысл |
| attribute [ə'trɪbjʊt] (v) | – приписывать, относить, придавать |
| accept [ək'sept] (v) | – принимать, допускать |
| proof [pruːf] (n) | – доказательство |
| unique [juː'nɪːk] (a) | – единственный, однозначный |
| plane [pleɪn] (n) | – плоскость |
| congruent [kɒn'ɡruːnt] (a) | – конгруэнтный; совмещающийся |
| arc [ɑːk] (n) | – дуга, арка |
| remaining [rɪ'meɪnɪŋ] (a) | – остающийся |
| corollary [kə'rɒləri] (n) | – следствие |
| distinguish [dɪs'tɪŋɡwɪʃ] (v) | – различать; выделять; распознавать |
| hypothesis [haɪ'pɒθɪsɪs] (n) | – гипотеза |
| conclusion [kɒn'kluːʒən] (n) | – вывод |
| consider [kən'sɪdər] (v) | – считать, полагать, рассматривать |
| require [rɪ'kwaɪə] (v) | – требовать, нуждаться |
| rephrase [rɪ'freɪz] (v) | – перефразировать |
| converse [kɒnvɜːs] (n) | – обратная теорема |
| bisector [baɪ'sektər] (n) | – биссектриса |
| assumption [ə'sʌmpʃən] (n) | – предположение, допущение |

deduce [dɪ'dʒʌs] (v) – выводить (заключение, формулу)

Memorize the following word combinations

properties of geometric figures – свойства геометрических фигур

it would be instructive – было бы поучительно

one of the four angles turns out to be right – один из четырех углов
оказывается прямым

at most – самое большее; максимум

it is useful to notice – полезно отметить

the theorems are converse to each other – теоремы обратны друг другу

This is not always the case. Это не всегда так.

to be true/false – быть истинным/ложным

to acquaint yourself with the forms of reasoning – ознакомиться с моделями
рассуждения

it follows from the axiom – из теоремы следует

one can distinguish two parts – можно выделить две части

to take for (as) granted – считать доказанным, принимать без
доказательства

Reading Activity

Mathematical propositions

In geometry, the process of reasoning is a principal way to discover properties of geometric figures. It would be instructive therefore to acquaint yourself with the forms of reasoning usual in geometry.

All facts established in geometry are expressed in the form of **propositions**. The propositions that we take for granted without proof are called **assumptions**. With regard to a different set of assumptions the same proposition may, or may not be true. The assumptions themselves are neither true nor false. They may be said to be “true” only in the sense that their truth has been assumed.

Definitions are propositions which explain what meaning one attributes to a name or expression.

Axioms (some axioms are traditionally called postulates) are those facts which are accepted without proof. This includes, for example, some propositions: through any two points there is a unique line; if two points of a line lie in a given plane then all points of this line lie in the same plane.

Propositions that can be logically deduced from the assumptions are often called **theorems**. For example, if one of the four angles formed by two

intersecting lines turns out to be right, then the remaining three angles are right as well.

Corollaries are those propositions which follow directly from an axiom or a theorem. For instance, it follows from the axiom "there is only one line passing through two points" that "two lines can intersect at one point at most."

In any theorem one can distinguish two parts: the **hypothesis** and the **conclusion**. The **hypothesis** expresses what is considered given, the **conclusion** what is required to prove. For example, in the theorem "if central angles are congruent, then the corresponding arcs are congruent" the hypothesis is the first part of the theorem: "if central angles are congruent," and the conclusion is the second part: "then the corresponding arcs are congruent;" in other words, it is given (known to us) that the central angles are congruent, and it is required to prove that under this hypothesis the corresponding arcs are congruent.

It is useful to notice that any theorem can be rephrased in such a way that the hypothesis will begin with the word "if," and the conclusion with the word "then." For example, the theorem "vertical angles are congruent" can be rephrased this way: "if two angles are vertical, then they are congruent."

The theorem **converse** to a given theorem is obtained by replacing the hypothesis of the given theorem with the conclusion (or some part of the conclusion), and the conclusion with the hypothesis (or some part of the hypothesis) of the given theorem. For instance, the following two theorems are converse to each other:

If central angles are congruent,
then the corresponding arcs are
congruent.

If arcs are congruent, then the
corresponding central angles are
congruent.

If we call one of these theorems **direct**, then the other one should be called converse.

In this example both theorems, the direct and the converse one, turn out to be true. This is not always the case. For example the theorem: "if two angles are vertical, then they are congruent" is true, but the converse statement: "if two angles are congruent, then they are vertical" is false.

Indeed, suppose that in some angle the bisector is drawn. It divides the angle into two smaller ones. These smaller angles are congruent to each other, but they are not vertical.

Post-Reading Activity

Ex. 4. *Answer the following questions.*

1. What is a principal way to discover properties of geometries figures?

2. Dwell on the types of propositions.
3. What is a definition?
4. Axioms are statements that must be proved, aren't they?
5. What is particular about theorems?
6. Does a corollary follow directly from a definition or from a theorem?
7. How many parts can one distinguish in any theorem?
8. Can the hypothesis of one theorem become the conclusion of the other?
9. Give your own examples of two theorems which are converse to each other.
10. What is the difference between an assumption and an axiom?

Ex. 5. Match the English words and word combinations with their Russian equivalents.

- | | |
|---|----------------------------------|
| 1. the process of reasoning | a. пересекаться в одной точке |
| 2. to discover properties of figures | b. существует единственная линия |
| 3. what meaning one attributes | c. какое значение придают |
| 4. to accept without proof | d. процесс рассуждения |
| 5. there is a unique line | e. начинать со слов |
| 6. to lie in the same plane | f. конгруэнтные дуги |
| 7. congruent arcs | g. обнаружить свойства фигур |
| 8. the remaining angles | h. принимать без доказательства |
| 9. to intersect at one point | i. остающиеся углы |
| 10. under this hypothesis | j. провести биссектрису |
| 11. to be converse to the given theorem | k. быть обратным данной теореме |
| 12. to begin with the words | l. по этой гипотезе |
| 13. to draw a bisector | m. лежать на одной плоскости |

Ex. 6. Find out whether the statements are True or False according to the information in the text. Use the introductory phrases:

I think, it is right.

I am afraid, it is wrong.

Quite so. Absolutely correct.

I don't quite agree to it.

I quite agree to it.

On the contrary. Far from it.

1. In geometry all facts are expressed in the form of formulas.
2. Two parts are distinguished in any theorem: the proposition and the conclusion.
3. Scientists discover properties of geometric figures by means of reasoning.
4. Corollaries follow directly from definitions.

5. We obtain a converse theorem by replacing the hypothesis of the given theorem with the conclusion.
6. The direct and the converse theorems always turn out to be true.
7. Axioms are postulates which should be proved.
8. There are two types of propositions: congruent and central.
9. In any theorem the hypothesis can begin with the word “if”, and the conclusion with the word “then”.

Ex. 7. Fill in the blanks with the words from the box. Mind there are two extra words.

- | | | |
|---------------|----------------|-----------------|
| a. hypothesis | e. accepted | i. deduced |
| b. further | f. meaning | j. remaining |
| c. theorems | g. to discover | k. established |
| d. reasoning | h. conclusion | l. propositions |

1. All that is necessary is that the words and phrases used shall have the same ... for everybody.
2. The ... that we take for granted without proof are called assumptions.
3. That which is given is sometimes called the ..., and that which is to be proved is sometimes called the
4. Propositions that can be logically deduced from the assumptions are often called
5. All facts ... in geometry are expressed in the form of propositions.
6. The answer to a problem in actual life can often be obtained by ... investigation of the actual facts, while in geometry it can always be obtained by ... alone.
7. The scientist has two problems – one, ... new scientific propositions; the other, to devise a set of assumptions from which all his propositions can be logically

Ex. 8. Match the left and the right parts of the following statements.

- | | |
|--|---|
| 1. If the same quantity is added or subtracted from equal quantities, then | a. these two quantities are equal to each other. |
| 2. If two points of a line lie in a given plane, then | b. it is divisible by 6. |
| 3. If each of two quantities is equal to a third quantity, then | c. the equality remains true. |
| 4. If central angles are congruent, then | d. the remaining three angles are right as well. |
| 5. If a number is divisible by 2 and by 3, then | e. all points of this line lie in the same plane. |
| 6. If one of the four angles formed by | f. the corresponding arcs are congruent. |

two intersecting lines is right, then

Ex. 9. Translate the sentences according to the models.

Model 1. *There are various ways of evaluating formulae.*

Существуют различные способы вычисления формул.

1. There are a lot of important theorems in this book.
2. There are sets containing no elements.
3. There has been recently developed a new method of proving the theorem.
4. There are many measurements to be made.
5. There weren't any problems with my term paper last year.
6. There will be enough work for everybody at the next conference.

Model 2. *There exist a lot of equivalent relations.*

Существует много эквивалентных отношений.

1. There exists no difference between these two expressions.
2. There exists at least one element in a non-empty set.
3. There exist some important statements in the article.
4. There exist many different ways of defining a circle.
5. There exist no solutions to the problem presented.

Model 3. *To a pair of numbers there corresponds a point in the plane.*

Паре чисел соответствует точка на плоскости.

1. To a linear equation there corresponds a straight line in the Euclidean space.
2. To a point in three dimensional space there correspond its three coordinates.
3. To each number in X there corresponds a unique element in Y.
4. To any two objects a, b there corresponds a new object.
5. If to each member x of a set there corresponds one value of a variable y , then y is a function of x .

Ex. 10. Let us revise Present, Past and Future Simple Tenses (Active and Passive).

a) Which auxiliary verb will you use when making the following sentences questions.

A) do B) did C) does D) had E) have F) was

1. A lot of students combine work and studies.
2. A lot of additional information was required.
3. That is where I used to live in my childhood.

4. Last Friday I was late for classes because of the heavy rain.
5. They got married last year.
6. In Britain most shops close at 5.30 p.m.
7. I usually have breakfast before I go to work.
8. We see each other only occasionally.
9. Because of his bad answer the student had to solve another problem.
10. Harry looks very untidy in these dirty jeans.

b) Choose the best English equivalent for the words given in Russian.

1. He thought that you (занимаетесь) in for swimming.
a. went b. go c. will go
2. We are sure that they (разрешили) all the problems yesterday.
a. were solved b. are solved c. solved
3. In day-to-day life mathematics (используется) in every sphere, from telling the time to hobbies.
a. are used b. is used c. used
4. The train (отправляется из) London next Friday at 8 a.m. and (прибывает в) in Leeds at 11 a.m.
a. will leave, arrives b. leaves, will arrive c. leaves, arrives
5. As soon as the classes (окончатся), we shall hurry to the canteen.
a. will be over b. are over c. is over
6. The Dean said that a lot of interesting subjects (изучаются) by the students.
a. were studied b. will be studied c. studied
7. This equation essentially (отличается) from the one which we (решали) last time.
a. differed, solved b. differs, solved c. differed, solves
8. The main thing geometry (дает) us is the ideal of a logical system and of precise thinking.
a. is given b. gave c. gives

Ex. 11. Rewrite the following passages in the Passive Voice.

A. Charles Babbage, an English professor of mathematics, built the first computer in 1827. They called it a "Difference Engine". Babbage also devised the basic principles of the modern computer. He spent much of his own money on his inventions. In 1834 Babbage designed a more complex "Analytical Machine" – the world's first digital computer with a memory and programming, but couldn't get the finance to build it. People forgot about Babbage's machine till 1937 when they rediscovered his papers.

B. The school provides the Internet for students to conduct research and communicate with others in relation to schoolwork. They give the access to network service to those students who agree to act in a responsible manner. The staff thinks that access is a privilege, not a right. They expect that the user will follow the certain rules of behavior.

Ex. 12. Ask special questions.

1. Some properties are established by way of reasoning (how).
2. Geometry is concerned with the properties and relationships of figures in space (what ... with).
3. Some figures such as cubes and spheres have three dimensions (how many).
4. Many discoveries were made in the nineteenth century (when).
5. The truth of non-mathematical propositions in real life is much less certain (where).
6. The given proposition and its converse can be stated as follows (in what way).
7. Pure mathematics deals with the development of knowledge for its own purpose and need (what ... with).
8. Carl Gauss proved that every algebraic equation had at least one root (who).
9. There are three words having the same meaning (how many).
10. The given definition corresponds to the idea of uniqueness (what).

Ex. 13. Write the converses of the following propositions and decide in each case whether you think the converse is true or false.

1. If all three sides of a triangle are equal, the three angles of the triangle are also equal.
2. If all four sides of a quadrilateral are equal, the quadrilateral is a parallelogram.
3. If two triangles are equal, the angles of the two triangles are respectively equal.

4. If two rectangles are equal, the diagonals of one rectangle are equal to the diagonals of the other.
5. If dew (poca) has fallen, the grass is wet.
6. If the milkman has come, there are three bottles of milk on the back porch.
7. If Aunt Marian is coming, we shall have waffles for supper.
8. If the tree is dead, it has no sap (сок) in it.
9. A squirrel (белка) is an animal having a thick bushy tail.
10. A hungry baby cries.
11. Every point in line AB is a point in line ABC .

Ex. 14. Turn direct speech into reported speech.

1. Plato advised, "The principal men of our state must go and learn arithmetic, not as amateurs, but they must carry on the study until they see the nature of numbers with the mind only."
2. Descartes, father of modernism, said, "All nature is a vast geometrical system. Thus all the phenomena of nature are explained and some demonstration of them can be given."
3. In Descartes's words, "You give me extension and motion then I'll construct the universe."
4. The often repeated motto on the entrance to Plato's Academy said, "None ignorant of geometry enter here."
5. J. Kepler affirmed: "The reality of the world consists of its maths relations. Maths laws are true cause of phenomena."
6. I. Newton said, "I don't know what I may appear to the world; but to myself I seem to have been only like a boy playing on the seashore, and diverting myself now and then by finding a smoother pebble or a prettier shell than usual; whilst the great ocean of truth lay all undiscovered before me. If I saw a little farther than others, it is because I stood on the shoulders of giants".

Ex. 15. Choose the correct variant of translation.

1. **We thought that you were going to enter an institute.**
 - a. Мы думали, что вы собираетесь поступить в институт.
 - b. Мы думали, что вы собирались поступить в институт.
 - c. Мы думали, что вы собирались войти в институт.
2. **Scientists use mathematical formulas to express their findings precisely.**
 - a. Ученые используют математические формулы, чтобы аккуратно описать свои находки.

- b. Ученые используют математические формулы для точного выражения своих находок.
 - c. Ученые используют математические формулы, чтобы точно выразить полученные данные.
- 3. Where there is a choice of two expressions, we should always choose the more accurate one.**
- a. Там, где существует выбор из двух выражений, нам всегда следует выбирать более точное выражение.
 - b. Там, где есть выбор из двух выражений, мы всегда выберем более точное выражение.
 - c. Там, где есть выбор из двух выражений, мы бы всегда выбирали более точное выражение.
- 4. Assumptions are related to theorems in the same way that undefined terms are related to definitions.**
- a. Допущения связаны с теоремами таким же путем, как неопределенные термины связаны с определениями.
 - b. Допущения сопоставимы с теоремами точно также, как неопределенные термины сопоставимы с определениями.
 - c. Допущения связываются с теоремами таким же путем, как неопределенные термины связываются с определениями.
- 5. Very often a proposition is so worded that it requires thought to state the converse proposition correctly.**
- a. Очень часто утверждение формулируется таким образом, что нужно как следует подумать, чтобы сформулировать обратное утверждение правильно.
 - b. Зачастую утверждение составляется так, что требуется поразмыслить, чтобы правильно заявить об обратном утверждении.
 - c. Очень часто утверждение выражается так, что оно требует размышления над правильной формулировкой обратного утверждения.

Ex. 16. Translate the following sentences into English.

- 1. В данном случае обе теоремы – как прямая, так и обратная – оказываются справедливыми.
- 2. Пять аксиом Евклида – это предложения, вводящие отношения равенства или неравенства величин.
- 3. Учебник Евклида по геометрии «Начала» читали, читают и будут

читать многие (люди). 4. Предложение, которое следует непосредственно из аксиомы, называется следствием. 5. Следующие две теоремы обратны друг другу. 6. Одно и то же предложение может быть или не быть истинным относительно другого множества допущений. 7. В любой теореме есть две части: гипотеза и вывод. 8. Вас просят записать кратко предположения, которые вы сделали. 9. Аксиома – это истинное, исходное положение теории. 10. Постулат – это утверждение, принимаемое в какой-либо научной теории как истинное, хотя и недоказуемое ее средствами, и поэтому он играет в ней роль аксиомы.

Ex. 17. Read the text and find the answers to the following questions.

1. What is logical deduction?
2. Do we proceed from the general to the particular or from the particular to the general in induction?
3. Which method of thinking is more useful: deductive or inductive?

Deduction and Induction

The scientists have proved a chain of theorems and have come to recognize the entire structure of undefined terms, definitions, assumptions, and theorems as constituting an abstract logical system. In such a system we say that each proposition is derived from its predecessor by the process of logical deduction. This process of logical deduction is **scientific reasoning**.

This scientific reasoning must not be confused with the mode of thinking employed by the scientist when he is feeling his way toward a new discovery. At such times the scientist, curious about the sum of the angles of a triangle, proceeds to measure the angles of a great many triangles very carefully. In every instance he notices that the sum of the three angles is very close to 180° ; so he puts forward a guess that this will be true of every triangle he might draw. This method of **deriving a general principle from a limited number of special instances is called induction**.

The method of induction always leaves the possibility that further measurement and experimentation may necessitate some modification of the general principle. The method of deduction is not subject to upsets of this sort.

When the mathematician is groping for (ищет) new mathematical ideas, he uses induction. On the other hand, when he wishes to link his ideas together into a logical system, he uses deduction. The laboratory scientist also uses deduction when he wishes to order and classify the results of his observations and his inspired guesses and to arrange them all in a logical system. While building this logical system he must have a pattern (модель) to guide him, an ideal of what a logical system ought to be. The simplest exposition

(изложение) of this ideal is to be found in the abstract logical system of demonstrative geometry.

It is clear that both deductive and inductive thinking are very useful to the scientist.

Ex. 18. Writing. Put the sentences into the right order to make a complete paragraph. The first sentence is given to you.

WHAT IS MATHEMATICS?

1. Maths, as science, viewed as a whole, is a collection of branches.
- A. The largest branch is that which builds on ordinary whole numbers, fractions, and irrational numbers, or what is called collectively the real number system.
- B. Hence, from the standpoint of structure, the concepts, axioms and theorems are the essential components of any compartment of maths.
- C. These concepts must verify explicitly stated axioms. Some of the axioms of the maths of numbers are the associative, commutative, and distributive properties and the axioms about equalities.
- D. Arithmetic, algebra, the study of functions, the calculus differential equations and other various subjects which follow the calculus, in logical order are all developments of the real number system. This part of maths is termed the maths of numbers.
- E. Some of the axioms of geometry are that two points determine a line, all right angles are equal, etc. From these concepts and axioms, theorems are deduced.
- F. A second branch is geometry consisting of several geometries. Maths contains many more divisions. Each branch has the same logical structure: it begins with certain concepts, such as the whole numbers or integers in the maths of numbers or such as points, lines, triangles in geometry.

UNIT 2

*“Mathematics is the gate
and key to science”*

Roger Bacon

Grammar: The Participle

Причастие (The Participle)

Причастие – неличная форма глагола, имеет признаки как прилагательного, так и глагола.

| Active | | Passive | |
|--------------------|-------------|------------------|--|
| Participle I | doing | being done | Выражает действие, одновременное с действием глагола-сказуемого |
| Participle II | — | done | Выражает действие, одновременное с действием глагола-сказуемого или предшествующее ему |
| Perfect Participle | having done | having been done | Выражает действие, предшествующее действию глагола-сказуемого |

Participle I Active – doing – в предложении выполняет функцию:

1) Определения (an Attribute)

The **writing** student will be...

The student **writing** a new programme ...

Пишущий студент будет ...

Студент, пишущий новую программу ...

2) Обстоятельства (an Adverbial Modifier)

Solving these problems we must use a new rule.

While/ When solving a problem use a computer.

Решая эти задачи, мы должны использовать новое правило.

Решая (при решении) задачу, используйте компьютер.

3) Части сказуемого (a part of Predicate) (времена группы Continuous и Perfect Continuous)

Students are **considering** the properties of sets.

Студенты рассматривают свойства множеств.

Participle I Passive – being done – в предложении выполняет функцию:

1) Определения (an Attribute)

The computers **being developed** now will be extensively used.

Разрабатываемые сейчас компьютеры будут широко использоваться.

2) Обстоятельства (an Adverbial Modifier)

Being written on time, the article was Будучи написанной вовремя, статья

published in the journal.

была опубликована в журнале.

3) Части сказуемого (a part of Predicate)

The system which **is being tested** seems very complicated.

Система, которую сейчас испытывают, кажется очень сложной.

Participle II – done, translated – выполняет функцию:

1) Определения (an Attribute)

The **proposed** method was used in our calculations.

Предложенный метод использовался в наших вычислениях.

The method **proposed** by the mathematician was used in our calculations.

Метод, предложенный математиком, использовался в наших вычислениях.

The method just **referred** to is of great interest.

Метод, на который только что сослались, представляет большой интерес.

2) Обстоятельства (an Adverbial Modifier)

Translated from the language of mathematics into everyday language the relation became easier to understand.

Будучи переведенным с языка математики на обычный язык, это соотношение стало легче для понимания.

As seen from the results the information was carefully collected.

Как видно из результатов, информация была тщательно собрана.

When given enough time he will write his paper.

Если ему дадут достаточно времени, он напишет свою статью.

Unless properly constructed the device will not be reliable.

Если прибор неправильно сконструирован, он не будет надежным.

3) Части сказуемого (a part of Predicate)

He **was told** about some new developments in this field of mathematics.

Ему сказали о новых разработках в этой области математики.

Perfect Participle – having done, having been done – выполняет функцию:

1) Обстоятельства (an Adverbial Modifier)

Having answered the teacher's questions the student left.

Ответив на вопросы учителя, студент ушел (после того, как он ответил).

Having been given the problem we began to analyse it.

После того, как нам дали задачу, мы начали ее анализировать.

Ex. 1. Read these groups of words and note the function and the form of the Participle.

- a) 1. The moving point is ... 2. The drawing man is ... 3. The line segment joining points A and B ... 4. The scientist measuring distance ...
- b) 1. The student proving the correctness of the statement ... 2. Mathematicians using symbols instead of words ... 3. A post-graduate collecting statistical data ... 4. The researcher testing the new method...
- c) 1. The divided angle remained ... 2. The named geometric objects ... 3. The extended line was ... 4. The expected information will be derived...
- d) 1. The points referred to as ... 2. The two lines drawn parallel will never ... 3. The work continued the following day showed ... 4. This object taken as a model served ...
- e) 1. The statement made is consistent with ... 2. The problem dealt with seems important ... 3. The calculations made were accurate ... 4. The number added equals ...
- f) 1. Drawing a geometric figure one must ... 2. Finding the measure of an angle you can ... 3. When realizing this plan we ... 4. While considering the example he ... 5. When applying these rules one must remember ... 6. While checking these operations he ...
- g) 1. When asked about the date he ... 2. When applied carefully this method may ... 3. If changed a little the problem will be easy to solve. 4. If continued further the work will be helpful ...
- h) 1. Being drawn carefully the figure will be ... 2. Being multiplied the fraction will not ... 3. Being published the article was ... 4. Being given the dimensions of an object one can ...
- i) 1. Having reduced the fraction the student ... 2. Having obtained the expected results the scientist ... 3. Having compared the results he could ... 4. Having been asked to find the solution to the problem they ...

Ex. 2. Change the following according to the model.

Model 1: When we study geometry we ...

When studying geometry we ...

- 1. When we measure the distance we ... 2. When they use this system they ...
- 3. When you divide a decimal fraction you can ... 4. When we deal with this kind of problem we ...

Model 2: When the scientist was showing the film he ...

While showing the film the scientist ...

1. When the student was speaking he... . 2. When the operator was getting ready for the work he 3. When the young men were discussing their work they 4. When they were considering the results of our experiment they ...

Model 3: If you know the measure of the sides you can ...

Knowing the measure of the sides you can ...

1. If you apply this rule you will 2. If he used a computer he must 3. If one extends the segment one will 4. When they perform such operations they can ...

Model 4: I have got a book which deals with computers.

I have got a book dealing with computers.

1. I know the man who teaches you English. 2. Give me the journal which lies on the table. 3. Give them a letter which informs them about the conference.

Ex. 3. Translate the sentences from Russian into English. State the functions and the forms of the Participles.

1. Mathematicians have developed geometric ideas from the world around us having many physical objects.
2. When naming geometric ideas we usually use letters of the alphabet.
3. The line AB shown below is called a line segment as you might remember.
4. A line segment is a set of points consisting of the two end points and all of the points on the line between them.
5. A geometric figure being formed by a set of points is an abstract concept, it cannot be seen.
6. Having performed the operation of subtraction they found the difference.
7. Drawing a straight line I used a ruler.
8. The program improved by the expert was checked yesterday.
9. The procedure being fulfilled by the researchers needed modern equipment.
10. The translated text dealt with the practical use of geometry.

Ex. 4. Translate from Russian into English, using the Participles.

1. Переходя улицу, будьте внимательны.
2. Будучи очень усталыми, мы отказались идти на прогулку.
3. Большое дерево, сломанное ветром, лежало поперек дороги.
4. На собрании, проходящем сейчас в соседней комнате, обсуждается ряд важных вопросов.
5. Я покажу тебе статью, написанную моим научным руководителем.
6. Получив хороший учебник, он смог быстро повторить сложную тему.

7. Покажите мне список студентов, выполняющих эту лабораторную работу.
8. Составляя телеграмму, мы должны употреблять как можно меньше слов.
9. Книги, прочитанные в детстве, кажутся старыми друзьями.
10. Услышав об изменении погоды, они надели теплые куртки.

Pre-Reading Activity

Guess the meaning of the following words

capital ['kæpɪtəl] (n), subject ['sʌbdʒɪkt] (n), fundamental [fʌndə'mentl] (a), discuss [dɪs'kʌs] (v), mechanical [mɪ'kæniəl] (a), direction [dɪ'rekʃn] (n), perpendicular [pə'pendɪkjʊlə] (a), interval ['ɪntəvəl] (n)

Read and learn the basic vocabulary terms.

location [ləʊ'keɪʃn] n – определение местонахождения, место

point [pɔɪnt] n – точка, to point v – указывать

dot [dɒt] n – точка

dimension [dɪ'menʃn] n – измерение, pl. размеры

space [speɪs] n – 1. пространство, 2. космос

exact [ɪg'zækt] a – точный, exactly adv. – точно

refer (to) [rɪ'fɜː] v – ссылаться (на), иметь отношение

mark [mɑːk] n – отметка, знак

undefined [ʌndɪ'faɪnd] a – неопределенный

description [dɪs'krɪpʃn] n – описание

length [leŋθ] n – длина

thickness ['θɪknes] n – толщина

depth [depθ] n – глубина

extend [ɪks'tend] v – простирается

flat [flæt] a – плоский

surface ['sʌfɪs] n – поверхность

infinitely ['ɪnfɪnɪtli] adv – бесконечно

characteristic [kæ'rɪktɪ'rɪstɪk] a

intersect [ɪntə'sekt] v – пересекаться

right [raɪt] a – 1. правильный, правый; 2. прямой

angle ['æŋɡl] n – угол

coincide [kəʊɪn'saɪd] v – совпадать

vertex [vɜː'teks] n – вершина

sine [saIn] n – синус
interior [In'tIqrIq] n – внутренняя часть
measure ['meZq] n – мера, v – измерять
degree [dI'grJ] n – 1. степень, порядок; 2. градус
acute [q'kjHt] a – острый
obtuse [qb'tjHs] a – тупой (угол)
straight [streIt] a – прямой, прямолинейный
bisect [baI'sekt] v – делить пополам
align [q'laIn] v – ставить в ряд
protractor [prq'trɔktq] n – транспортир

Memorize the following word combinations

to be referred to as – называться
to extend forever – продлевать бесконечно
coplanar lines – копланарные линии
skew lines – ассиметричные линии
adjacent angles – смежные углы
complementary angles – взаимодополняемые углы

Reading Activity

Points, lines, planes and angles

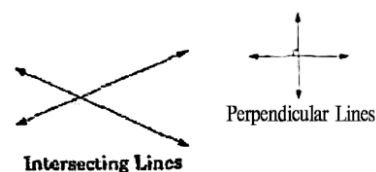
The most fundamental idea in the study of geometry is the idea of a **point**. Think of a point as an exact location in space, it has no dimensions. When writing about points, you represent the points by dots. Remember, the dot is only a picture of a point, and not the point itself. Points are commonly referred to by using capital letters. The dots mark points and are referred to as point A, point B and point C.

A **line** is one of the undefined terms in geometry. A description of a line is that it has length but no thickness or depth. In theory, a line may be extended infinitely in each direction.

A **plane** is a flat surface that extends infinitely in all directions. Imagine extending the length and width of a table top forever.

Lines that lie in the same plane are called coplanar lines. Any two coplanar lines must have one and only one of the characteristics listed below.

- The lines may intersect. If they intersect and form right angles, they are perpendicular lines.



- The lines may be parallel. Parallel lines will never meet.
- The lines may coincide. Lines that coincide are actually the same lines.



Lines that lie in different planes and do not intersect are called noncoplanar lines or skew lines.

- If two planes do not intersect, the planes are parallel.
- If two planes intersect, their intersection is a line.

An **angle** is formed by two rays that have the same endpoint, which is called the **vertex** of the angle. The rays are called the sides of the angle. (A ray is a part of a line drawn from a given point called the endpoint. The ray continues forever in the other direction.) A point between the sides of the angle is in the interior of the angle. " \angle " is the symbol for angle. To name an angle use three letters. The center letter corresponds to the vertex. The other two letters are points on each ray.

The angle can be named ABC or CBA. It can be read as "angle ABC or angle CBA."

An angle is measured in degrees with an instrument called a protractor.

There are five types of angles that are essential to the study of geometry.

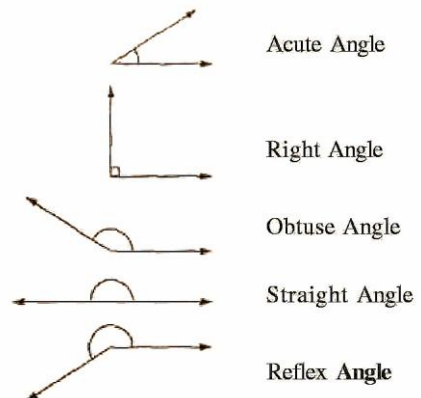
Acute angle – an angle whose measure is less than 90° .

Right angle – an angle whose measure equals 90° . A box in the vertex denotes a right angle.

Obtuse angle – an angle whose measure is greater than 90° and less than 180° .

Straight angle – an angle whose measure equals 180° .

Reflex angle – an angle whose measure is greater than 180° and less than 360°



- Equal angles are angles that have the same number of degrees.
- A ray that bisects an angle divides it into 2 equal parts. The line is called the angle **bisector**.
- **Congruent** angles have the same measure.
- Perpendiculars are lines that form right angles.
- All right angles are congruent.
- The sides of a straight angle lie on a straight line.
- All straight angles are congruent.

- A perpendicular bisector of a line bisects the line and is perpendicular to the line.

Post-Reading Activity

Ex. 5. Answer the following questions.

1. What does this text deal with?
2. What is the most fundamental idea in the study of geometry?
3. What is a point?
4. What do we usually use the letters of the alphabet for?
5. What is a description of a line?
6. Does a plane extend infinitely in all directions?
7. What lines are called coplanar?
8. What characteristics can you list for coplanar lines?
9. What lines are called noncoplanar?
10. How is an angle formed?
11. What is a ray?
12. Is there any special symbol to denote an angle?
13. What are the ways of naming an angle?
14. How is an angle measured?
15. What kinds of angles do you know, and what are their degree measures?

Ex. 6. Match the English words and word combinations with their Russian equivalents.

- | | |
|------------------------------|---|
| 1. the undefined term | 1. вершина угла |
| 2. to extend indefinitely | 2. отличительные черты |
| 3. the vertex of the angle | 3. если не указано иное |
| 4. the interior of the angle | 4. неопределенный термин |
| 5. distinguishing features | 5. внутренняя часть угла |
| 6. the exterior part | 6. продолжаться бесконечно |
| 7. unless stated otherwise | 7. внешняя часть |
| 8. reflex angle | 8. смежные углы |
| 9. perpendicular bisector | 9. угол между 180° и 360° |
| 10. adjacent angles | 10. перпендикулярная биссектриса |

Ex. 7. Find out whether the statements are True or False according to the information in the text. Use the introductory phrases:

I think, it is right.

Quite so. Absolutely correct.

I quite agree to it.

I am afraid, it is wrong.

I don't quite agree to it.

On the contrary. Far from it.

1. A point has length, width or thickness.
2. A line is limited and extends infinitely in one direction.
3. A line unless stated otherwise is understood to be straight.
4. A line is the shortest distance between two points.
5. A surface has length and width, it doesn't have thickness.
6. Equal angles are angles that have the same number of degrees.
7. Right angles are not congruent.
8. A perpendicular bisector of a line bisects the line and is perpendicular to the line.
9. If two planes intersect, their intersection is a line.
10. A point is a location and it has size.
11. The size of the angle depends on the lengths of the rays forming it.

Ex. 8. Choose the correct form of the Participle.

1. (to name) geometric ideas we usually use letters of the alphabet.
2. We insisted on the (to follow) notation of the geometric object.
3. (to divide) both the numerator and the denominator by x you will get the following expression.
4. When (to speak) with my science adviser I got better understanding of the latest development in my special field.
5. The properties of the material (to use) in the experiment now are given in the latest article.
6. The advantages of the new system (to prove) by many tests are very important.
7. Two angles (to have) the same vertex and a common side are referred to as adjacent angles.
8. The concepts (to introduce) at the seminar should be considered in detail.
9. The (to obtain) difference must be checked carefully.
10. The (to expect) result must prove that this law holds for similar cases.

Ex. 9. Fill in the blanks with the necessary words.

1. To (измерить) an angle, compare its side to the corner of this page.
2. The corner represents (прямой угол), whose measurement is 90° .
3. If the angle is smaller than the corner, the angle is (острый угол).
4. If the opening is larger than the corner of the page, the angle is (тупой). Its measure is more than 90° .
5. Locate the point of your (транспортир) which represents the (вершина) and align the vertex with the point.

6. Rotate the protractor keeping the vertex aligned until one (сторона) of the angle is on the 0° - 180° line of the protractor.
7. The angle measure that is (определяется) by the side of the angle that is not on the 0° - 180° line of the protractor.
8. You may have to (продлить) one side of the angle so that it crosses the scale.
9. Use the proper (обозначение), m is the symbol for “measure of”.

Ex. 10. Match the left and the right parts of the following statements.

- | | |
|---|--|
| 1. A group of two angles is known | a. two angles whose measures add up to 180° . |
| 2. Adjacent angles are | b. two nonadjacent angles formed by two intersecting lines. |
| 3. Vertical angles are | c. is the complement of the other. |
| 4. Complementary angles are | d. two angles whose measures add up to 90° . |
| 5. One angle | e. as a pair of angles. |
| 6. Supplementary angles are | f. two angles that have the same vertex and a common side. |
| 7. If an angle is cut into two adjacent angles | g. are congruent. |
| 8. If the exterior sides of a pair of adjacent angles are perpendicular | h. then the sum of the measures of the adjacent angles equals the measure of the original angle. |
| 9. If two angles are congruent and supplementary | i. then the angles are complementary. |
| 10. Vertical angles are | j. then each angle is a right angle. |

Ex. 11. Mind the use of the Continuous and Perfect Continuous Tenses.

1. I (to look for) a photographs my brother sent to me.
2. They (to have) a meeting now.
3. The phone always (to ring) when I (to have) a bath.
4. Friends always (to talk) to me when I (to try) to concentrate.
5. He (to watch) television when the door bell (to ring).
6. He (to build up) his business all his life.
7. They (to stay) with us for a couple of weeks.
8. By 1992 he (to live) there for ten years.
9. The video industry (to develop) rapidly.
10. He (to work) nights next week.

11. She (to spend) this summer in Europe.
12. Why are you so late? I (to wait) you for hours.
13. The boys must be tired. They (to play) football in the garden all afternoon.
14. The old town theatre is currently (to rebuild).
15. I usually (to go) to work by car, but I (to go) on the bus this week while my car (to repair).

Ex.12. Complete each of the sentences below by choosing one of the pronouns in brackets.

1. ... arrived in good time and the meeting started promptly at 3.30. (anybody/ nobody/ everybody)
2. ... in the village went to the party but ... enjoyed it very much. (everybody/ no one/ some one), (anybody/ somebody/ nobody)
3. ... heard anything. (everyone/ nobody/ somebody)
4. "Who shall I give this one to? – You can give it to It doesn't matter." (everyone/ nobody/ anybody)
5. That's a very easy job. ... can do it. (everyone/ nobody/ somebody).
6. Would you like ... to drink? (anything/ something/ nothing)
7. I thought I'd seen you (anywhere/ somewhere/ nowhere)
8. There was ... to hide. (anywhere/ somewhere/ nowhere)
9. You still haven't told me (anything/ something/ nothing)
10. Does ... agree with me? (anybody/ somebody/ nobody)
11. I want to introduce you to ... (no one/ someone/ any one)
12. The box was completely empty. There was ... in it. (nothing/ anything)
13. "Excuse me, you've dropped Yes, look. It's passport." (something/ anything/ everything)
14. It's all finished. I am afraid there's ... left. (nothing/ anything/ something)
15. I heard a noise, but I didn't see (any one/ no one)
16. It's too late. We can't do ... to help. (anything/ nothing)
17. I agree with most of what he said, but I don't agree with (something/ everything/ anything)
18. ... offered to help. They probably didn't have the time. (anybody/ nobody/ everybody)
19. If ... asks, you can tell them I'll be back soon. (somebody/ anybody/ everybody)
20. There was ... in the box, it was completely empty. (nothing/ anything/ something)

Ex. 13. Ask special questions to which the sentences below are the answers.

1. A statement satisfying certain conditions is true. (what)
2. Like terms being arranged in the following way will be enclosed in the parenthesis.(where)
3. Reference is made to the commonly accepted system. (what ... to)
4. The force keeping all material bodies including people on the Earth is called gravitation. (what kind)
5. Having used the classification suggested by my science adviser I found it very convenient. (when)
6. Having been given little information they couldn't continue the research. (why)
7. Having followed the procedure they obtained the required results. (how)
8. Any fraction represents the quotient of its numerator divided by its denominator. (what)
9. Having obtained a proper interpretation of this fact they realized the importance of the problem. (when)
10. The created method has no advantages over the old one. (what)

Ex. 14. Find the corresponding Russian sentence.

1. **Geometry is a branch of mathematics concerned with questions of shape, size, relative position of figures, and the properties of space.**
 - a. Геометрия – это область математики, которая рассматривала форму, размер, относительное расположение фигур и свойства пространства.
 - b. Геометрия – это область математики, рассматривающая вопросы формы, размера, относительного расположения фигур и свойства пространства.
 - c. Геометрия – это раздел математики, в котором рассматривали форму, размер, относительное расположение фигур и свойства пространства.
2. **From what you already know you may deduce that drawing two rays originating from the same end point forms an angle.**
 - a. Из того, что вы уже знаете, вы можете сделать вывод, что, рисуя два луча, исходящих из одной конечной точки, вы получаете угол.
 - b. Из того, что вам известно, вы можете сделать вывод, что изображение двух лучей, берущих начало в одной и той же конечной точке, образует угол.
 - c. Из того, что вы уже узнали, вы, возможно, сделали вывод, что рисунок двух лучей, берущих начало в одной конечной точке, образует угол.

3. The approach to the problem being considered remained traditional.

- a. Рассматривался оставшийся подход к традиционной проблеме.
- b. Подход к оставшейся проблеме рассматривался традиционно.
- c. Подход к рассматриваемой проблеме оставался традиционным.

4. Physical facts expressed in terms of mathematics do not seem unusual nowadays.

- a. Выраженные математические факты казались необычными в физических терминах в настоящее время.
- b. Физические факты, выраженные в математических терминах, не кажутся необычными сегодня.
- c. То, что физические факты в настоящее время выражаются математическими терминами, не кажется сегодня необычным.

5. Having made a number of experiments Faraday discovered electromagnetic induction.

- a. Проводя ряд экспериментов, Фарадей открыл электромагнитную индукцию.
- b. Прodelав ряд экспериментов, Фарадей открыл электромагнитную индукцию.
- c. Сделав число экспериментов, Фарадей открыл электромагнитную индукцию.

Ex. 15. Translate into English.

- 1. Первая линия, с которой мы знакомимся, изучая математику – это прямая линия.
- 2. Дать строгое определение этого понятия совсем непросто.
- 3. В работах Евклида (Euclid) линия определялась как длина без толщины.
- 4. Угол – самая простая геометрическая фигура после точки, прямой, луча и отрезка.
- 5. Если в плоскости из точки О провести два различных луча ОА и ОВ, то они разделят плоскость на две части, каждая из которых называется углом с вершиной О и сторонами ОА и ОВ.
- 6. Луч, делящий угол пополам и берущий начало в вершине угла, называется его биссектрисой.
- 7. Биссектриса развернутого угла делит его на два смежных угла, называемых прямыми углами.

8. Большое значение для теории и практики имеет определение величины или меры угла.
9. Основное свойство меры угла должно заключаться в том, чтобы равные углы имели одинаковую меру.
10. Градусная мера используется в элементарной геометрии для измерения углов.
11. Каждый, наверное, знаком с транспортиром – измерителем углов на чертежах.
12. Углы меньше прямого называются острыми, а углы больше прямого, но меньше развернутого, называются тупыми.
13. Первая книга Евклида начинается с 23 «определений», среди них такие: точка есть то, что не имеет частей; линия есть длина без ширины; линия ограничена точками; прямая есть линия, одинаково расположенная относительно своих точек; наконец, две прямые, лежащие в одной плоскости, называются параллельными, если они, сколь угодно продолженные, не встречаются.
14. Изложение геометрии в «Началах» Евклида считалось образцом, которому стремились следовать ученые и за пределами математики.

Ex. 16. Read the text and answer the following questions.

1. How did Euclid define a point?
2. How is a point represented in two dimensional space and in three dimensional space?
3. Is Euclid's postulate about points confirmed under modern developments of Euclidean geometry?
4. Can one say that Euclid's postulation of points was complete and definite?

Points in Euclidean geometry

Points are most often considered within the framework of Euclidean geometry, where they are one of the fundamental objects. Euclid originally defined the point vaguely, as "that which has no part". In two dimensional Euclidean space, a point is represented by an ordered pair, (x, y) , of numbers, where the first number conventionally represents the horizontal and is often denoted by x , and the second number conventionally represents the vertical and is often denoted by y . This idea is easily generalized to three dimensional Euclidean space, where a point is represented by an ordered triplet, (X, Y, Z) with the additional third number representing depth and often denoted by z .

In addition to defining points and constructs (построения) related to points, Euclid also postulated idea about points; he claimed that any two points can be connected by a straight line. This is easily confirmed under

modern developments of Euclidean geometry, and had lasting consequences at its introduction, allowing the construction of almost all the geometric concepts of the time. However, Euclid's postulation of points was neither complete nor definitive, as he occasionally assumed facts about points that didn't follow directly from his axioms, such as the ordering of points on the line or the existence of specific points. In spite of this, modern developments of the system serve to remove these assumptions.

UNIT 3

'There is no royal road to Geometry.'
Euclid

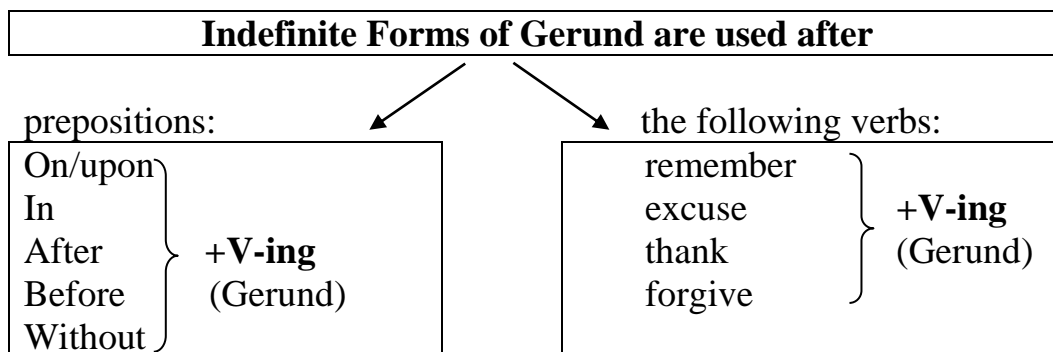
Grammar: The Gerund. Its Forms and Functions.

Forms

| Voice Tense | Active | Passive | Expresses the action |
|------------------------|----------------|---------------------|--|
| Indefinite | writing | being written | Выражает действие, одновременное с действием глагола-сказуемого. |
| Perfect | having written | having been written | Выражает действие, предшествующее действию глагола-сказуемого. |

I am surprised at
Меня удивляет то,

- { a) **his solving** problems so quickly.
 как быстро он *решает* задачи.
 b) **his having solved** the problem so quickly.
 как быстро он *решил* эту задачу.



On obtaining the data the scientist went on working.

Получив данные, ученый продолжил работу.

After developing this system we were able to get good results.

Разработав эту систему, мы смогли получить хорошие результаты.

I remember learning this important mathematical principle.

Я помню, что учил это важное математическое свойство.

Excuse me for not attending your lectures. I was ill.

Извините меня за то, что я не ходил на ваши лекции. Я был болен.

Active forms of Gerund are used after the verbs: **need** (нуждаться),
want (нуждаться), **require** (требовать), **deserve** (заслуживать)
and an adjective **worth** (стоящий).

Your suggestion is worth paying attention to.

Твоему предложению стоит уделить внимание.

His English requires improving.

Его английский нужно улучшить.

Functions

| | | |
|--|---|--|
| Subject (подлежащее) | Speaking English is easier than writing. It's no use waiting. There is no knowing what may happen. | <i>Говорить по-английски легче, чем писать. Ждать бесполезно. Неизвестно, что может произойти.</i> |
| Direct Object (прямое дополнение) | I remember preventing him from making such a mistake. He denied having been there. | <i>Я помню, что помешал ему совершить такую ошибку. Он отрицал то, что был там.</i> |
| Prepositional Object (предложное дополнение) | I look forward to meeting my science adviser. The students are accustomed to using capital letters to name geometric objects. | <i>Я с нетерпением жду встречи с моим научным руководителем. Студенты привыкли использовать заглавные буквы для обозначения геометрических объектов.</i> |
| Attribute (определение) | There are different ways of solving this problem. She hasn't got any difficulty in understanding the basic geometric theorems. | <i>Существуют различные способы решения этой задачи. У нее не возникает никаких проблем с пониманием основных теорем геометрии.</i> |
| Adverbial Modifier (обстоятельство) | In spite of being very tired he continued his work. | <i>Не смотря на то, что он был очень уставшим, он продолжил работу.</i> |

| | | |
|--|--|---|
| | After passing their exams the students went on holiday. | <i>Сдав экзамены, студенты отправились на каникулы.</i> |
| Predicative (именная часть сказуемого) | Seeing is believing. Our task is proving the correctness of the given statement. | <i>Увидеть – значит поверить. Наша задача – подтвердить корректность данного утверждения.</i> |
| Part of a compound verbal predicate (часть составного глагольного сказуемого) | When he entered the room I couldn't help smiling. He has finished dictating a letter. | <i>Когда он вошел в комнату, я не могла не улыбнуться. Он окончил диктовать письмо.</i> |

Verb + -ing

The gerund is used as a direct object.

| | |
|----------------------------------|---|
| to avoid – избегать, уклонять | to risk – рисковать |
| to deny – отрицать | to stop – прекращать |
| to enjoy – получать удовольствие | to suggest – предлагать |
| to excuse – прощать, извинять | to postpone – откладывать |
| to finish – заканчивать | to imagine – воображать, |
| to forgive – прощать | представлять |
| to give up – бросать | to dislike – не любить, испытывать |
| to go on – продолжать | неприязнь |
| to keep (on) – продолжать | to mind (in negative, interrogative |
| to continue – продолжать | sentences) – возражать, иметь что-либо против |

He tried to avoid answering the question.

On holiday, I enjoy not having to get up early.

Don't keep interrupting me. I'm speaking.

She suggests going to the sea.

Verb + preposition + -ing

The gerund is used as a prepositional object.

| | |
|-----------------------------------|--------------------------------------|
| to accuse of – обвинять в | to thank for – благодарить за |
| to aim at – стремиться к | to think of – думать об |
| to approve of – одобрять что-либо | to agree to – соглашаться с чем-либо |
| to charge with – обвинять в | to succeed in – преуспевать в чем- |
| to complain of – жаловаться на | |

| | |
|--------------------------------------|--------------------------------------|
| to depend on – зависеть от | либо, удаваться |
| to feel like – испытывать желание | to persist in – упорствовать, упорно |
| to give up – бросать | продолжать |
| to insist on – настаивать на | to prevent from – мешать, |
| to look like (raining) – похоже, | препятствовать |
| что... | |
| to object to – возражать | to look forward to – смотреть в |
| to rely on – полагаться на, доверять | будущее, ждать с нетерпением |
| to suspect of – подозревать в | |

Do you feel like going out this evening?

Dave insisted on helping me.

He apologized to Sue for being rude to her.

I don't approve of their watching a lot of TV.

to be + adjective (or P II) + preposition + -ing
The gerund is used as a prepositional object.

| |
|---|
| to be accustomed to – быть привыкшим к, приученным к |
| to be aware of – знать, сознавать, отдавать себе полный отчет в |
| to be capable of – быть способным на |
| to be engaged in – быть вовлеченным в, заниматься чем-либо |
| to be fond of – любить что-либо, кого-либо |
| to be good at – быть способным, умелым, искусным в |
| to be guilty of – быть виновным, виноватым |
| to be indignant at – возмущаться, негодовать |
| to be interested in – интересоваться чем-либо |
| to be pleased at – радоваться, испытывать удовольствие от чего-либо |
| to be proud of – гордиться чем-либо |
| to be responsible for – отвечать за, быть ответственным за |
| to be suitable for – быть подходящим для, годным для |
| to be sure of – быть уверенным в чем-либо |
| to be surprised at – удивляться чему-либо |
| to be tired of – быть уставшим от чего-либо |
| to be used to – привыкнуть к чему-либо |

She is not capable of doing the work.

Are you interested in collecting coins?

We are all tired of listening to his complaints.

I am not accustomed to sleeping during the day.

Expressions + -ing

It's no use, it's no good – бесполезно, совершенно не нужно

There's no point in – не имеет смысла

It's (not) worth – (не) стоит, (не) заслуживает

to have difficulty (in) – столкнуться с трудностями, испытывать проблемы

I can't (couldn't) help – не могу не (не мог не)

can't stand – не выносить кого-либо, не выдерживать что-либо

can't bear (inf. also possible) – не переносить что-либо

We use -ing after:

a waste of money – пустая трата денег

a waste of time – пустая трата времени

to be busy – быть занятым

to go swimming/ go fishing (after **go** for activities) – заниматься
плаванием/ходить на рыбалку

There is no point in persuading him.

I couldn't help being late. My train was delayed by fog.

I can't stand being fooled down.

It's a waste of money buying this dress.

She is busy translating the text.

-ing form and infinitive both possible

a) Without any difference.

to attempt – пытаться, пробовать

to propose – предлагать

to begin – начинать

to continue – продолжать

to start – начинать

to bother – надоедать, беспокоить

to intend – намереваться, иметь

ввиду

*It began raining. **or** It began to rain.*

But the verbs of knowing and understanding are better in the infinitive.

I began to understand (no alternative).

b) The gerund is used for habits and past actions.

The infinitive is used for future and conditional actions.

to like – нравиться

to remember – помнить

to love – любить
to hate – ненавидеть

to regret – сожалеть
to prefer – предпочитать

*I like climbing (habit). I would like to climb the top of this mountain.
I hate getting up early. I would hate to spend the night alone in the woods.
I remember seeing it on the notice-board. I must remember to post the letter.*

c) With important difference of meaning.

go on + -ing

(continue)

She went on talking about her illness for hours.

stop + -ing

(give up)

I've stopped smoking.

go on + to

(a change to a new activity)

She told me about her son and then she went on to talk about her other problems.

stop + to

(gives the reason for stopping)

I stopped for a few minutes to rest.

Ex. 1. Choose the correct item.

1. She had the feeling of
a. being deceived b. deceiving c. having deceived
2. It's a waste of time ... over trifles.
a. having argued b. having been argued c. arguing
3. My watch doesn't keep good time. It needs
a. having been repaired b. being repaired c. repairing
4. He mentioned ... it in the paper.
a. being read b. reading c. having read
5. Is it worth while your ... to convince him of being wrong?
a. being tried b. trying c. having tried
6. He insisted on ... with a certain respect.
a. having been treated b. treating c. being treated
7. Father didn't approve of my ... the offer.
a. having rejected b. having been rejected c. rejecting
8. Many apologies for not ... to your letter.
a. having replied b. replying c. being replied

9. She remembers ... him the message.
 a. having been given b. giving c. being given

10. I'm really looking forward to ... all your news.
 a. being heard b. having heard c. hearing

Ex. 2. Join the two sentences to make one sentence, beginning with a gerund.

Model: *She's a teacher. It's hard work.*

Being a teacher is hard work. / Teaching is hard work.

1. Capital letters are used to name geometrical objects. It is very convenient.
2. You are to classify these quadrilaterals. It requires the knowledge of some properties.
3. We are going to locate this point on the y axis. It will give us the first point on the line.
4. The student intends to divide a circle into a certain number of congruent parts. It will help him to obtain a regular polygon.
5. The base and the altitude of a rectangle are to be multiplied. It will give the product of its dimensions or the area of the rectangle.
6. Don't argue! It's no use. In a crossed quadrilateral, the interior angles on either side of the crossing add up to 720° .
7. Don't deny this fact! It is useless. A square is a quadrilateral, a parallelogram, a rectangle and a rhombus.
8. You are going to divide a heptagon (a 7-sided polygon) into five triangles. Is it any good?

Ex. 3. Choose the right preposition. Make sensible sentences.

| | | |
|---------------------------------|------|---|
| 1. Are you interested | on | a. disturbing you. |
| 2. She is very good | of | b. looking after the children. |
| 3. He insisted | to | c. learning foreign languages. |
| 4. I apologize | at | d. having more time for doing things he |
| 5. The teacher is fed up | in | wants to. |
| 6. She succeeded | with | e. understanding this – its too difficult. |
| 7. My friend is keen | for | f. answering our stupid questions. |
| 8. Professor is looking forward | | g. studying. |
| 9. This student is not capable | | h. considering his solution of the problem. |
| 10. His sister is tired | | i. doing sums. |
| | | j. getting good education. |

Ex. 4. Complete the sentences using a gerund as an attribute.

1. I didn't very much like the idea of
2. What is the purpose of ... ?
3. She had no difficulty (in)
4. You have made great progress in
5. He was late, and he was afraid of
6. Can you imagine the pleasure of
7. He always produces the impression of
8. I am afraid you do not realize the importance of

Ex. 5. Complete the second sentence so that it has a similar meaning to the first one. Use the word in bold and other words to complete each sentence.

1. I'll be happy when I can have a rest after exams.
forward to
I'm looking ... a rest after exams.
2. Learning new geometric theorems is something I like doing.
interested in
I'm always ... new geometric theorems
3. If I study a lot at night, it keeps me awake.
prevents from
... a lot at night ... sleeping.
4. I often operate the computer at university.
am used to
I ... the computer at university.
5. He didn't want to take the books back to the library.
feel like
He didn't... the books back to the library.
6. He hates it if he has to do a lot of boring exercises.
can't stand
He ... a lot of boring exercises.
7. 'I'm sorry. I've broken the speed limit', said Sue.
apologized for
Sue ... the speed limit.
8. Let us write a new program.
suggest
I ... a new program.

Ex. 6. Find and correct the mistakes in the sentences. Some of them are right sentences.

1. I'm looking forward to go on holiday.

2. To cheat in examination is not allowed.
3. It was kind of you inviting me joining you.
4. It's a waste of time watching TV.
5. She said she was too busy to do this.
6. Do you think that drawing a polygon is easier than drawing a circle?
7. Please stop to make that noise, it's driving me mad.

Pre-Reading Activity

Guess the meaning of the following words.

classify ['klɪksɪfaɪ] (v), positive ['pɒzɪtɪv] (a), exterior [eks'tɪərɪəl] (a), polygon ['pɒlɪɡɒn] (n), parallel ['pærələl] (a), parallelogram [ˌpærəlɪˈɡræm] (n), rhombus ['rɒmbəs] (n), diagonal [daɪˈæɡənəl] (n), perimeter [pə'rɪmɪtəri] (n), positive ['pɒzɪtɪv] (a).

Read and learn the basic vocabulary terms.

many-sided [menɪ'saɪdɪd] *a* – многосторонний
 closed [kləʊzd] *a* – закрытый, замкнутый
 according to [ə'kɒdɪŋ] *prep* – согласно
 quadrilateral [kwɒdrɪ'lætərl] *n* – четырехугольник
 pentagon ['pentæɡɒn] *n* – пятиугольник
 hexagon ['heksæɡɒn] *n* – шестиугольник
 heptagon ['heptæɡɒn] *n* – семиугольник
 octagon [ek'tæɡɒn] *n* – восьмиугольник
 nonagon ['nɒnæɡɒn] *n* – девятиугольник
 decagon ['dekæɡɒn] *n* – десятиугольник
 regular ['regjʊlə] *a* – правильный, регулярный
 certain ['sɜ:tən] *a* – определенный, некий
 connect [kə'nekt] *v* – связывать, соединять
 inscribe [ɪn'skraɪb] *v* – вписывать
 tangent ['tæŋɡənt] *n* – касательная, тангенс
 intersection [ɪntə'sekʃn] *n* – пересечение
 circumscribe ['sɜ:kəmskraɪb] *v* – описывать
 stand for [stænd] *v* – символизировать, означать
 emphasize ['emfəsaɪz] *v* – подчеркивать, делать ударение
 separate ['sepəreɪt] *v* – отделять
 rectangle ['rek,tæŋɡl] *n* – прямоугольник
 square [skwɛr] *n* – квадрат
 trapezium (trapezoid) [trə'pi:zjəm] *n* – трапеция

convex ['kɒn'veks] *a* – выпуклый
 concave ['kɒn'keɪv] *a* – вогнутый
 adjacent (sides) [ə'dʒeɪsɪnt] *a* – смежный, примыкающий
 deltoid ['deltɔɪd] *a, n* – дельтовидный, дельтоид
 kite [kaɪt] *n* – гладкий ромб
 supplementary [ˌsʌplɪ'ment(e)rɪ] *a* – дополнительный
 consecutive [kən'sekjʊtɪv] *a* – последовательный

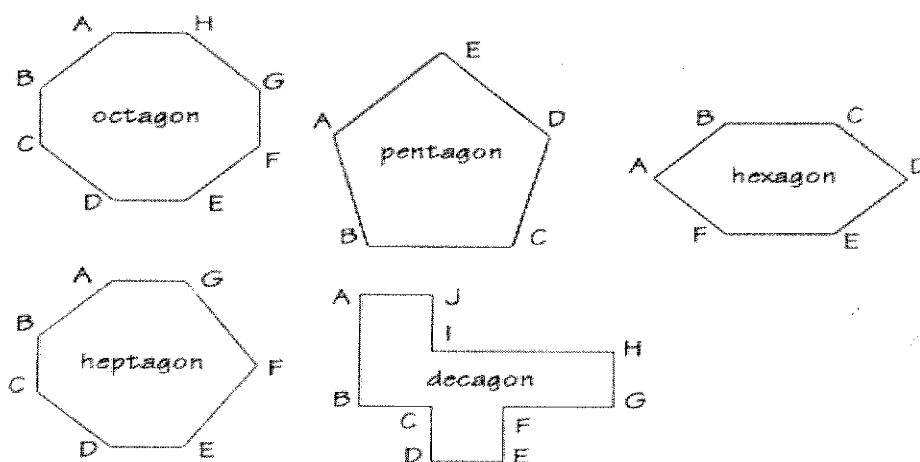
Memorize the following word combinations.

1. to be mostly concerned with – главным образом интересоваться
2. the process of constructing – процесс построения
3. to have no difficulty listing – не иметь затруднений с составлением списка
4. it should be pointed out – следует отметить
5. let's dwell on – давайте остановимся на
6. to have in common – иметь общее
7. may prove helpful – может оказаться полезной
8. to be closely related to – быть тесно связанным с
9. it is worth remembering – стоит запомнить
10. crossed quadrilaterals – пересекающиеся квадраты

Reading Activity

Regular Polygons. Special Quadrilaterals.

In this chapter we'll be mostly concerned with studying plane figures called polygons. Polygons are many-sided figures, with sides that are line segments. These simple closed figures are named according to the number of sides and angles they have, and may be classified by the measures of the angles or the measures of the sides. The simplest polygon is a triangle, a geometric plane figure having three sides. We have no difficulty listing all the polygons having up to ten sides. In the picture below you can see some of them.



A polygon is called **regular** if all of its sides and all of its interior angles are congruent. For instance, a **square** is a regular **quadrilateral** having four right angles and four equal sides.

It should be pointed out that the process of constructing a regular polygon is closely related to division of a circle into congruent parts. Students of mathematics will remember two major theorems concerning this problem.

Theorem. If a circle is divided into a certain number (greater than 2) of congruent parts, then:

- (1) connecting every two consecutive division points by chords, we obtain a regular polygon inscribed into the circle.
- (2) Drawing **tangents** to the circle at all the division points and extending each of them up to the intersection points with the tangents at the nearest division points we obtain a regular polygon circumscribed about the circle.

To find the sum of the interior angles of any polygon one can use the formula *sum of the angles* = $(n - 2) 180^\circ$ (where n stands for the number of sides or angles). For a triangle the sum is 180° . By drawing all **diagonals** from one single **vertex** of a polygon we can separate it into triangles. If you look back at the formula, you will see that $n - 2$ gives the number of triangles in the polygon, and that number is multiplied by 180° , which is the sum of the measures of all the interior angles in a triangle.

To find the **perimeter** of a regular polygon you should multiply the length of the sides by the number of sides.

Now let us dwell on polygons called quadrilaterals. In Euclidean plane geometry a **quadrilateral** is a polygon with four sides and four vertices or corners. Quadrilaterals are simple (not self-intersecting) or complex (self-intersecting), also called crossed. Simple quadrilaterals are either **convex** or **concave**. A **kite** is a convex trapezium that has two congruent pairs of adjacent sides. A **deltoid** is a concave trapezium.

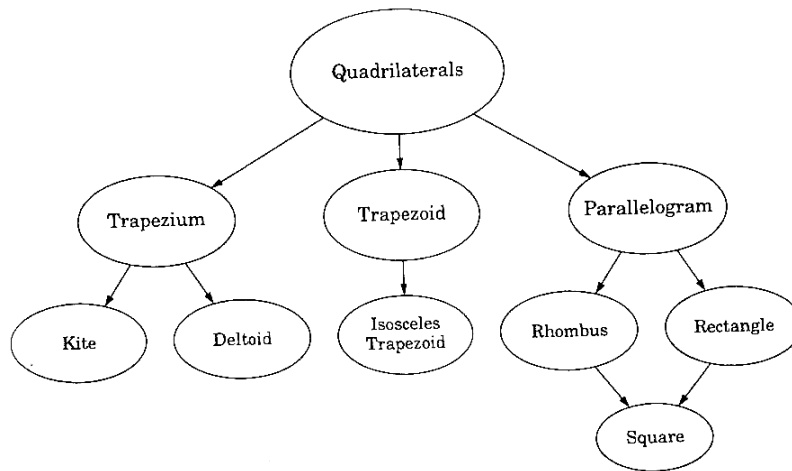
The five most common types of quadrilaterals are the **parallelogram**, the **rectangle**, the square, the **trapezoid** and the **rhombus**. All quadrilaterals have some things in common. All of them 1) have four sides, 2) are coplanar, 3) have two diagonals and 4) the sum of their four interior angles equals 360° .

In addition, some of quadrilaterals possess special properties. As an example let's take a parallelogram. Its special properties are as follows:

- Opposite sides are parallel.
- Opposite angles are congruent.
- Consecutive pairs of angles are supplementary.
- Opposite sides are congruent.
- Diagonals bisect each other.

Below is a summary of the types of quadrilaterals. You might think of a quadrilateral like this: every square is a rectangle, but not every rectangle is a square. A rectangle is also a parallelogram, but a parallelogram may not be a rectangle.

Such a classification may prove helpful. It is worth remembering.



Ex. 7. Answer the following questions.

1. What is a polygon?
2. In what way do we classify polygons?
3. What polygon is called regular?
4. How is the process of constructing a regular polygon related to division of a circle into congruent parts?
5. Is it possible to obtain a regular polygon inscribed into the circle? (a regular polygon circumscribed about the circle)
6. Which formula is used for finding the sum of the interior angles of any polygon?
7. How can we find the perimeter of a regular polygon?
8. What are the most common types of quadrilaterals?
9. How many things do all quadrilaterals have in common?

10. What special properties does a parallelogram possess?
 11. Do you know any other classifications of quadrilaterals? Are they worth remembering?

Ex. 8. Match the English words and word combinations with the Russian equivalents.

- | | |
|---------------------------------------|--|
| 1. to draw diagonals | a. делят друг друга пополам |
| 2. from one single vertex | b. специальные четырехугольники |
| 3. in addition to | c. дополнительные углы |
| 4. to circumscribe about the circle | d. плоская фигура |
| 5. adjacent sides | e. вписать в окружность |
| 6. to draw tangents to the circle | f. описать вокруг окружности |
| 7. a convex or a concave trapezium | g. означает |
| 8. stands for | h. выпуклая или вогнутая трапеция |
| 9. special quadrilaterals | i. последовательная пара |
| 10. regular polygons | j. начертить диагонали |
| 11. supplementary angles | k. провести касательные к окружности |
| 12. bisect each other | l. обладают свойствами |
| 13. the measure of the sides | m. кроме того |
| 14. a plane figure | n. из одной вершины |
| 15. possess properties | o. смежные стороны |
| 16. a consecutive pair | p. сложные или пересекающиеся четырехугольники |
| 17. to inscribe into the circle | q. величины сторон |
| 18. complex or crossed quadrilaterals | r. правильные многоугольники |

Ex. 9. Fill in the blanks with the words from the box. Mind there are two extra words.

- | | | |
|------------------|---------------|--------------------|
| a. rectangle | h. concave | o. interior length |
| b. regular | i. special | p. quadrilateral |
| c. vertices | j. product | q. diagonals |
| d. line segments | k. rhombus | r. number |
| e. corners | l. dimensions | s. inscribed |
| f. vertex | m. trapezoid | t. circumscribed |
| g. convex | n. congruent | u. kite |

1. A simple closed figure formed by ... is called a polygon.

2. In Euclidean plane geometry, a ... is a polygon with four sides and four ... or
3. The area of a rectangle figure is the ... of its
4. A shape that is both a ... and a ... is a square (four equal sides and for equal angles).
5. A polygon is called ... if all of its sides and all of its interior angles are
6. Applying these geometric theorems we can obtain both a regular polygon ... into the circle and a regular polygon ... about the circle.
7. Finding the sum of the ... angles of a polygon is not difficult.
8. If you wish to find the perimeter of a regular polygon you should multiply ... of the sides by the ... of the sides.
9. By drawing all ... from one single ... of a polygon we can separate it into triangles.
10. Simple quadrilaterals are either ... or
11. A parallelogram possesses ... properties.

Ex. 10. Guess what figure possesses the following properties and memorize them (a square, a trapezoid, a kite, a rectangle, a parallelogram, a rhombus).

1. A ... has two parallel pairs of opposite sides.
2. A ... has two pairs of opposite sides parallel, and four right angles. It is also a parallelogram, since it has two pairs of parallel sides.
3. A ... has two pairs of parallel sides, four right angles, and all four sides are equal. It is also a rectangle and a parallelogram.
4. A ... is defined as a parallelogram with four equal sides. It does not have to have 4 right angles.
5. ... only has one pair of parallel sides. It's a type of quadrilateral that is not a parallelogram.
6. ... has two pairs of adjacent sides that are equal.

Ex. 11. Find out whether the statements are True or False. Use the introductory phrases:

I think it is right.

Quite so. Absolutely correct.

I quite agree to it.

I am afraid it is wrong.

I don't quite agree to it.

On the contrary. Far from it.

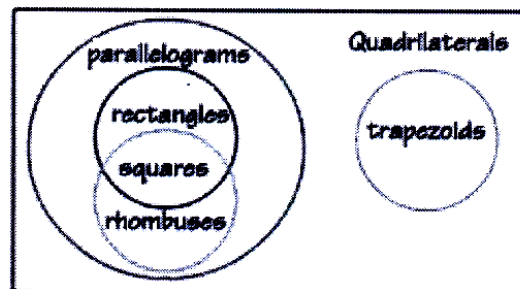
1. Plane figures bounded by four sides are called triangles.
2. The area of a square is the product of the length of its sides.
3. A rectangle is a parallelogram that has four obtuse angles.
4. Every interior angle in a convex polygon has a measure greater than 180° .
5. Rhombus is a parallelogram with four congruent angles.

6. Every square is a rectangle, but not every rectangle is a square.
7. To find the perimeter of a regular polygon, divide the length of the sides by the number of sides.
8. The area of a geometric figure is a quantity expressed by negative numbers.
9. A quadrilateral is a square if and only if it is both a rhombus and a rectangle.
10. The base and the altitude of a rectangle are called its dimensions.

Ex. 12. Ask special questions using the question words in brackets.

Venn Diagram

1. Let us use a Venn diagram to group the types of quadrilaterals (why).
2. A Venn diagram uses overlapping (частично совпадающие) circles. It shows relationships between groups of objects (what).
3. All quadrilaterals can be separated into three sub-groups: general quadrilaterals, parallelograms and trapezoids (how many).



4. Since all four sides of a rectangle don't have to be equal a rectangle isn't always a rhombus (why). 5. However, the sets of rectangles and rhombuses intersect (which). 6. Their intersection is the set of squares (whose). All squares are both a rectangle and a rhombus.

7. We can put squares in the intersection of the two circles (where). 8. From this diagram, you can see that a square is a quadrilateral, a parallelogram, a rectangle, and a rhombus (from what).

9. A trapezoid isn't a parallelogram because it has only one pair of parallel sides (how many). 10. That is why we must show the set of trapezoids in a separate circle on the Venn diagram (in what way).

Let's consider kites. 11. Kites are quadrilaterals that can be parallelograms. (what type of). 12. If its two pairs of sides are equal, it becomes a rhombus (in what case).

Ex. 13. Choose the best alternative to the English sentence.

1. They're used to coming back late.

- a. Они часто возвращались домой поздно.
- b. Они привыкли возвращаться поздно.
- c. Они воспользовались своим поздним возвращением.

2. I can't help doing it myself.

- a. Ничем не могу помочь, так как делаю это сама.
- b. Не может быть, что я сделала это сама.
- c. Не могу не сделать это сама.

3. He regrets leaving school at fourteen.

- a. Он сожалеет о том, что ушел со школы в 14 лет.
- b. Он сожалеет о том, что уходит со школы в 14 лет.
- c. Покидая школу, он сожалел, что ему только 14 лет.

4. I object to being treated like a child.

- a. Я боюсь лечения, как ребенок.
- b. Я против того, чтобы со мною обращались как с ребенком.
- c. Я возражал, чтобы меня лечили как ребенка.

5. I feel like going for a walk.

- a. Я чувствую, что мне нравится ходить на прогулки.
- b. Вероятно, я пойду на прогулку.
- c. Я хочу (испытываю желание) пойти на прогулку.

Ex. 14. Translate into English.

1. Простая замкнутая фигура, сформированная отрезками, называется многоугольником. 2. Само слово многоугольник состоит из двух греческих слов – ‘poly’ – много, ‘gon’ – угол. 3. Правильный многоугольник – это многоугольник, у которого все углы и стороны конгруэнтны. 4. Простейшим многоугольником является треугольник, имеющий три стороны, три угла и три вершины. 5. Пятиугольник имеет пять сторон, шестиугольник – шесть, восьмиугольник – восемь, десятиугольник – десять. 6. Многоугольники могут быть сгруппированы в соответствии с величиной их углов и сторон. 7. Четырехугольник – это также плоская фигура. 8. Если стороны четырехугольника равны и все углы прямые, то такой четырехугольник называется квадратом. 9. Линия вокруг плоской фигуры называется периметром. 10. Периметр плоской фигуры равен сумме длин его сторон.

Ex. 15. Let us revise Modal Verbs and their equivalents.

Complete the sentences with have to, has to, had to and the verbs from the box. Some of them are interrogative or negative.

| |
|---|
| do, get, help, do , take, wear, learn, study, correct, look |
|---|

1. 'I don't want to take exams.' – 'You ... them. You have no choice.'
2. Why ... I ... this exercise? It's really boring.
3. Yesterday he ... me with my homework. It was impossible.
4. She is going to bed now. She ... up early tomorrow morning.
5. What uniform ... they ... in Oxford university?
6. The work was very important, and he understood that he ... it in a hurry.
7. She ... everything by heart.
8. He doesn't speak English very well. He ... more.
9. How often ... your teacher ... your homework?
10. Some students ... up a lot of words in their dictionaries.

Ex. 16. Choose the correct modal verb to fill in each gap. (Modals of deduction/criticism.)

1. You ... have had a terrible fright. You're still trembling.
a. might b. should c. must
2. I ... be able to come. I'll have to ask my parents though.
a. must b. might c. could
3. That ... be Mary. She is supposed to be at university.
a. shouldn't b. can't c. ought not to
4. You ... take a coat. It's going to get cold later.
a. can b. shall c. should
5. He ... have forgotten again. I reminded him about fifty times.
a. can't b. mustn't c. shan't
6. That ... be Michael. He always gets home from work at about this time.
a. may b. must c. could
7. You ... have told me. I would have got you a present.
a. must b. might c. should
8. She ... know. I certainly haven't told her.
a. might not b. can't c. mustn't

9. You ... have spent it. I only gave it to you yesterday.
a. might not b. can't c. shouldn't
10. They ... have seen it. It's been on for a couple of weeks.
a. might b. can c. ought to

Ex. 17. Choose the correct modal verb.

1. You *must/have* to get a good night's sleep before the exam in trigonometry.
2. She *needn't/mustn't* find the sum of the interior angles of this polygon. She has already found it.
3. I *didn't need to/couldn't* solve the problem after all – it was too difficult for me.
4. How wonderful! I *don't have to/mustn't* revise the properties of special quadrilaterals. I know them very well.
5. What you *should/may have done* is to learn formulas for perimeter and areas for basic figures.
6. Her student has done so little work, he *shouldn't/needn't have bothered* to come to class today.
7. You *will/could be able to* focus on understanding the basic geometric formulas and their applications.
8. One *may/can* remember old and wise saying 'Practice makes a man perfect'.
9. Geometry *can/ought to* be made quite fascinating if you follow some rules while studying it.
10. Riemann *was able to/had to* collect and systematize his work at the end of the 19th century.
11. You *are allowed/should* bear in mind that every plane section of a sphere is a circle.

Ex. 18. Find and correct the mistakes.

1. I checked the timetable so I *mustn't* be wrong about the time of my lessons.
2. You *needn't* to worry about carrying out this experiment.
3. Do I *ought to* use a ruler for drawing a line? I may do without it.
4. You *must* having read about the Arabs who gave us a present form for writing fractions.
5. You *need* spend as much time as you can on writing your report.
6. May you tell me where I *may* get Euclid's chief work Elements?
7. You *mustn't* write anything down unless you want to.

8. Don't be silly, you not ought to use this inaccurate and restricted method for obtaining a trigonometric function.
9. Finding the area of the circle was a problem for her. You must have given her the formula.
10. It was Sunday and he stayed at home. He needn't have gone to university.

Ex. 19. Read the text and find the answers to the following questions.

1. What are the main properties of the areas of geometric figures?
2. What numbers is the area of a geometric figure expressed by?
3. How is measuring areas done?
4. What is called the dimensions of a rectangle?

Areas of Polygons

We all have some idea about the quantity called area, from everyday life. We will establish here more precisely the concept of area of geometric figures, and develop methods for its computation. Assume that the area of a geometric figure is a quantity, expressed by positive numbers, and is well-defined for every polygon. Further assume that the areas of figures possess the following properties:

(1) Congruent figures have equal areas. Figures of equal area are sometimes called **equivalent**. Thus, according to this property of areas, congruent figures are equivalent. The converse can be false: equivalent figures are not always congruent.

(2) If a given figure is partitioned into several parts, then the number expressing the area of the whole figure is equal to the sum of the numbers expressing the areas of the parts. This property of areas is called **additivity**. It implies, that the area of any polygon is greater than the area of any other polygon enclosed by it.

(3) The square, whose side is a unit of length, is taken for the unit of area, i.e. the number expressing the area of such a square is set to 1. When the unit of length is taken to be, say, 1 meter (centimeter, foot, inch, etc.), the unit square of the corresponding size is said to have the area of 1 **square** meter (respectively square centimeter, square foot, square inch, etc.), which is abbreviated as 1m^2 (respectively cm^2 , ft^2 , in^2 , etc.). Measuring areas is done not by direct counting of unit squares or their parts fitting into the measured figure, but indirectly, by means of measuring certain linear sizes of the figure. Let us agree to call one of the sides of a triangle or parallelogram the **base** of those figures, and a perpendicular dropped to this side from the vertex of the

triangle, or from any point of the opposite side of the parallelogram, the **altitude**. In a rectangle, the side perpendicular to the base can be taken for the altitude. In a trapezoid, both parallel sides are called bases, and a common perpendicular between them, an altitude. The base and the altitude of a rectangle are called its **dimensions**.

Theorem. *The area of a rectangle is the product of its dimensions.*

This brief formulation should be understood in the following way: the number expressing the area of a rectangle in certain square units is equal to the product of the numbers expressing the length of the base and the altitude of the rectangle in the corresponding linear units. It should be pointed out that the lengths of the base and the altitude (measured by the same unit) are expressed by whole numbers.

Unit 4

“Mathematics is the queen of sciences”.

Carl Friedrich Gauss

Grammar: The Infinitive. Its forms and functions.

Таблица форм инфинитива

| | Active | Passive | |
|--------------------|-----------------------------|-----------------------------|--|
| Indefinite | to write | to be written | Выражает действие одновременное с действием глагола сказуемого |
| Continuous | to be writing | - | Выражает одновременное длительное действие |
| Perfect | to have written | to have been written | Выражает действие предшествующее действию глагола сказуемого (переводиться прошедшим временем) |
| Perfect Continuous | to have been writing | - | Выражает предшествующее длительное действие |

Таблица функций инфинитива

| | | |
|------------|--|--|
| 1. Subject | To learn two foreign languages simultaneously is difficult. | Изучать два иностранных языка одновременно трудно. |
|------------|--|--|

| | | |
|---|--|--|
| | It's useless to discuss the question. | Бесполезно обсуждать этот вопрос. |
| 2. Part of Predicate | Her task was to pass the exams. He began to read the book a week ago. | Её задача состояла в том, чтобы сдать экзамены. Он начал читать книгу неделю назад. |
| 3. Object | He doesn't like to be asked personal questions. | Ему не нравится, когда задают вопросы личного характера. |
| 4. Attribute (инфинитив переводится с оттенком модальности или будущности) | The problem to be discussed is interesting. He was the first to do the exercise. There are some important things to be considered at the lesson. | Проблема, которая будет обсуждена (нужно, предстоит обсудить) интересна. Он первым сделал это упражнение. Существует несколько важных моментов, которые нужно рассмотреть на уроке. |
| 5. Adverbial Modifier | I'm studying English <u>in order (so as) to get</u> a better job. To understand the importance of this event you should know all the facts. | Я изучаю английский язык для того, <u>чтобы</u> устроиться на лучшую работу. Чтобы понять важность этого события, вы должны знать все факты. |
| 6. Compound Modal Predicate | He must be working now. She must have translated the text. They must have been reading the text-book for an hour. He may (might) be at his studies now. She may (might) have done the exercise. | Он, вероятно , сейчас работает. Должно быть , она уже перевела текст. Они, вероятно , читают этот учебник уже в течение часа. Возможно , он на занятиях сейчас. Она, возможно , выполнила упражнение. |
| Verbs which are usually followed by the Infinitive | agree, refuse, promise, threaten, offer, attempt, manage, fail, decide, plan, arrange, hope, appear, seem, pretend, afford, forget, learn (how), dare, tend | We promised not to be late for our classes. – Мы пообещали не опаздывать на занятия. He hoped to solve the problem at once. - Он надеялся решить проблему сразу. |

Ex.1. Read these sentences and state the form and the function of the Infinitive. Translate into Russian.

1. To solve the equation was not difficult for her. 2. The speaker at the conference didn't like to be interrupted. 3. The article is difficult to translate. 4. They must have attended his lecture before. 5. He is always the first to come to the University. 6. The method to be applied is rather complicated. 7. He worked hard in order not to be behind the other students. 8. The topic may

have been considered at the previous lesson. 9. Our aim is to extend the definition. 10. It isn't easy to speak any foreign language. 11. He must be improving his knowledge of mathematics. 12. The scientist might have been working on this problem for many years.

Ex.2. Open the parentheses and give the correct form of the infinitive.

1. I am glad (read) this book now.
2. I hope (award) a scholarship for the coming semester.
3. He is happy (work) at this company for more than five years.
4. He does not like (interrupt) by anybody.
5. Ann was surprised (pass) the exams.
6. The question is too unexpected (answer) at once.
7. I want (solve) these equations.
8. This theorem was the first (prove).
9. She might (forget) to translate the text yesterday.
10. The question must (settle) an hour ago.
11. The article is (write) in time.
12. (Understand) the situation one must (know) the details.

Ex.3. Complete the sentences by using infinitives. Supply a preposition after the infinitive if necessary. The first is done for you.

1. I'm planning to fly to the USA next year.
2. The student promised not ... late for the lecture.
3. I need ... my homework tonight.
4. I want ... computer games after my classes.
5. He intends ... a programmer when he graduates from the university.
6. I hope ... all of my courses this term. So far my grades have been pretty good.
7. I try ... class on time every day.
8. I learned (how) ... when I entered the university.
9. I like ... a lot of e-mails from my friends.
10. I hate ... in front of a large group.
11. My roommate offered ... me with my English.

Ex.4. Write the correct form (gerund or infinitive) of the verbs given in parentheses. Sometimes more than one answer is possible.

1. He regrets (not study) harder when he was at school.
2. The teacher was very strict and nobody dared (talk) during his lessons.
3. She suggested (go) to the University by taxi.
4. (learn) English involves (speak) as much as you can.

5. (Solve) this equation multiply each term in it by the quantity that precedes it.
6. On (obtain) the data the scientists went on working.
7. The procedure (follow) depends entirely on the student.
8. This equation must (solve) at the previous lesson.
9. Euclid was the first (bring) all the known facts about geometry into one whole system.
10. We don't mind (give) further assistance.
11. The method (apply) is rather complicated.
12. (prove) this theorem means (find) a solution for the whole problem.
13. Students are (study) the laws of mathematics and mechanics.

Pre-Reading Activity

Guess the meaning of the following words.

| | |
|-----------------------------------|------------------------------------|
| segment n. ['segmənt]; | mathematician n. |
| [mæt (q) mət 'tɪs (q) n]; | |
| formula n. ['fɒljʊlə]; | hypotenuse n. [haɪ'pɒt (q) nj Hz]; |
| cosine n. ['kɒsaɪn]; | special adj. ['speʃ (q) l]; |
| Pythagorean [paɪ'tæg (q) 'rɪjən]; | sine n. [saɪn]. |

Read and learn the basic vocabulary terms:

| | |
|---------------------------------|----------------------------------|
| triangle n. ['traɪəŋɡl] | треугольник |
| shape n. ['ʃeɪp] | фигура, форма |
| edge n. [eɪdʒ] | грань, край |
| denote v. [dɪ'noʊt] | обозначать, значить |
| determine v. [dɪ'tɜːmɪn] | определять, устанавливать |
| relative adj. ['relatɪv] | относительный, соответственный |
| equilateral adj. [ˌɛkwɪ'lætrəl] | равносторонний |
| isosceles adj. [aɪ'sɒsɪlɪz] | равнобедренный |
| namely adv. ['neɪmli] | а именно, то есть |
| whereas conj. [weə'rɪz] | тогда как |
| define v. [dɪ'faɪn] | определять |
| scalene adj. ['skeɪlɪn] | неравносторонний, разносторонний |
| internal adj. [ɪn'tɜːnl] | внутренний |
| external adj. [ɪk'stɜːnl] | наружный, внешний |
| formerly adv. ['fɒmlɪ] | прежде |

| | |
|-------------------------------------|---|
| cathetus n. (pl. catheti) ['kæθəti] | катет |
| leg n. [leg] | катет |
| obey v. [q'beɪ] | подчиняться |
| square n., v. [skweɪ] | квадрат (величины), возводить в квадрат |
| property n. ['prɒpəti] | свойство |
| therefore adv. ['ðeəfɔː] | поэтому, следовательно |
| degenerate adj. [dɪ'ʒen(ə)rɪt] | вырожденный |
| compasses n. ['kæmpəseɪz] | циркуль |
| straightedge n. ['streɪtɛdʒ] | угольник |
| base n. [beɪs] | основание |
| area n. ['eəriə] | площадь |
| arbitrary adj. ['ɹɒbɪtrɪəri] | произвольный, случайный |
| bound v. [baʊnd] | ограничивать |
| derive (from) v. [dɪ'reɪv] | происходить (от) |
| depend (on, upon) v. [dɪ'pend] | зависеть (от) |
| trace (to) v. [treɪs] | восходить (к), находить, проследивать(ся) |

Memorize the following word combinations.

a right triangle – прямоугольный треугольник
 an acute triangle – остроугольный треугольник
 an obtuse triangle – тупоугольный треугольник
 an oblique triangle – косоугольный треугольник
 a regular polygon – правильный многоугольник

Reading Activity

Triangles

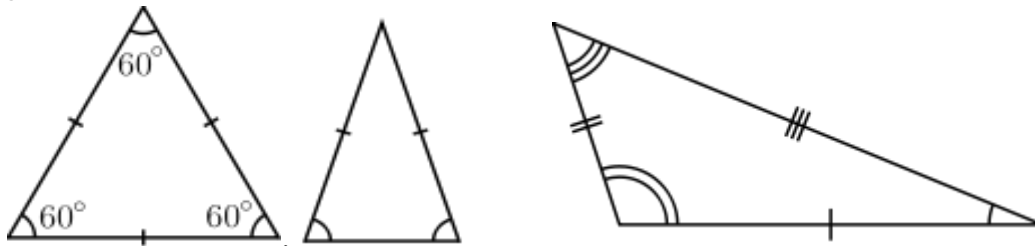
A **triangle** is one of the basic shapes of geometry: a polygon with three corners or vertices and three sides or edges which are line segments. A triangle with vertices *A*, *B*, and *C* is denoted $\triangle ABC$.

There exist different types of triangles. They can be classified: 1) according to the relative lengths of their sides:

- In an **equilateral triangle** all sides have the same length. An equilateral triangle is also a regular polygon with all angles measuring 60° . It is possible to construct an equilateral triangle of a given side length using just compasses and a straightedge.

- In an **isosceles triangle** two sides are equal in length. An isosceles triangle also has two angles of the same measure; namely, the angles opposite the two sides of the same length; this fact is the content of the Isosceles triangle theorem.

- In a **scalene triangle** all sides are unequal. The three angles are also all different in measure. Some (but not all) scalene triangles are also right triangles.



Equilateral

Isosceles

Scalene

2) according to their internal angles, measured here in degrees:

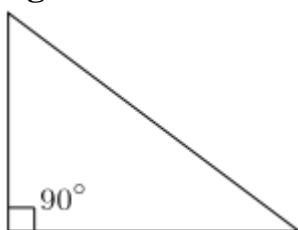
- A **right triangle** (or right-angled triangle, formerly called a rectangled triangle) has one of its interior angles measuring 90° (a right angle). The side opposite the right angle is the **hypotenuse**; it is the longest side of the right triangle. The other two sides are called the **legs** or **catheti** of the triangle.

- Triangles that do not have an angle that measures 90° are called **oblique** triangles.

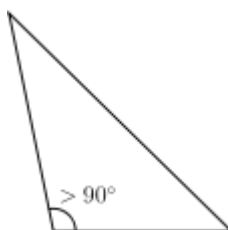
- A triangle that has all interior angles measuring less than 90° is an **acute** triangle or acute-angled triangle.

- A triangle that has one angle that measures more than 90° is an **obtuse** triangle or obtuse-angled triangle.

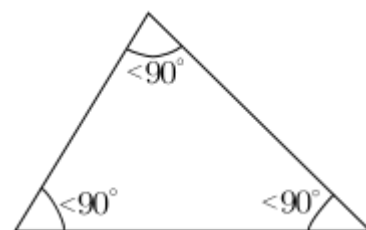
- A triangle with an interior angle of 180° (and collinear vertices) is **degenerate**.



Right



Obtuse



Acute

Oblique

Triangles have some distinctive properties which are common to all types. The two most common properties are: 1) the interior angles of a triangle

always add up to 180° ; 2) the exterior angles of a triangle always add up to 360° .

The area of a triangle can be calculated by using the following geometric formula: Area of a triangle = $\frac{1}{2}$ Base \times Height;

The perimeter of a triangle is equal to the sum of its three sides.

For all triangles, angles and sides are related by the law of cosines and law of sines (also called the cosine rule and sine rule).

The law of cosines is a statement about a general triangle that relates the lengths of its sides to the cosine of one of its angles. This law states that $c^2 = a^2 + b^2 - 2ab \cos \gamma$, where γ denotes the angle contained between sides of lengths a and b and opposite the side of length c .

The law of cosines generalizes the Pythagorean theorem, which holds only for right triangles: if the angle γ is a right angle, then $\cos(\gamma) = 0$, and thus the law of cosines reduces to $c^2 = a^2 + b^2$.

The law of cosines is useful for computing the third side of a triangle when two sides and their enclosed angle are known, and in computing the angles of a triangle if all three sides are known.

The law of sines is an equation relating the lengths of the sides of an arbitrary triangle to the sines of its angles. According to the law, $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$ where a , b , and c are the lengths of the sides of a triangle, and A , B , and C are the opposite angles. The law of sines can be used to compute the remaining sides of a triangle when two angles and a side are known.

Post-Reading Activity

Ex.5. Answer the following questions.

1. What is a triangle? (Give the definition of a triangle)
2. How many types of triangles there exist?
3. According to what can they be classified?
4. What triangle is called equilateral?
5. How many sides are equal in length in an isosceles triangle?
6. In what triangle are all three angles different in measure?
7. Does a right triangle contain three right angles?
8. What triangles are referred to as oblique?
9. Can any triangle be called acute-angled?
10. How do we call a triangle with an interior angle of 180° ?
11. Do triangles have any properties which are common to all types?
12. How can the area and the perimeter of a triangle be calculated?

Ex.6. Fill in the blanks with the words from the box. Mind there are two extra words.

- | | | |
|-----------------|--------------|-------------------------|
| a. equilateral, | e. right, | i. hypotenuse, |
| b. isosceles, | f. legs, | j. Pythagorean theorem, |
| c. interior, | g. oblique, | k. degenerate, |
| d. scalene, | h. triangle, | l. acute. |

1. A ... is one of the basic shapes of geometry.
2. In a ... triangle all sides are unequal.
3. In an ... triangle two sides are equal in length.
4. A ... triangle has one of its interior angles measuring 90° .
5. The other two sides are called the ... of the triangle.
6. Right triangles obey the
7. In an ... triangle all sides have the same length.
8. A triangle with an interior angle of 180° is
9. Triangles that do not have an angle that measures 90° are called ... triangles.
10. The side opposite to the right angle is the

Ex.7. Find out whether the statements are True or False according to the information in the text. Use the introductory phrases:

I think, it's right.

I'm afraid, it is wrong.

Quite so. Absolutely correct.

I don't quite agree to it.

I quite agree to it.

On the contrary. Far from it.

1. A triangle is a polygon with three vertices and three edges which are not line segments.
2. Triangles can be classified according to the relative lengths of their sides and according to their external angles.
3. An equilateral triangle is a regular polygon with all angles measuring 60° .
4. An isosceles triangle has three angles of the same measure.
5. In a scalene triangle its three angles are all different in measure.
6. Triangles having an angle that measures 90° are called oblique triangles.
7. The longest side of the right triangle is called the hypotenuse.
8. A triangle having one angle that measures more than 90° is an acute triangle.
9. A triangle with an exterior angle of 180° is degenerate.
10. Triangles have only one distinctive property which is common to certain types.
11. The interior angles of a triangle always add up to 360° .
12. The perimeter of a triangle is equal to the sum of its three sides.

Ex.8. Match the English words and word combinations with their Russian equivalents.

- | | |
|--|--|
| 1. regular polygon; | a. отличительные свойства; |
| 2. to construct an equilateral triangle; | b. прямой угол; |
| 3. to define an isosceles triangle; | c. высота и основание треугольника; |
| 4. different in measure; | d. внутренний угол; |
| 5. to find a scalene triangle; | e. измерять в градусах; |
| 6. to measure in degrees; | f. найти неравносторонний треугольник; |
| 7. the right angle; | g. строить равносторонний треугольник; |
| 8. an interior angle; | h. построить косоугольный треугольник; |
| 9. the legs of the right triangle; | |
| 10. to construct an oblique triangle; | i. катеты прямоугольного треугольника; |
| 11. distinctive properties; | j. различные по величине; |
| 12. height and base of a triangle | k. правильный многоугольник; |
| | l. определять равнобедренный треугольник |

Ex.9. Complete the grid with the nouns from the text.

| | | | | | | | | | |
|---|--|---|---|----|--|--|--|--|--|
| 1 | | | | 10 | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| | | 4 | | | | | | | |
| | | 5 | | | | | | | |
| | | 6 | | | | | | | |
| | | 7 | | | | | | | |
| | | | 8 | | | | | | |
| 9 | | | | | | | | | |

Across

- the side opposite to the right angle;
- area or a figure having four equal sides and right angles;
- corner points of any figure or angle;
- form or figure;
- a measurement of distance or dimension;
- the unit of angle;
- a plane figure that is bounded by a closed path or circuit;

- 8 the measurement of vertical distance;
- 9 the other name for 'catheti';

Down

- 10 figures that have three sides and three angles.

Ex.10. Match the left and the right parts of the sentences.

- | | |
|---|--|
| 1. The interior angles of a triangle | a. are all different in measure |
| 2. A triangle is a polygon with | b. is degenerate |
| 3. In a scalene triangle | c. two sides are equal in length |
| 4. A right-angled triangle has | d. always add up to 360° |
| 5. The three angles of a scalene triangle | e. the cosine rule and sine rule |
| 6. A triangle with an interior angle of 180° | f. all sides have the same length |
| 7. The exterior angles of a triangle | g. always add up to 180° |
| 8. In an equilateral triangle | h. three vertices and three edges |
| 9. Angles and sides in triangles are related by | i. all sides are unequal |
| 10. In an isosceles triangle | j. one of its interior angles measuring 90° |

Ex.11. Let's revise Perfect Tenses. Complete the sentences using the words from the box.

| |
|--|
| already before ever for just by since so still yet never |
|--|

1. Have you ... dreamt of going to London?
2. I haven't worked out how to set the timer on the video
3. My dad's lived in the same house ... he was born.
4. The film's only been on ... a couple of minutes.
5. Kate has passed three exams out of five ... far.
6. He will have translated the text ... 3 o'clock tomorrow.
7. He's only ... got home.
8. It's eleven o'clock and he ... hasn't come home. Where could he be?
9. I've ... met Ann What's she like?
10. He has ... finished doing his homework.

Ex.12. Transform the sentences from Perfect Active into Perfect Passive.

1. She has just typed her report for the conference.
2. The teacher told us that she had checked all the tests.
3. The student will have written his degree work by May.
4. They have learnt a lot of new English words.
5. He hasn't found the answer yet.
6. I've just received my exam results.
7. By the end of the conference, the participants had discussed a number of important questions concerning the problem.
8. They will have read two books on topology by the

end of the month. 9. We had planned the meeting months in advance, but we still had problems. 10. I had discussed the plan of my work with my science adviser before the end of the class.

Ex.13. Find mistakes in the following sentences. Mind the use of Perfect Tenses in the Active and Passive Voice.

1. They finished their experiment by 5 o'clock yesterday.
2. The production of such computers has reduced by the end of the previous year.
3. I can't do the exercise. I had forgotten my text-book at home.
4. The article just translates by all the students.
5. By the time Kate returned from her studies, her brother goes to his friends.
6. His graduation paper will present by 3 o'clock tomorrow.
7. He is doing this work by tomorrow.
8. The solution for the problem is found by the end of the meeting yesterday.
9. The students already pass their credits.
10. She is written her course-paper by next month.
11. The advantages of this program already spoke of by the scientists at the conference.
12. The algorithm carefully hadn't worked out at the recent seminar yet.

Ex.14. Ask special questions using question words given in parentheses.

The development of geometry

1. The earliest recorded beginnings of geometry can be traced to early predecessors. (to whom) 2. They discovered obtuse triangles in the ancient Indus Valley and ancient Babylonia from around 3000 BC. (where; when) 3. Early geometry was a collection of empirically discovered principles concerning lengths, angles, areas, and volumes. (what collection) 4. In geometry a spatial point is a primitive notion upon which other concepts may be defined. (where) 5. Points have neither volume, area, length, nor any other higher dimensional analogue. (what (question to the subject)) 6. In branches of mathematics dealing with a set theory, an element is often referred to as a point. (where; how) 7. A point could also be defined as a sphere which has a diameter of zero. (how)

Ex.15. Choose the correct variant of translation.

1. It's difficult to study a foreign language.

- a. Это трудный иностранный язык для изучения.
- b. Трудно изучать иностранный язык.
- c. Изучать иностранный язык было трудно.

2. He hopes to pass his examination in mathematical analysis.

- a. Он надеется сдать экзамен по математическому анализу.
- b. Он надеялся на сдачу экзамена по математическому анализу.
- c. Он будет надеется на сдачу экзамена по математическому анализу.

3. She was writing the dictation very carefully in order not to make mistakes.

- a. Она написала диктант очень осторожно и не сделала ошибок.
- b. Она писала диктант очень тщательно и в правильном порядке, не делая ошибок.
- c. Она писала диктант очень внимательно, чтобы не сделать ошибок.

4. I'm sorry not to have seen this film in English at the lesson.

- a. Мне жаль, что на уроке я не посмотрела этот фильм на английском языке.
- b. Я сожалею о том, что не посмотрю этот английский фильм на уроке.
- c. Я не сожалею о том, что не посмотрела этот фильм на уроке английского языка.

5. He read the rule several times to understand it better.

- a. Он читает правило несколько раз, чтобы понять его лучше.
- b. Он прочитал правило несколько раз, чтобы лучше понять его.
- c. Он читал правило несколько раз и понимал его лучше.

6. This is just the person to speak to on this problem.

- a. Вот человек, о котором говорится в этой проблеме.
- b. Это как раз тот человек, с которым можно поговорить на эту тему.
- c. Только с этим человеком говорят об этой проблеме.

Ex.16. Translate these sentences from Russian into English.

- 1. Треугольник – это плоская фигура, ограниченная тремя линиями и содержащая три угла.
- 2. Треугольники бывают равносторонние, разносторонние, равнобедренные.
- 3. Треугольник с вершинами N, O, P обозначается $\triangle NOP$.
- 4. У равнобедренного треугольника два угла имеют одинаковую величину.

5. Название треугольника происходит от латинского слова «триангулум» = треугольный.
6. Существуют семь видов треугольников в зависимости от формы и градусной меры углов.
7. Равносторонний треугольник – это тот, у которого три стороны равны.
8. Другие математики определяют равнобедренный треугольник как треугольник, по крайней мере, с двумя равными сторонами.
9. Площадь треугольника может быть вычислена при помощи формулы.
10. Треугольник, у которого все внутренние углы меньше 90° является остроугольным.

Ex.17. Read the text below and find the answers to the following questions.

1. Was Pythagoras the first to know about the theorem that bears his name? In what was he the first? 2. What is the earliest indicator showing knowledge of the relationship between right triangles? 3. Who had a mechanical device for demonstrating the converse of the Pythagorean Theorem? 4. Who apart from the Egyptians knew of specific instances of the Pythagorean Theorem? 5. Is Pythagorean Property true for all right triangles? 6. What must one do to prove that $c^2=a^2+b^2$ for the triangle under consideration?

The Pythagorean Theorem

Pythagoras was not the first in antiquity to know about the remarkable theorem that bears his name, but he was the first to formally prove it using deductive geometry and the first to actively ‘market’ it (using today’s terms) throughout the ancient world. One of the earliest indicators showing knowledge of the relationship between right triangles and side lengths is a hieroglyphic-style picture, of a knotted rope (*связанная узлом верёвка*) having twelve equally-spaced knots (*узел*).

The rope was shown in a context suggesting its use as a workman’s tool (*рабочий инструмент*) for creating right angles, done via (*через, посредством*) the fashioning (*придание вида, формы*) of a 3-4-5 right triangle. Thus, the Egyptians had a mechanical device for demonstrating the converse of the Pythagorean Theorem for the 3-4-5 special case.

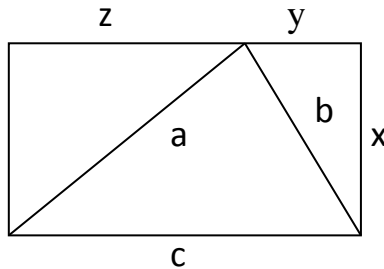
Not only did the Egyptians know of specific instances (*примеры, отдельные случаи*) of the Pythagorean Theorem, but also the Babylonians and Chinese some 1000 years before Pythagoras definitively institutionalized

(устанавливать на практике) the general result circa (приблизительно) 500 BC.

The Pythagorean Theorem is a central theorem which states: in any right triangle the sum of the squares of the lengths of the two legs is equal to the square of the length of the hypotenuse: $a^2 + b^2 = c^2$, where a and b are the lengths of the legs and c is the length of the hypotenuse. The Pythagorean Property is true for all right triangles. There exist several proofs of the Pythagorean Theorem. Let's discuss one of them.

A rectangle encloses the basic right triangle as shown below. The three triangles comprising the rectangle are similar, allowing the unknown dimensions x , y , to be solved via similarity principles in terms of a , b , and c . Once we have x , y , and z in hand, the proof proceeds as a normal dissection (разбиение, рассечение).

A Rectangular Dissection Proof:



- 1) $x/b = a/c \Rightarrow x = ab/c$, $y/b = b/c \Rightarrow y = b^2/c$ & $z/a = a/c \Rightarrow z = a^2/c$
- 2) $A = c \{ ab/c \} = ab$
- 3) $A = 1/2 \{ ab/c \times b^2/c + ab + ab/c \times a^2/c \} = ab/2 \{ b^2/c^2 + 1 + a^2/c^2 \}$

$$4) ab = ab/2 \{ b^2/c^2 + 1 + a^2/c^2 \} \Rightarrow 2ab = ab \{ b^2/c^2 + 1 + a^2/c^2 \} \Rightarrow 2 = \{ b^2/c^2 + 1 + a^2/c^2 \} \Rightarrow 1 = b^2/c^2 + a^2/c^2 \Rightarrow b^2/c^2 + a^2/c^2 = 1 \Rightarrow a^2 + b^2 = c^2$$

Unit 5

*“ ... it is written in the language of mathematics,
and its characters are triangles, circles,
and other geometrical figures ... ”*

Galileo (speaking of understanding the universe)

Grammar: Complex Object. Complex Subject.

Complex Object (объектный падеж с инфинитивом)

Глагол **существительное (общий падеж)**
(сказуемое) + +

Infinitive

в действитель- *местоимение (объектный падеж)*
ном залоге)

| Глагол-сказуемое | Примеры | Перевод |
|---|--|---|
| 1.(в действительном залоге) Глаголы, выражающие восприятие посредством органов чувств: to see; to hear; to watch; to observe – наблюдать; to notice – замечать; to feel (инфинитив без частицы to) | The professor saw the students (them) carry out the laboratory work. We heard them discuss a new lecture in geometry. | Профессор видел, что студенты (они) выполняли лабораторную работу. Мы слышали, что они обсуждали новую лекцию по геометрии. |
| 2. Глаголы, выражающие желание: to want, to wish; to desire; to like; to hate; to require – требовать от кого-либо что-либо; should (would) like – хотел бы; to enable – давать возможность | They required us to take an examination in time. He'd like his colleagues (them) to complete the experiment soon. | От нас потребовали, чтобы мы сдали экзамен вовремя. Он хотел бы, чтобы его коллеги (они) скоро закончили эксперимент. |
| 3. Глаголы, выражающие предположение: to think, to suppose – полагать, to consider } полагать, to believe } считать to find – находить, признавать; to expect – ожидать, рассчитывать; to prove – доказывать; to assume – допускать. | The teachers believe first-year students to study English with great pleasure. The experiment proved the scientist's assumption to be valid | Преподаватели полагают, что первокурсники изучают английский язык с большим удовольствием. Эксперимент доказал, что предположение ученого верно. |

| | | |
|---|--|---|
| <p>4. Глаголы, выражающие приказание, просьбу, разрешение, принуждение:</p> <p>to make – заставлять; to force to let – позволять; to allow – разрешать to permit to compel – вынуждать make/let + infinitive without to</p> | <p>The teacher made the students do the translation. Let us take the value of the unknowns to be equal to a and b.</p> <p>The Mechanics and Mathematics Faculty enabled its graduates (them) to get decent jobs.</p> | <p>Учитель заставил студентов сделать перевод. Давайте примем значение неизвестных равными а и b. Мех-мат дает возможность своим выпускникам получить достойную работу.</p> |
|---|--|---|

Ex 1. Replace the Object Clause with the Complex Object. Follow the models.

Model 1: *I want to measure this line with a meter. (he)*

I want him to measure the line with a meter.

1. They want to complete this experiment as soon as possible. (she)
2. The supervisor requires to write this thesis in three years. (we)
3. The teacher expects to speak at the students' conference. (they)
4. I want to assign the letter X to the vertical line. (you)
5. I should like to draw a circle. (he)
6. She means first to inscribe a square. (we)
7. They expect to extend the line in one direction. (I)
8. We desire to speak on the properties of this circle. (she)
9. They would like to inscribe a square in a circle. (we)

Model 2: *We believe that the experiment is of great importance.*

We believe the experiment to be of great importance.

1. The teacher knows that they intersect two-number lines at the zero point.
2. I know that they have solved the equation easily.
3. The professor watches that his students carry out the experiments carefully.
4. I expect that they describe the circle in more details.
5. He believes that she designates a circle by a special symbol.
6. We know that mathematics has become man's second language.
7. They heard that the scientists had discussed a new theory.

Ex 2. In the sentences to follow look for the Complex Object and then translate them into Russian.

1. We know all points on the circle to be equidistant from the center point.
2. They can assume a line to be defined as an infinitely large set of points.
3. The teacher heard them discuss a new theorem.
4. We consider both theories to be necessary, though they are contradictory.
5. I expect this equation to have a different solution.
6. Some prominent scientists believe many problems of maths to be solved in the 21st century.
7. We want the students to learn and revise the rules regularly not only before the exams.
8. The professor desired his postgraduate student to apply a new method of investigation.
9. We watched the professor (him) draw a new axis in order to prove the theorem considered.
10. They expected a solution to be found as soon as possible.
11. Mathematicians have found the ratio of the circumference to a diameter to be the same for all circles.
12. They didn't expect trigonometric functions to be so complicated.

Complex Subject
(именительный падеж с инфинитивом)

Существительное

(общий падеж)

+

Глагол-сказуемое

+

Infinitive

Местоимение

(Active, Passive)

(именительный

падеж)

| Глагол-сказуемое | Примеры | Перевод |
|---|---|---|
| 1. В страдательном залоге: is/was believed – полагают, считают; полагали, считали is/was expected – ожидают, ожидали; рассчитывают, рассчитывали is/was known – известно, было известно is/was said – говорят, говорили, признают, признавали | The problem is considered to be complicated. The Internet is reported to be in great demand. Mathematics is known to be the language of | Считают, что задача трудна. Сообщают, что интернет пользуется большим спросом. Известно, что математика – это язык науки. |

| | | |
|--|--|--|
| <p>is/was reported – сообщают, как сообщали, по имеющимся данным</p> <p>is/was supposed – полагают, предполагают; полагали, предполагали; должен</p> <p>is/was considered – считают, считали</p> <p>is/was thought – считают, думают, считали, думали</p> <p>is/was understood – считают, считали, по имеющимся сведениям</p> <p>is/was found – оказывается, оказалось</p> | <p>science.</p> <p>The explanation was found to be convincing.</p> <p>The students are supposed to know the rules well.</p> <p>They were understood to agree with our viewpoint.</p> | <p>Объяснение оказалось убедительным.</p> <p>Полагают, что студенты хорошо знают правила.</p> <p>Считали, что они согласятся с нашей точкой зрения.</p> |
| <p>2. В действительном залоге</p> <p>seem/seemed – кажется, казалось, по-видимому</p> <p>appears/appeared – по-видимому, оказывается, оказалось</p> <p>proves/proved } оказывается, turns out/ } оказалось turned out }</p> <p>happens/happened – оказывается, оказалось, случаться, случайно</p> <p>оказалось</p> | <p>The data proved to be wrong.</p> <p>The book does not appear to be difficult</p> <p>My group-mate happened to have prepared for the exam better.</p> <p>There seems to be some confusion of tenses in his test.</p> <p>He turned out to be a good friend.</p> | <p>Оказалось, что данные неверны.</p> <p>По-видимому, эта книга нетрудная.</p> <p>Оказалось, что мой одноклассник приготовился лучше к экзамену.</p> <p>Кажется, в его контрольной есть некоторая путаница во временах.</p> <p>Оказалось, что он хороший друг.</p> |
| <p>3. Глагол-связка <i>be</i> + прилагательное</p> <p>is likely – вероятно, по всей вероятности, похоже на то</p> <p>is unlikely – маловероятно, вряд ли; не может быть чтобы</p> <p>is sure/is certain – несомненно, наверняка, обязательно, конечно и др.</p> | <p>They are likely to come in time.</p> <p>This scientist is sure to get a Noble Prize for his outstanding discovery.</p> <p>This problem is</p> | <p>Вероятно, они придут вовремя.</p> <p>Несомненно этот ученый получит нобелевскую премию за его выдающееся открытие.</p> <p>Несомненно, эта</p> |

| | | |
|--|-------------------|------------------------|
| | certain to arise. | проблема ВОЗНИКНЕТ. |
|--|-------------------|------------------------|

Ex. 3. In the sentences to follow look for the Complex Subject and translate them into Russian.

1. Every point at a distance from point 0 is said to be on the circle.
2. This rule does not appear to hold for all operations of arithmetic.
3. When two angles have the same vertex and the line between them is a side of both, the angles are said to be adjacent.
4. When one of the angles of a triangle is obtuse, the triangle is considered to be an obtuse one.
5. Like terms are expected to be arranged in a similar way.
6. A proper solution of this equation is likely to be obtained.
7. The students appeared to be unable to carry out these complex calculations.
8. The line drawn perpendicular to a radius through an endpoint of the radius is known to be a tangent of the circle.
9. Two tangents can always be drawn to a circle from any point outside the circle, and these tangents are said to be equal in length.
10. A circle is known to be a set of points in a plane each of which is equidistant from some given point called the center.
11. Every point at a distance less than r from 0 is said to be inside the circle.
12. The sets are supposed to be designated by capital letters A, B, C..
13. Two circles which have two common points are said to intersect each other.

Ex. 4. Change according to the model.

It is believed that he is a hard-working student.

He is believed to be a hard-working student.

1. It is expected that all second-year students will pass the exams successfully.
2. It is known that the experiments have been finished in time.
3. It is certain that this problem will be solved very soon.
4. It is likely that he has given them wrong instructions.
5. It is reported that the postgraduates of our Faculty have finished their investigations.
6. It seems that she is a very talented researcher.
7. It happened so that the error was easily detected.

8. It is expected that the delegation of prominent foreign mathematicians will arrive at our University next week.

Pre-Reading Activity

Guess the meaning of the following words:

coordinate [kou'ou:dnIt] (n) diameter [daI'xmItq] (n)
arc [a:k] (n) perpendicular
[pq:pqn'dikjulq] (n)

Read and learn the basic vocabulary terms:

circle [sWkl] (n) – круг
curved line [kWvd] – кривая линия
radius [reIdIqs] radii ['reIdIaI] pl., (n) – радиус, радиусы
half-line [hRflaIn] (n) – полупрямая, луч
measure [meZq] (v) – мерить, измерять
reference-line (n) – базисная линия
equidistant (adj) – равноудаленный
chord [kLd] (n) – хорда
secant [sJkqnt] (n) } секущая
secant line }
come from (v) – происходить, иметь, происхождение
inscribe (v) – вписывать
bisect (v) – делить пополам
arc [Rk] – дуга
tangent [txnGqnt] line – касательная прямая
annulus ['xnjulqs] (n) – (плоское) круговое кольцо
ratio [reISiou] (n) – соотношение, коэффициент, отношение

Memorize the following word-combinations.

a major arc – большая из двух дуг (окружности)
a minor arc – меньшая из двух дуг
internally tangent circles – круги, касающиеся внутренним образом
externally tangent circles – круги, касающиеся внешним образом
a circumscribed polygon – описанный многоугольник
an inscribed polygon – вписанный многоугольник
a regular octagon – правильный восьмиугольник
to arrive at a more precise definition – (для того) чтобы прийти к более
точному определению

are subtended – стянуты
 by a similar process – подобным образом
 in other words – иными словами
 as closely as desired – так близко, как хотелось бы
 no matter how short an arc is – какой бы короткой не была дуга

Reading Activity

The Circle and Regular Polygons

Let's turn now to the simplest of all curved lines, the circle. We shall study its properties and its relation to straight lines and to figures made up of straight lines, especially polygons.

In a plane all the points at a given distance from a given fixed point are said to form a circle. A **circle** is a set of points in a plane, all of which are the same distance from a given point.

The fixed point O is called the **CENTER** of the circle, from which all other points are equidistant. The distance r is called the **RADIUS**. A **radius** is a line segment from the center of a circle to a point on the circle.

Every point at a distance r from O is said to be **on the circle**. Every point at a distance less than r from O is said to be **inside the circle**, and every point

at a distance greater than r from O is said to be **outside the circle**. If the center of the circle is taken as the origin of a rectangular network, it follows from the Pythagorean Theorem that the coordinates (x, y) of every point P of the circle will satisfy the equation $x^2 + y^2 = r^2$. This equation is the equation of the circle.

On any half-line with end-point O there is a point at the distance r from O . We may

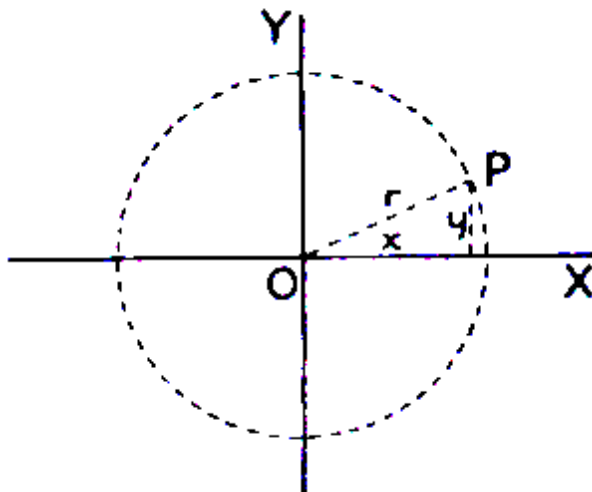


Fig. 1.

select one such half-line – for example, OX in Fig.1 as a reference line from which to measure the angles to all other such half-lines. If we measure these angles in degrees, then on every half-line which makes an angle of between 0 and 360 degrees with OX there is a point of the circle.

All the points of the circle which lie on half-lines from p to q (Fig.2) are said to form an **ARC PQ** of the circle. The word "**arc**" comes from a Latin word meaning "**bow**."

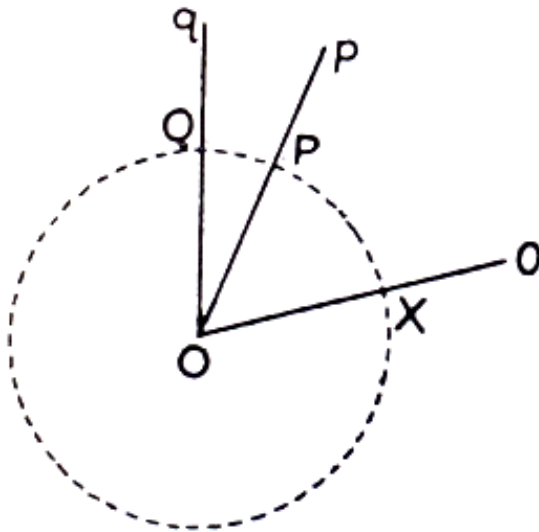


Fig. 2.

In Fig.2 notice that the half-lines OP and OQ form two angles whose sum is 360° . Ordinarily when we speak of angle POQ we refer to the lesser of these

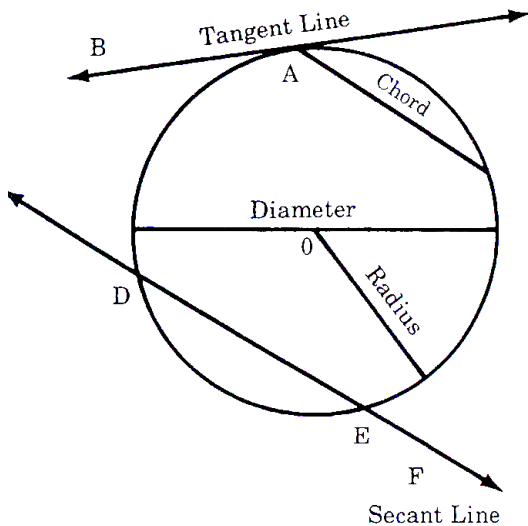


Fig. 3.

In Fig.2 arc PQ corresponds to angle POQ . Angle POQ is called **a central angle** because its vertex is at the center of the circle.

A **chord** of a circle is a line segment whose two endpoints lie on the circle. The **diameter**, passing through the circle centre, is the longest chord in a circle. A **tangent** to a circle is a straight line that touches the circle at a single point, thus guaranteeing that all tangents are perpendicular to the radius and diameter. A **secant** is an extended chord: a straight line cutting the circle at two points.

two angles; only rarely do we mean the greater angle. Similarly, when we speak of the arc PQ , we ordinarily mean the arc that corresponds to the lesser central angle POQ ; but occasionally we mean the arc that corresponds to the greater central angle. Except for the end-points P and Q , all the points of the first arc PQ are sometimes called the **minor arc** which are distinct from the points of the second arc PQ which are sometimes called the **major arc**. If the two central angles POQ are equal, each of the two corresponding area PQ is called a **semicircle**.

Instead of speaking of the perimeter of a circle, we usually use the term **circumference** to mean the distance around a circle. We cannot find the circumference of a circle by adding the measure of the segments, because a

circle does not contain any segments. No matter how short an arc is, it is curved at least slightly. Mathematicians have discovered, that the ratio of the circumference (c) to a diameter (d) is the same for all circles and is expressed $\frac{c}{d}$. The number $\frac{c}{d}$ or $\frac{c}{2r}$ (since $d=2r$ – the length of a diameter is equal to twice the length of a radius), which is the same for all circles, is designated by π .

$$\frac{c}{d} = \pi \text{ or } \frac{c}{2r} = \pi$$

By using the multiplication property of equation, we obtain the following:
 $c = \pi d$ or $c = 2\pi r$.

Post-Reading Activity

Ex. 5. Answer the following questions.

1. How can we define a circle?
2. What is the center of a circle?
3. What is a radius?
4. When do we say that a point is on the circle, inside the circle and outside the circle?
5. How can you formulate the equation of the circle using the Pythagorean Theorem?
6. What is an arc?
7. When is an angle called a central angle?
8. What kind of line segment is a chord?
9. What is the longest chord in a circle? Give the definition of this figure.
10. What is a tangent to a circle?
11. What kind of chord is a secant? Give the definition of a secant.
12. What is a circumference? Give the formula of a circumference.

Ex. 6. Match the English words and words combinations with their Russian equivalents.

- | | |
|-------------------------------|--------------------------------------|
| 1. reference line | a. круговое кольцо |
| 2. equidistant | b. иметь происхождение |
| 3. an inscribed polygon | c. хорда |
| 4. come from | d. секущая |
| 5. chord | e. круги, касающиеся внешним образом |
| 6. externally tangent circles | f. вписанный многоугольник |
| 7. by a similar process | g. подобным образом |

- | | |
|---------------------------|------------------------------|
| 8. a regular octagon | h. равноудаленный |
| 9. a circumscribed circle | i. описанный круг |
| 10. concentric circle | j. правильный восьмиугольник |
| 11. an annulus | k. базисная линия |
| 12. a secant | l. концентрический круг |

Ex. 7. Mark the following as True or False. Use the introductory phrases:

| | |
|-------------------------------|--|
| The statement is true | Quite the contrary (the reverse). |
| It's correct to say | I can't agree with the statement. |
| I share this viewpoint | You are wrong there, I am afraid. |

1. In a plane all the points at a given distance from a given fixed point are said to form a chord.
2. The diameter passing through the circle centre, is the shortest chord in a circle.
3. Angle POQ is called a central angle because its vertex is at the centre of the circle.
4. A tangent to a circle is a curved line that touches the circle at two points.
5. A secant is an extended chord: a straight line cutting the circle at a single point.
6. Mathematicians have discovered that the ratio of the circumference to a diameter is the same for all circles.
7. The circumference of a circle may be defined as the limit of the perimeter of an circumscribed regular polygon.
8. The equation $x^2 + y^2 = r^2$ is the equation of the semicircle.

Ex.8. Fill in the blanks with necessary words and word combinations. Mind there are two extra words.

- | | | |
|--------------------|-------------------|---------------------|
| a. a line segment; | h. are said; | o. a set of points; |
| b. only; | i. bisect; | p. fixed; |
| c. circumscribed; | j. arc; | q. meaning; |
| d. vertex; | k. a chord; | r. the measure; |
| e. circumference; | l. given; | s. connects; |
| f. through; | m. on the circle; | t. perimeter |
| g. in a plane; | n. intersect; | |

1. A circle is ... in a plane, all of which are the same distance from a ... point.
2. A radius is ... from the center of a circle to a point
3. Tangent circles are two circles that at one point.
4. A ... circle is a circle passing ... each ... of a polygon.

5. ... all the points of a given distance from a given ... point ... to form a circle.
6. The word ... comes from a Latin word ... “bow”.
7. A diameter is ... which ... the center to any points on the circle.
8. We cannot find ... of a circle by adding ... of the segments.

Ex.9. Match the definitions of the circles with their names.

Based upon their relative positions, two circles in a plane or a circle and a polygon have special names.

- | | |
|-------------------------------|--|
| 1. Tangent circles | a. are circles that have different centers. |
| 2. Concentric circles | b. are both circles which are on the opposite sides of the tangent line. |
| 3. A circumscribed circle | c. is a polygon that is inside a circle so that each of its vertices lies on the circle. |
| 4. Externally tangent circles | d. is a circle to which all the sides of a polygon are tangents. |
| 5. An inscribed circle | e. is a polygon that is outside the circle in such a way that all of its sides are tangent to the circle. |
| 6. Eccentric circles | f. is a circle passing through each vertex of a polygon. |
| 7. Inscribed polygon | g. both circles which are on the same side of the tangent line. |
| 8. A circumscribed polygon | h. are two or more circles in a plane with the same center, but the lengths of their radii vary. The annulus is the region between concentric circles. |
| 9. Internally tangent circles | i. are two circles that intersect only at one point. |

Ex.10. Let us revise the Degrees of Comparison. Give the best English equivalents for the words in parentheses.

1. A circle is (самая простая) of all curved lines.
2. Every point at a distance (больше) than radius (говорят) to be outside the circle.
3. A secant segment is a line segment with an endpoint in the exterior of a circle, and the other endpoint on the circle, (самой далекой) from the external point.
4. Tom comes top in all the exams – he must be (самый умный) student in the group.
5. (Чем меньше) students think, (тем больше) they talk.
6. How are you today? – I’m very (хорошо), thanks.
7. Is this proof (более правильно)?

8. Peter speaks English (наиболее бегло) of all the students in this group.
9. (Чем больше) I learn, (тем больше) I forget and (тем меньше) I know.
10. (Чем скорее) the problem is solved, (тем лучше).
11. This contribution of the ancient Greeks is (намного больше, чем) the formulas of the Egyptians.

Ex. 11. Translate into Russian, paying attention to the degrees of comparison.

1. The diameter is the longest possible chord of any circle.
2. The lecture given to the second-year students last week was not as complicated as the one the professor delivered last month.
3. The science advisor was very glad that his postgraduates continued further discussion.
4. The maths lessons are getting more and more difficult in the third year of studies.
5. For the 8.15 class, the latest the students must leave the hostel is 7.40.
6. The diameter is twice as long as the radius.
7. A major arc is an arc greater than a semicircle but less than 360^0 .
8. His argument is less convincing than his proof.
9. The ruler is the simplest instrument for drawing.
10. The proof is not so valid as he supposed at first.

Ex. 12. Choose the correct variant.

1. These rules are ... to understand than others.
 a) so difficult b) more difficult c) much difficult
2. We have never been ... than on that day.
 a) more happier b) the happiest c) happier
3. This is ... translation I have ever done.
 a) the most worse b) the worst c) the worser
4. Can you repeat ... sentence.
 a) the latest b) the least c) the last
5. Which is ... textbook of the two?
 a) better b) the best c) the better
6. I don't think this is ... thing for us at the moment.
 a) a more important b) much more important c) the most important

7. She is getting ... with every day.
a) more weaker b) the weakest c) much weaker
8. Girls tend to be ... than boys.
a) more tidier b) tidier c) much tidy
9. ... than twenty students passed all the exams.
a) a fewer b) a few c) fewer

Ex. 13. Ask special questions using the words in parenthesis.

1. An arc is usually named by its endpoints. (how)
2. A chord is a line segment connecting any two points on the circle. (what)
3. They attended the lectures on geometry twice a week. (how often)
4. Most mathematical proofs can be given in many different ways. (how)
5. In geometry we separate all geometric figures into two groups: plane figures and space figures or solids. (how many)
6. Later you ought to do some measurements to check your calculations. (when)
7. We are already familiar with the basic concepts of geometry through our high school studies of maths. (what)
8. The points of geometry have no size and no dimensions. (what)
9. Numbers became abstract when we began to reason about their nature and enumerate their properties through arithmetical and logical operations. (when)
10. A straight line extends indefinitely only in one direction. (where)
11. Every math problem must be settled either in the form of a direct answer to the question, or by the proof of the impossibility of its solution. (how)
12. The Greeks were able to carry out many constructions with two tools. (how many)
13. The theory in question was developed successively by different scientists. (who)

Ex. 14. Choose the correct variant of translation.

1. We expect them to solve this problem.

- a. Мы ожидаем, что они решат эту задачу.
- b. Мы ждали, что они решат эту задачу.
- c. Мы ждем их, пока они решат эту задачу.

2. They are believed to have done their best.

- a. Они верят, что сделали все возможное.
- b. Полагают, что они сделали все возможное.
- c. Полагали, что они сделали все возможное.

3. They appear to have known all about the set theory.

- a. Они появляются, чтобы узнать все о теории множеств.
- b. Они пришли и узнали все о теории множеств.
- c. Оказывается, они узнали все о теории множеств.

4. What made the students do the test quickly?

- a. Что сделали студенты, чтобы выполнить тест быстро?
- b. Что заставляет студентов выполнять тест быстро?
- c. Что заставило студентов выполнять тест быстро?

5. First-year students are thought to show very good results at the exams.

- a. Первокурсники, как считают, показывают очень хорошие результаты на экзамене.
- b. Считают, что первокурсники хотят показать очень хорошие результаты на экзамене.
- c. Считали, что первокурсники покажут очень хорошие результаты на экзамене.

Ex. 15. Translate into English.

- 1. Отрезок прямой, соединяющий две какие-либо точки окружности, называется хордой.
- 2. Хорда, проходящая через центр окружности, называется диаметром.
- 3. Диаметр равен сумме двух радиусов и поэтому все диаметры одной окружности равны между собой.
- 4. Любая часть окружности называется дугой.
- 5. Существует более точное определение окружности.
- 6. Математики нашли, что соотношение окружности к диаметру одно и то же для всех кругов и обозначено знаком π .
- 7. Мы сначала впишем квадрат в круг.
- 8. Иными словами окружность круга может быть определена, как предел периметра вписанного правильного n-угольника.
- 9. Линейка – простейший инструмент для черчения.
- 10. На этой лекции было столько же студентов, сколько на предыдущей лекции.
- 11. Ваши волосы такого цвета, как мои.

Ex. 16. Read the text and find the answers to the following questions.

13. How do we define the circumference of a circle in traditional mathematics?
14. What concept is it necessary to introduce if we are going to arrive at a more precise definition of a circle?
15. How can we inscribe a regular octagon in a circle?
16. Give the definition of a circumference using the concept of limits.

Circumference of a Circle

In traditional approaches to mathematics, the circumference of a circle has not always been clearly defined. Sometimes the circle itself was called the circumference, and at other times, the measure of the distance around the circle was called the circumference. If we define the circumference as the perimeter of the circle the measure of the circle is symbolized by the formula **$c = \pi d$ or $c = 2\pi r$** .

There exist more precise definitions of a circumference. To arrive at a more precise definition it is necessary to introduce the concept of limits. By using the limit concept, the circumference of a circle may be defined as the limit of the perimeter of an inscribed regular polygon. To illustrate this we can first inscribe a square in a circle. The sum of the sides of the square will be an approximation of the circumference of the circle. Then, bisecting the central angles, which are subtended by the sides of the square we can inscribe a regular octagon. The sum of the sides of the octagon will be a closer approximation of the circumference. Next bisecting the central angles subtended by the sides of the octagon, we can inscribe a regular 16-gon. The sum of the sides of the 16-gon will be an even closer approximation of the circumference. By a similar process we can then inscribe a regular 32-gon and 64-gon and so on. Clearly the sum of n sides of an inscribed regular n -gon can be made to approximate the circumference of the circle as closely as desired by choosing n sufficiently large.

In other words the circumference of a circle may be defined as the limit of the perimeter of an inscribed regular n -gon as n increases.

UNIT 6

“It appears to me that if one wants to make progress in mathematics, one should study the masters and not the pupils.”

N.H. Abel

Grammar: The conditional sentences

Условные предложения (Conditional sentences)

Придаточное предложение условия соединяется с главным предложением союзами *if*(если), *unless*(если не), *provided (that)*, *providing (that)*, *on condition (that)* (при условии если, при условии что), *supposing (that)*, *suppose (that)* (предположим (что)).

Существует три типа условных предложений.

1. В условных предложениях первого типа глагол в придаточном предложении употребляется в **Present Indefinite**, а в главном предложении в **Future Indefinite**.

| | | |
|--|---|---|
| <i>If it stops raining, we will go to the beach.</i> | <i>Если дождь перестанет, мы пойдем на пляж.</i> | Предложение выражает реальное предположение, относящееся к будущему времени и соответствует в русском языке условному предложению с глаголом в изъявительном наклонении . |
| <i>Unless Peter comes over, I shall be very upset.</i> | <i>Если Петя не придет к нам, я очень расстроюсь.</i> | |

2. В условных предложениях второго типа глагол в придаточном предложении употребляется в **Past Indefinite**, а в главном предложении – сочетание **should** или **would** с **Indefinite Infinitive** (без *to*).

| | | |
|---|---|---|
| <i>If Mary got better next week, she would join us for a pick-nick.</i> | <i>Если бы Мэри стала лучше себя чувствовать на следующей неделе, она бы поехала с нами на пикник.</i> | Предложение выражает нереальное или маловероятное предположение, которое относится к настоящему или будущему времени. Оно соответствует в русском языке условному предложению с глаголом в сослагательном наклонении . |
| <i>If John saw June tomorrow, he would invite her for a party.</i> | <i>Если бы Джон увидел Джун завтра, он пригласил бы ее на вечеринку.</i> | |

Глагол *to be* в форме **were** употребляется со всеми лицами единственного и множественного числа.

*If he **were** here now, he **would arrange** everything.*

*Если **бы он был** здесь сейчас, он **уладил бы** все.*

3. В условных предложениях третьего типа глагол в придаточном предложении употребляется в **Past Perfect**, а в главном предложении сочетание **should** или **would** с **Perfect Indefinite**.

| | | |
|---|--|--|
| <i>If the child had been more careful, he would not have fallen down.</i> | <i>Если бы ребенок был более внимательным, он бы не упал.</i> | Предложение выражает предположение, относящееся к прошедшему времени и являющееся поэтому невыполнимым. Оно соответствует в русском языке условному предложению с глаголом в сослагательном наклонении . |
| <i>We would not have got lost if we had taken a map.</i> | <i>Мы бы не заблудились, если бы взяли карту.</i> | |

Ex. 1. Define the type of conditionals in the following sentences and translate them:

1. If I had known you were in hospital, I would have gone to see you.
2. If I had not gone to the party, they would have been offended.
3. When I phone Kate this evening, I will invite her to the cinema.
4. What would you do if you won one million pounds?
5. Would you mind if I used your phone?
6. If I had been hungry, I would have eaten something.
7. Hurry up! If we don't catch a 10 o'clock coach, we will be late for a flight.
8. If the driver in front hadn't stopped so suddenly, the accident wouldn't have happened.
9. If it rains this evening, I will not go out.
10. If I were taller, I would join the basketball team.

Ex. 2. Choose the correct item.

1. I will be furious if he ever ... about it.
a. finds out b. found out c. had found out
2. Unless we ... a wrong turning, we would not have arrived late.
a. took b. had taken c. take
3. If I had known you were back from your holiday, I ... you.
a. will phone b. would phone c. would have phoned

4. If you ... smoking, you will damage your health.
a. don't give up b. didn't give up c. hadn't given up
5. What ... you ... if you missed the last bus?
a. will ... do b. would ... do c. would ... have done
6. If he ... me earlier, I would have changed my plans.
a. warns b. warned c. had warned
7. I ... to lend you some money if I sell my car.
a. would be able b. would have been able c. will be able
8. If I ... you, I wouldn't go out in such weather.
a. were b. had been you c. am
9. If I had more time, I ... tennis.
a. will take up b. would have taken up c. would take up
10. If you ... more exercises, you would feel better.
a. did b. do c. will do

Ex. 3. Open the brackets using the appropriate verb-forms in both parts of the conditional sentences.

1. If you (like) Julia Roberts, you (love) this film.
2. If he (not see) the other car, there (be) a car accident last night.
3. It's a shame, Paul is late. If he (leave) home earlier, he (not miss) the train and would be in time.
4. If Mark (be) younger, he (join) the army. But he is already 27.
5. If I (earn) enough money, I (buy) a car of my dream.
6. If the weather (be) good tomorrow, we (go) to the beach.
7. Leon, your test is bad. If you (be) more careful, you (not make) so many mistakes.
8. If I (not have) to work such long hours, I (not be) always so tired.
9. I (let) you know if the meeting (start) earlier. Don't worry!
10. Emily (give) definitely you a ring if she (change) her mind.

Pre-Reading Activity

Guess the meaning of the following words.

orthogonal [O: 'Tɒɡonqɪ] (a)

group [gru:p] (n)

vector ['vektɪ] (n)

normal ['nɒ:mqɪ] (a)

| | |
|------------------------------------|--------------------------------|
| inverse [in'vq:s] (n) | isometry [aisou'metri] (n) |
| transformation [trɪnsfɔ'meɪʃn] (n) | discrete [dis'kri:t] (a) |
| linear ['liniə] (a) | basis ['beɪsɪs] (n) |
| special ['speʃl] (a) | determinant [di'tɜːmɪnənt] (n) |

Read and learn the basic vocabulary terms.

transpose [trɪns'pəʊz] (n) – транспонированная матрица
 inverse [in'vɜːs] (n) – инверсия, обращение, обратная величина
 rotation [rou'teɪʃn] (n) – вращение
 reflection [rɪf'lektʃn] (n) – отражение
 remainder [ri'meɪndə] (n) – остаток
 interchange ['ɪntʃeɪʃn] (v) – обмениваться
 constrain [kən'streɪn] (v) – ограничить
 entry ['entri] (n) – элемент (матрицы)
 row [rou] (n) – ряд
 column ['kɒləm] (n) – колонка

Memorize the following word combinations.

a square matrix – квадратичная матрица
 an orthogonal unit vector – ортогональный единичный вектор
 an identity matrix – единичная матрица
 a linear transformation – линейное преобразование
 a unitary transformation – унитарное (единичное) преобразование
 an orthogonal group – ортогональная группа
 to bring to identity – привести к единице
 finite-dimensional linear isometries – конечномерные линейные изометрии
 an inner product – скалярное произведение
 a bottom right entry – элемент матрицы, расположенный в нижнем правом углу таблицы
 a matrix inverse – обратная матрица
 simultaneous equations – совместные уравнения, система уравнений

Reading Activity

Matrices

A **matrix** is a set of quantities arranged in rows and columns to form a rectangular array. Matrices don't have a numerical value. They are used to

represent relations between quantities as well as to represent and solve simultaneous equations. A matrix of **m** rows and **n** columns is called an (**mn**) matrix.

There are a few types of matrices: a square matrix, a row matrix, a column matrix, a unit matrix, a transpose of a matrix and others. Here we'll regard more closely a **square matrix**.

In algebra a square matrix is an orthogonal matrix with real entries whose columns and rows are orthogonal unit vectors. Equivalently, a matrix Q is orthogonal if its transpose – the matrix that results from interchanging the rows and columns – is equal to its inverse: $Q^T = Q^{-1}$, which derives $Q^T Q = Q Q^T = I$, where **I** is the identity matrix. This type of matrix is a square matrix in which all the elements in the leading diagonal are ones and the other elements are equal to zero. An **orthogonal matrix** is the real specialization of a unitary matrix.

The set of $n \times n$ orthogonal matrices forms a group $O(n)$, known as the **orthogonal group**. The subgroup $SO(n)$ consisting of orthogonal matrices with determinant +1 is called the special orthogonal group, and each of its elements is a special orthogonal matrix. Orthogonal matrices arise naturally from **inner products**, and from matrices of complex numbers. Orthogonal matrices preserve inner product, so for vectors u, v in an n -dimensional real inner product space $\langle u, v \rangle = \langle Qu, Qv \rangle$.

To see the inner product connection, let's consider a vector v in an n -dimensional real inner product space. Written with respect to an orthonormal basis, the squared length of v is $v^T v = (Qv)^T (Qv) = v^T Q^T Q v$.

The finite-dimensional linear isometries – rotations, reflections, and their combinations – produce orthogonal matrices. The converse is also true: orthogonal matrices imply orthogonal transformations. However, linear algebra includes orthogonal transformations between spaces which may be neither finite-dimensional nor of the same dimension.

The inverse of every orthogonal matrix is again orthogonal. In fact, the set of all $n \times n$ orthogonal matrices satisfies all the axioms of a group. It is a compact Lie group of dimension $n(n-1)/2$, called the orthogonal group and denoted by $O(n)$.

The orthogonal matrices whose **determinant** is +1 form the special orthogonal group $SO(n)$ of rotations. Now let's consider $(n+1) \times (n+1)$ orthogonal matrices with bottom right entry equal to 1. The remainder of the last column (and last row) must be zeros, and the product of any two such matrices has the same form. The rest of the matrix is an $n \times n$ orthogonal matrix; thus $O(n)$ is a subgroup of $O(n+1)$ (and of all higher groups).

$$\begin{bmatrix} & & 0 \\ & O(n) & \vdots \\ 0 & \dots & 0 & 1 \end{bmatrix}$$

Since an elementary reflection can reduce any orthogonal matrix to this constrained form, a series of such reflections can bring any orthogonal matrix to the identity; thus an orthogonal group is a reflection group.

Orthogonal matrices are important for a number of reasons, both theoretical and practical.

Post-Reading activity

Ex. 4. Answer the following questions:

1. What is a matrix?
2. Do matrices have a numerical value?
3. An orthogonal matrix is the real specialization of a unitary matrix, isn't it?
4. What types of matrices do you know?
5. What is an orthogonal group?
6. Do orthogonal matrices arise from inner products or from matrices of complex numbers?
7. What is a finite – dimensional isometry?
8. What does a linear algebra include?
9. The inverse of every orthogonal matrix is again orthogonal, isn't it?
10. What produces an orthogonal matrix?
11. Do the orthogonal matrices whose determinant is +1 form the special orthogonal group $SO(n)$ of rotations or do they form the orthogonal group $O(n)$?
12. What reasons are orthogonal matrices important for?

Ex. 5. Match the English words and word combinations with their Russian equivalents.

- | | |
|--|---|
| 1. both theoretical and practical | a. противоположное также верно |
| 2. preserve inner product | b. привести любую ортогональную матрицу к тождеству |
| 3. matrices arise from | c. ортогональные единичный векторы |
| 4. finite-dimensional linear isometries | d. матрицы возникают из |
| 5. bring any orthogonal matrix to the identity | e. как теоретический, так и практический |
| 6. orthogonal unit vectors | f. сохранять внутреннее произведение |
| 7. with respect to the basis | g. по отношению к базису |

8. include the identity
9. the converse is also true

- h. конечномерные линейные изометрии
- i. включать тождество

Ex. 6. Define the following statements as True or False. Use the introductory phrases:

I think it's right.

Quite so. Absolutely correct.

I quite agree to it.

I am afraid it is wrong.

I don't quite agree to it.

On the contrary. Far from it.

1. A matrix is a set of quantities arranged in rows and columns to form a rectangular array.
2. Simultaneous equations can be solved by means of matrices.
3. Only two types of matrices are considered in mathematics.
4. Matrices of complex numbers are derived from orthogonal ones.
5. The horizontal lines in a matrix are called columns.
6. Matrices are applied only in mathematics.

Ex. 7. Fill in the blanks with the necessary words and word combinations given bellow. Mind there are two extra ones.

- | | |
|---|----------------------------|
| a. finite-dimensional linear isometries | g. orthogonal unit vectors |
| b. a linear transformation | h. spaces |
| c. an orthogonal group | i. orthogonal |
| d. a unitary matrix | j. an orthogonal matrix |
| e. the special orthogonal group | k. inner products |
| f. determinant | l. a transpose |

1. In algebra a square matrix is ...with real entries whose columns and rows are
2. The set of $n \times n$ orthogonal matrices forms a group $O(n)$ known as
3. An orthogonal matrix is the real specialization of....
4. Orthogonal matrices arise naturally from....
5. Thus ... – rotations, reflections, and their combinations – produce orthogonal matrices.
6. Linear algebra includes orthogonal transformations between
7. The inverse of every orthogonal matrix is again
8. The orthogonal matrices whose ...is +1 form

Ex. 8. Match the left and the right parts of the following statements.

- | | |
|---------------------------|-----------------------------------|
| 1. A matrix consists of | a. both theoretical and practical |
| 2. A matrix of m rows and | reasons |

- | | |
|--|--|
| n columns | b. with real entries |
| 3. The remainder of the last column | c. must be zeros |
| 4. A square matrix is an orthogonal matrix | d. row vectors and column vectors |
| 5. A series of such reflections | e. is called an (mn) matrix |
| 6. Matrices are important for | f. can bring any orthogonal matrix to the identity |

Ex. 9. Let us revise all tenses in the Active and Passive Voice.

1. You can borrow my dictionary. I (use) it a lot but I (not use) it now.
2. A lot of new houses(built) nowadays in Belarus provinces.
3. Helen (travel) to Kiev next month to attend a conference.
4. A new underground station (complete) in Minsk by 2014.
5. I (meet) my group-mate when I (go) to university yesterday.
6. A new drug for cancer (find) last year.
7. They (make) two attempts to pass the exam in algebra this week.
8. A new university campus (open) in a week.
9. Mr. Grey (work) for a software company for 20 years already.
10. The workshop on mechanical modelling (be held) tomorrow.

Ex. 10. Translate the sentences according to the models.

Model 1: One can – можно (*One can use this numerical method.*

Можно воспользоваться этим числовым методом.)

One cannot (one can't) – Невозможно (*One can't swim a few miles without having a pause. Невозможно плыть несколько миль не отдыхая.*)

1. One can speak many languages.
2. One can have a few jobs at a time.
3. One can take exams in advance.
4. One can't be back into the childhood.

Model 2: One has to – необходимо (*One has to remember the relationship between these facts. Необходимо помнить о соотношении этих фактов.*)

One doesn't have to – нельзя (*One doesn't have to cross the road at a red light. Нельзя переходить дорогу на красный свет.*)

1. One has to sleep seven hours at night at least.
2. One has to bear in mind the formulae while solving equations.
3. This week one has to work longer hours.
4. One doesn't have to drive without having a driving license.

Model 3: One needs – необходимо (*One needs to mend the roof. Необходимо починить крышу.*)

One doesn't need – нет необходимости (*One doesn't need to come here every day. Нет необходимости приходить сюда каждый день.*)

1. One needs to inform them about the cancellation of the conference.
2. One doesn't need to drive fast. There is plenty of time.
3. One doesn't need to take an umbrella. It is not raining.

Model 4: One may – можно (*One may work in the reading hall at any time. В читальном зале можно работать в любое время.*)

One may not – нельзя (*One may not feed animals in zoos. Нельзя кормить животных в зоопарке.*)

1. One may get a free museum admission on Sundays.
2. Next Saturday one may have lectures by choice.
3. I don't know if one may or may not leave this place at nights.
4. One may not smoke aboard the plane.

Model 5: One must – необходимо (*One must invite her for a meeting. Необходимо пригласить ее на встречу.*)

One must not (one mustn't) - нельзя (*I'm sure that one mustn't be rude to anybody. Я уверен, что нельзя быть грубым ни с кем.*)

1. One mustn't be late for an appointment.
2. Tomorrow one must come to university half an hour earlier than today.
3. One mustn't pollute the environment.

Model 6: One should – следует, надо (*One should go to the dentist twice a year. К дантисту следует ходить два раза в год.*)

One should not (one shouldn't) – нельзя (*One shouldn't put such questions. Нельзя (не следует) задавать такие вопросы.*)

1. One should be more careful while writing a dictation.
2. One should think over the plan once again.
3. One shouldn't leave little children alone.

Ex.11. Match the left and the right parts of the conditional sentences.

- | | |
|---|---|
| 1. If I were you, | a. we will go skating. |
| 2. If you had told me that you were coming, | b. I could be in trouble. |
| 3. If you run into Peter by chance, | c. if I had a day off? |
| 4. If I could have your attention for a moment, | d. I would be very grateful. |
| 5. If the lake freezes, | e. he would have missed the train. |
| 6. If he had arrived a minute later, | f. I wouldn't waste my time reading this novel. |
| 7. Would it be all right | g. I would have met you at the station. |
| 8. Take care! You will hurt your leg | h. tell him to call me. |
| 9. Unless he were with me now, | i. if he had done more work. |
| 10. He would have passed the exam | j. if you fall off the bike. |

Ex. 12. Ask special questions.

1. A matrix Q is orthogonal if it is equal to its inverse. (when)
2. An elementary reflection can easily reduce any orthogonal matrix to this constrained form. (how)
3. Matrices never have a numerical value. (what)
4. A compact Lie group of dimension $n(n-1)/2$ is denoted by $O(n)$. (what...by).
5. Matrices are represented in rows and columns. (how)
6. If there are m rows and n columns, the matrix is an $m \times n$ matrix. (when)
7. Matrices are used in many fields of mathematics. (where)
8. In geometry every theorem must be proved. (what)
9. The identity property is being considered by the students. (by whom)
10. All the digits have been given in a line. (what)

Ex. 13. Translate from English into Russian.

1. If the team had trained more last season, it would not have lost the match.

- a. Если бы команда тренировалась больше в прошлом сезоне, она не проиграла бы матч.
- b. Если команда будет тренироваться больше, она не проиграет матч.
- c. Если бы команда тренировалась больше в прошлом сезоне, она не проигрывала бы матч сейчас.

2. One must remember about the family members' birthdays.

- a. Нужно помнить о дне рождения членов своей семьи.
- b. Вы можете помнить о дне рождения членов своей семьи.
- c. Вы, возможно, помните о дне рождения членов своей семьи.

3. If the experiment comes to nothing, we will be very upset.

- a. Мы очень огорчены, если эксперимент оканчивается неудачно.
- b. Мы были очень огорчены, когда эксперимент окончился неудачно.
- c. Если эксперимент окончится неудачно, мы будем очень огорчены.

4. We have been asked to leave the hall as soon as possible.

- a. Нас попросили покинуть зал как можно скорее.
- b. Мы попросили покинуть зал как можно скорее.
- c. Нас просят покинуть зал как можно скорее.

5. When we came to the city again, the palace had already been built.

- a. Когда мы приехали в город опять, дворец еще строился.
- b. Когда мы опять приехали в город, дворец уже был построен.
- c. Когда мы приедем в город опять, дворец все еще будет строиться.

Ex. 14. Translate into English the following sentences.

- 1. Мы можем представить, что нулевая матрица определена линейной комбинацией $A-A$.
- 2. Матрица порядка $|x|$, состоящая из одного ряда и одной колонки, является единичной матрицей.
- 3. Теория матриц и детерминантов возникла из необходимости решения линейных уравнений.
- 4. Матрицы подчиняются некоторым законам элементарной алгебры.
- 5. Две матрицы A и B равны, когда они являются матрицами одного порядка.
- 6. Мы продолжаем разрабатывать алгебру матриц.
- 7. Векторы могут быть записаны в ряды и колонки.
- 8. Если мы изменим любую из колонок и рядов матрицы, то мы получим новую матрицу.
- 9. Необходимо отметить, что умножение матриц возможно, если число колонок в B такое же, как и число рядов в A .
- 10. Студенты применили бы матрицы для решения задачи, если бы нашли этот способ рациональным.

Ex.15. Read the text and find the answers to the following questions.

- 1. Where do matrices find applications?
- 2. What matrices can be added and subtracted?
- 3. Is a matrix multiplication commutative?
- 4. What properties do matrices have?

Application of matrices

A matrix is a rectangular table of elements (or entries) which may be numbers or more generally any abstract quantities that can be added and multiplied. Matrices find many applications. They are a key tool in linear algebra. One use of matrices in linear algebra is to represent linear transformations. Matrices can also keep track of the coefficients in a system of linear equations. Physics makes use of matrices in various domains, for example, in geometrical optics, mechanics. Graph theory uses matrices to measure distances. Computer graphics uses them to project a 3-dimensional space onto a 2-dimensional screen.

To apply a matrix correctly one should bear in mind its properties. Matrices of the same size can be added and subtracted. Matrices of compatible sizes can be multiplied. These operations have many properties of ordinary arithmetic, except that a matrix multiplication is not commutative, that is, \mathbf{AB} and \mathbf{BA} are not equal in general.

Matrices have the following properties:

- to add matrices, add corresponding elements together to obtain another matrix of the same order.
- only matrices of the same order may be added.
- to subtract matrices, subtract corresponding elements to obtain another matrix of the same order.
- only matrices of the same order may be subtracted.
- to multiply a matrix by a number (also called a scalar), multiply each element of it.
- to multiply matrices, multiply rows by columns and add.