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АНГЛИЙСКИЙ ЯЗЫК

Практическое руководство

для студентов 1 курса математического факультета
специальности 1-31 03 01-02 «Математика
(научно-педагогическая деятельность)»
по разделу «Геометрия»

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Целью практического руководства является оказание помощи студентам 1 курса математического факультета в накоплении и систематизации словарного запаса профессиональной лексики по теме «Геометрия» и развитии навыков устной речи.

Практическое руководство состоит из уроков, включающих тематические тексты и задания к ним.

Практическое руководство адресовано студентам 1 курса специальности 1-31 03 01-02 «Математика (научно-педагогическая деятельность)» по разделу «Геометрия».

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Содержание

Введение

Целью предлагаемого руководства является помощь студентам в работе с текстами и в овладении лексикой по теме «Геометрия».

В практическое руководство включены тексты и упражнения, необходимые для использования английского языка в профессиональной деятельности.

Обучение происходит путем ограничения изучаемого языка математической лексикой, отбором минимального объема лексики и грамматики, необходимого для чтения математической литературы и овладения устной речью, а также параллельным и взаимосвязанным изучением устной и письменной речи на одном и том же учебном материале.

Лексическая база представлена на основе тематики, предусмотренной программой по английскому языку для высших учебных заведений. На каждую лексическую единицу предлагаются разнообразные задания для активного усвоения.

Грамматический материал рассматривается в каждом уроке и закрепляется при помощи специальных тренировочных упражнений.

Работа с текстом предполагает наличие предтекстовых и послетекстовых упражнений. Тексты снабжены иллюстрациями, способствующими графическому восприятию описанных в них образов и понятий.

Структура и распределение учебного материала направляет и организовывает всю учебную деятельность и позволяет наметить программу формирования требуемых навыков и умений в различных видах речевой деятельности.

Lesson 1

Words to be Learned

Exercise 1

Follow your teacher. Read these international words and try to guess their meaning.

diagram *n*, separate *a*, *v*, decimal, indefinitely, procedure *n*, situation, introduce *v*, algorithm, placement, vertical, standard *n*, *a*.

Exercise 2

Repeat after the teacher.

comma	запятая	lie (lay, lain)	лежать
align	располагать на одной линии	keep (kept)	1. держать; 2. хранить
left	левый	point	точка
skip	пропускать	appropriate	1. соответствующий; 2. подходящий
repeat	повторять	hour	час
pattern	схема, образец	affect	воздействовать
observe	1. наблюдать; 2. соблюдать	far	1. далеко; 2. далекий
namely	а именно	agreement	согласие
full	полный	step	шаг
careful	1. тщательный 2. внимательный	correspond	1. соответствовать; 2. переписываться
care	забота		

Notes

1) over and over again – многократно;
2) may prove helpful – может оказаться полезным;
3) to the left (right) of – налево (направо) от …;
4) at the right of – справа;
5) just as well – точно так же;
6) take care of – (*зд.*) охватить, предусмотреть;
7) in full agreement with – в полном соответствии с …;
8) this keeps each digit – это удерживает каждую цифру;
9) as appropriate – как полагается.

Exercise 3

Listen and repeat after the speaker.

[eɪ] – stable, waste, famous, danger, raise, con'tain, ob'tain, a'gain, mainly, stay, day, way, say, they, grey, 'stimulate, 'calculate, 'formulate, great; [aɪ] – mild, bind, find, design, a'lign, sign, i'deal, item, shine, light, de'fine, ap'ply, sky, shy, 'typist, im'ply, high; [au] – brown, town, down, out, about, found, stout, loud; [ou] – note, so, only, though, low, slow, own, cold, hold, most, load, boat, road, coat, coast.

Exercise 4

Read these words.

may, veil, sigh, idle, outer, wild, design, old, designate, fight, mind, amount explain, town, cloud, fable, rain, gold coal, try, host, cycle, fly, wait, graduate, blow, round, noble, break, blind, flow, approach, although, stout, mild, load, low, mail, sign, align, plain.

Exercise 5

Ask questions about the sentences below.

1. I found this article very helpful. (why). 2. You should skip this chapter because it is not interesting. (why). 3. You are to place a point between these two digits. (what). 4. You ought to repeat these words again. (why). 5. The vertical line separates the two groups of digits. (how). 6. Our discussion dealt only with the general pattern. (why). 7. They are going to introduce the new system. (when). 8. He will have to be very careful if he is going to perform this operation. (why). 9. The student gave an example of an algorithm. (who). 10. Our teacher introduced a new system of equations, during the previous seminar. (when).

Exercise 6

Read the text below and find in it answers for the following questions.

1. How many numerals are used in our numeration system? 2. What does a comma separate? 3. What kind of numbers do all the digits to the left of the decimal number represent? 4. Can you give an example of a repeating decimal? 5. Can rational numbers be named by decimal numerals? 6. Why is it more difficult to learn division in decimal form? 7. Does each step of addition in fractional form have a corresponding step in decimal form?

Decimal Numerals

In our numeration system we use ten numerals called digits. These digits are used over and over again[1] in various combinations. Suppose, you have been given numerals 1, 2, 3 and have been asked to write all possible combinations of these digits. You may write 123, 132, 213 and so on. The position in which each digit is written affects its value. How many digits are in the numeral 7086? How many place value positions does it have? The diagram below may prove helpful[2]. A comma separates each group or period. To read 529, 248, 650, 396, you are to say: five hundred twenty-nine billion, two hundred forty-eight million, six hundred fifty thousand, three hundred and ninety-six.

Billions period			Millions period			Thousands period			Ones period		
Hundred billions	Ten-billions	One-billion	Hundred millions	Ten-millions	One-million	Hundred-thousands	Ten-thousands	One-thousand	Hundreds	Hundreds	Hundreds
5	2	9	2	4	8	6	5	0	3	9	6

But suppose you have been given a numeral 587.9 where 9 has been-separated from 587 by a point, but not by a comma. The numeral 587 names a whole number. The sign (.) is called a decimal point.

All digits to the left of[3] the decimal point represent whole numbers. All digits to the right of the decimal point represent fractional parts of 1.

The place-value position at the right[4] of the ones place is called tenths. You obtain a tenth by dividing 1 by 10. Such numerals like 687.9 are called decimals.

You read .2 as two tenths. To read .0054 you skip two zeroes and say fifty four ten thousandths.

Decimals like .666..., or .242424..., are called repeating decimals. In a repeating decimal the same numeral or the same set of numerals is repeated over and over again indefinitely.

We can express rational numbers as decimal numerals. See how at may be done.

$$\frac{31}{100} = 0.31 \qquad \frac{4}{25} = \frac{4\times4}{4\times25} = \frac{16}{100} = 0.16$$

The digits to the right of the decimal point name the numerator of the fraction, and the number of such digits indicates the power of 10 which is the denominator. For example, .217 denotes a numerator 217 and a denominator of 10^3 (ten cubed) or 1000.

In our development of rational numbers we have named them by fractional numerals. We know that rational numerals can just as well[5] be named by decimal numerals. As you might expect, calculations with decimal numerals give the same results as calculations with the corresponding fractional numerals.

Before performing addition with fractional numerals, the fractions must have a common denominator. This is also true of decimal numerals.

When multiplying with fractions, we find the product of the numerators and the product of denominators. The same procedure is used in multiplication with decimals.

Division of numbers in decimal form is more difficult to learn because there is no such simple pattern as has been observed for multiplication.

Yet, we can introduce a procedure that reduces all decimal-division situations to one standard situation, namely the situation where the divisor is an integer. If we do so we shall see that there exists a simple algorithm that will take care of[6] all possible division cases.

In operating with decimal numbers you will see that the arithmetic of numbers in decimal form is in full agreement with[7] the arithmetic of numbers in fractional form.

You only have to use your knowledge of fractional numbers.

Take addition, for example. Each step of addition in fractional form has a corresponding step in decimal form.

Suppose you are to find the sum of, say, .26 and 2.18. You can change the decimal numerals, if necessary, so that they denote a common denominator. We may write .26 = .260 or 2.18 = 2.180. Then we add the numbers just as we have added integers and denote the common denominator in the sum by proper placement of the decimal point.

We only have to write the decimals so that all the decimal points lie on the same vertical line. This keeps each digit[8] in its proper place-value position.

Since zero is the identity element of addition it is unnecessary to write .26 as .260, or 2.18 as 2.180 if you are careful to align the decimal points, as appropriate[9].

Exercise 7

Listen and repeat. Guess the meaning of the words in italics.

to 'separate – *separation* – *'separable* – *in'separable;* indefinitely – *'definitely* – *'definite* – *in'definite;* ˌsitu'ation – *to 'situate;* to introˈduce – *ˌintro'duction;* to place – *to re'place* – *to dis'place* – *'placement* – *displacement;* i'dentity – *i'dentical* – *i'dentify;* to re'peat – *ˌrepe'tition;* to ob'serve – *ˌobser'vation;* full – *fully;* care *n* – *to care* – *'careful* – *'carefully* – *'careless* – *'carelessness;* to a'lign – *a'lignment.*

Exercise 8

Ask the speaker a question to find out the details.

1. He had to dwell on the disadvantages of the old procedure. (why). 2. They were to prove that the generally accepted method was not good. (how). 3. We were able to visit this ancient town twice. (when). 4. They had to come to a certain agreement. (what kind of). 5. I was allowed to replace this complicated and old machine. (when). 6. They were able to choose some articles for publication. (which articles).

Exercise 9

Listen to the questions about the text and write down your answers (+, –).

1. Are there five digits in the decimal system of notation? 2. Does the position of the digit affect its value? 3. Does a point separate each period? 4. Do the digits to the right of the decimal point represent whole numbers? 5. Do you obtain a tenth by dividing 1 by 10? 6. Can rational numbers be named by decimal numerals? 7. Must we have a common denominator before we add decimal numerals? 8. Is division in decimal form difficult? 9. Can we express rational numbers as decimal numerals? 10. Is zero the identity element of addition?

Exercise 10

a) *Ask questions to which the following sentences could be answers.*

1. We consider your data very helpful. 2. All these combinations have been repeated over and over again. 3. There is a diagram below. 4. The change of the order may affect the result. 5. It has to be pointed out that the procedure developed is very complicated. 6. On the right and on the left of the comma you see three digits. 7. The identity property is being considered by the students. 8. The value of the digit is defined by its position. 9. Yes, the necessary procedure has always been followed. 10. The given definition corresponds to the idea of uniqueness.

b) *Name the predicate in each one of the sentences above. Pay special attention to the functions of the verb 'to have'.*

Exercise 11

Go back to the text 'Decimal Numerals',

a) *Shorten the text leaving out the unimportant details;*

b) *Write a few questions to ask your group-mates;*

c) *Be prepared to render and discuss the text in class.*

Exercise 12

Ask questions about the text to follow.

Developing the definition of addition of rational number, the students discover that the basic rule of addition applies to every addition involving rational numbers.

In a rigorous treatment (*строгий подход*) to rational numbers a mathematician will define addition as follows:

$$\frac{a}{b}+\frac{c}{d}=\frac{ad+bc}{bd}.$$

Then he will check to determine whether or not this definition preserves (*сохранять*) the usual closure, commutative, and associative properties and whether or not the number zero remains the identity element.

Exercise 13

Read these words and give Russian equivalents of the words in italics.

digit – *digital;* use – *useful – usefulness – uselessness;* possible – *possibly – possibility;* value – *valuable – valueless;* separate *a – to separate – separable – inseparable;* to suppose – *supposition;*

to repeat – *repetition;* power – *powerless – powerful;* to expect – *unexpected;* difficult – *difficulty;* integer – *integration;* to exist – *existence;* agreement – *disagreement;* to use – *usable;* to change – *changeless – unchanged;* placement – *displacement;* identity – *identify* [aɪ'dentɪfaɪ]; element – *elementary*.

Exercise 14

Render the text (you may work in pairs).

Exercise 15

Say the following in English.

1. Эти числа использованы в различных комбинациях. 2. Диаграмма оказалась полезной. 3. Запятая отделяет периоды. 4. Этот знак называют десятичной точкой. 5. В числе 5.2 цифра 5 находится слева от точки и обозначает целое число. 6. Если мы разделим 1 на 10, то мы получим одну десятую. 7. Периодические дроби были введены сегодня на уроке. 8. Рациональные числа могут быть выражены в десятичных дробях. 9. Покажите мне диаграмму. 10. Где схема? 11. Эту дробь нельзя сократить. 12. Отдели запятой эти три цифры.

Exercise 16

Discuss the text of Exercise 12. Work in pairs.

Exercise 17

Read and translate the text

A Short Introduction to the New Math

Many who have been out of school for a number of years find, If they want to refresh their knowledge of mathematics, that there has been a great change, a sort of mathematical revolution while they were away from school. The old, classical math has had its face lifted and has taken on a new look which modern instructors claim is a great improvement.

In the classical math often taught in high-school courses, many simple truths were taken for granted and there was a failure to analyze these truths to find out why they are true and under what particular conditions they might not be true.

During the past centuries, great, world-shaking theories were born, notably the Maxwell electromagnetic theory, the theory of relativity, and the concept of differential and integral calculus. And all these extremely important doctrines came about as a result of questioning and continually asking WHY?

The results obtained using the New Math agree, of course, with those obtained using the old, classical math, but the method of the former is much more thorough and therefore more satisfactory to the student who has never before studied math. The New Math teaches a student to think a problem through rather than try to recall tricks of manipulation.

Let's take a simple example of the two methods:

We all learned that if $x^2 - 4 = 0$, x must equal either 2 or –2. Either of these numerical replacements for the letter x makes the statement meaningful. This is so elementary it hardly needs comment. But just how did we arrive at this ±2? Did we actually «transpose» the –4 to the other side of the equal sign where it became +4, the equation becoming $x^2 = 4$ and x becoming ±2? Any child might well ask, «Why do we change signs when we «transpose» from one side to the other in an equation». This, of course, is a sensible question. In the New Math this is dealt with before the child asks the question. We say:

If $x^2 - 4 = 0$, then by adding +4 to both sides of the equation we get $x^2 - 4 + 4 = 0 + 4$.

Next we show that –4 and +4 cancel each other and that $0 + 4 = 4$. Then $x^2 + 0 = 4$ or $x^2 = +4$. Thus $x = \pm 2$.

As a matter of fact, it is not at all difficult to demonstrate that we solved our little problem by making use of some of the eleven laws that form the foundation of arithmetic. Yes, that is a truly startling fact – and a truly startling discovery. Numbers are one of the most basic of the great ideas of mathematics. And believe it or not, eleven laws – not an infinity of manipulative devices – are the tools available to us when we want to solve problems. These are the eleven laws of real numbers:

1. *The Closure Law of Addition.* The sum of any two real numbers is a unique real number. For example, the sum of 10 and 117 is 127.

2. *The Commutative Law of Addition.* The order in which we add is trivial. For example, the sum of 3 and 4 is 7; the sum of 4 and 3 is also 7.

3. *The Associative Law of Addition.* Since addition is defined for pairs of numbers, the addition of three numbers depends on our first

adding any two of the numbers and then adding their sum to the third number; the order in which we do this is trivial. For example, when 3, 4 and 5 are added in three different orders, the same sum is obtained:

$$3 + 4 = 7,\ \ 7 + 5 = 12$$
$$4 + 5 = 9,\ \ 9 + 3 = 12$$
$$3 + 5 = 8,\ \ 8 + 4 = 12$$

4. *The Identity Law for Addition.* The number zero is the additive identity, for the addition of it to any other number leaves the second number unchanged. For example, the sum of 0 and 9 is 9.

5. *The Inverse Law for Addition.* The sum of any number and its negative is zero. For example, the sum of 5 and –5 is 0.

6. *The Closure Law for Multiplication.* The product of any two-real numbers is a unique real number. For example, the product of 117 and 10 is 1,170.

7. *The Commutative Law of Multiplication.* The order in which we multiply is trivial. For example, the product of 3 and 4 is the same as the product of 4 and 3.

8. *The Associative Law of Multiplication.* Since multiplication is defined for pairs of numbers, the multiplication of three numbers depends on our first multiplying two of the numbers and then multiplying their product by the third number; the order in which we do this is trivial. For example:

$$3 \times 4 = 12,\qquad 12 \times 5 = 60$$
$$3 \times 5 = 15,\qquad 15 \times 4 = 60$$
$$4 \times 5 = 20,\qquad 20 \times 3 = 60$$

9. *The Identity Law for Multiplication.* The number one is the multiplicative identity, for the product of it and any other number leaves the second number unchanged. For example, the product of 1 and 8 is 8.

10. *The Inverse Law for Multiplication.* The product of any number (except zero) and its reciprocal is one. For example, the product of 3 and $\frac{1}{3}$ is 1; the product of 5 and $\frac{1}{5}$ is 1; the product of $\frac{3}{10}$ and $\frac{10}{3}$ is 1. Division of a number by zero is meaningless.

11. *The Distributive Law.* Multiplication «distributes» across addition. For example:

$$6 \times (4 + 5) = 6 \times 9 = 54$$
$$6 \times (4 + 5) = (6 \times 4) + (6 \times 5) = 24 + 30 = 54$$

Lesson 2

Words to be Learned

Exercise 1
Read these words and guess their meaning.

Babylonia [bæbi'louniə] *n,* Egypt ['i:ʤipt] *n,* pyramid ['piramid] *n,* Egyptian [i'ʤipʃən] *a,* Greece [gri:s] *n,* Greek [gri:k] *a,* intriguing [in'tri:giŋ] *a,* mysterious [mis'tiəriəs] *a,* Euclid ['ju:klid], object [obʤikt] *n,* 'segment *n,* fundamental [ˌfʌndə'mentl] *a,* end-'point n.

Exercise 2
Read these words.

earth [ə:θ]	земля	di'mension	размер
land	земля	sky	небо
di'rection	направление	dot	точка
refer (to) [ri'f ə:]	1. ссылаться; 2. отсылать; 3. иметь отношение к …	volume ['vɔljum]	объем
spread (spread)	распространять (ся)	prove [pru:v]	1. доказывать; 2. оказываться
sequence ['si:kwəns]	последовательность	capital ['kæpitəl]	1. главный, основной; 2. прописная (заглавная) буква
location [lou'keiʃən]	1. определение местонахождения; 2. расположение	improve [im'pru:v]	1. улучшать; 2. исправлять
letter	1. буква; 2. письмо	figure ['figə]	1. цифра; 2. рисунок; 3. фигура
imagine [i'mæʤin]	1. воображать, 2. представлять себе	in'sist (on)	настаивать (на) …

worth [wə:θ]	1. стоящий, 2. заслуживающий	ex'tend	простираться
extension	1. протяженность; 2. расширение; 3. продолжение	avoid [ə'void]	избегать
pre'vent (from)	1. мешать, 2. предотвращать	straight [streit]	прямой
com'plete	1. *v* заканчивать; 2. *a* полный; 3. *a* завершенный	suggest [sə'ʤest]	предлагать
in'clude	включать	common ['kɔmən]	общий
shape	1. форма; 2. очертание	succeed (in) [sək'si:d]	добиться успеха
space	пространство	object [əb'ʤekt]	возражать
feel (felt)	чувствовать	measurement ['meʒəment]	1. измерение; 2. мера

Notes

1) Egyptians were mostly concerned with – египтян главным образом интересовало;

2) B. C. – до нашей эры (до Рождества Христова);

3) put into a logical sequence – дать в логической последовательности;

4) think of a point as – представьте себе точку как;

5) points are commonly referred to – обычно точки называют.

Exercise 3

a) Ask questions using the question words in brackets;

b) State the function of the Gerund;

c) Translate the given sentences.

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

Exercise 4

Translate the following sentences.

1. The method is certainly worth applying. 2. I suggested measuring this object. 3. He remembered having seen her at the last conference. 4. He insisted on following the model developed by them. 5. We consider repeating their experiment. 6. You should avoid changing the direction of your further investigation. 7. He suggested exchanging information on the subject. 8. They could not avoid including him in their research group.

Exercise 5

Write questions to which the sentences below could be answers.

1. Both geometry and algebra deal with equations. 2. One can easily measure the amount of work performed. 3. Mathematical measurements have many practical uses. 4. Nowadays information spreads all over the world within a few hours, if necessary. 5. This method can be applied for measuring volumes. 6. One, two, three, four and so on make a sequence of numbers.

Exercise 6

a) *Read the text to follow without consulting the dictionary to get its general idea;*

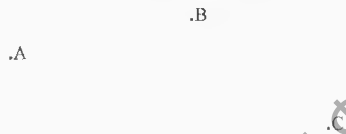
b) *After you have read the text, analyze the sentences you find difficult to understand and translate them. Consult the dictionary whenever necessary;*

c) *Read the same text again. You will have to discuss it.*

The Meaning of Geometry

1. Geometry is a very old subject. 2. It probably began in Babylonia and Egypt. 3. Men needed practical ways for measuring their land, for building pyramids, and for defining volumes; 4. The Egyptians were mostly concerned with[1] applying geometry to their everyday problems. 5. Yet, as the knowledge of Egyptians spread to Greece the Greeks found the ideas about geometry very intriguing and mysterious. 6. The Greeks began to ask "Why? Why is that true?" 7. In 300 B. C.[2] all the known facts about Greek geometry were put into a logical sequence[3] by Euclid. 8. His book, called. Elements, is one of the most famous books of mathematics. 9. In recent years men have improved on Euclid's work. 10. Today geometry includes not only the study of the shape and size of the earth and all things on it,

but also the study of relations between geometric objects. 11. The most fundamental idea in the study of geometry is the idea of a point. 12. We will not try to define what a point is, but instead discuss some of its properties. 13. Think of a point as[1] an exact location in space. 14. You cannot see a point, feel a point, or move a point, because it has no dimensions. 15. There are points (locations) on the earth, in the earth, in the sky, on the sun, and everywhere in space. 16. When writing about points, you represent the points by dots. 17. Remember the dot is only a picture of a point and not the point itself. 18. Points are commonly referred to[5] by using capital letters. 19. The dots below mark points and are referred to as point *A*, point *B*, and point *C*.



Lines and Line Segments

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

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

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

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

Exercise 7

Follow the speaker as he is reading the words. Pay special attention to the stress.

'meaning, 'measure, 'object *n*, building, 'Egypt, 'subject, *n*, 'volume, 'problem, 'knowledge, 'sequence, 'famous, 'recent, 'also, 'study, 'point, 'picture, 'common, 'paper, 'figure, 'segment, 'ruler;

e'xact, pre'sent, re'fer, be'low, in'clude, be'tween, com'plete, ex-'tend, a'gree, ap'ply, im'prove, re'late, ob'ject *v,* sub'ject *v;*

'probably, ge'ometry, 'pyramid, 'property, 'capital, 'separate, 'multiply, 'calculate, 'definite, 'transitive, mys'terious, in'definite.

Exercise 8

Repeat these words after the speaker. Guess the meaning of the words in italics.

mysterious – *mystery n – to mystify;* measure *n, v* – measurement – *measurable – measurability – immeasurable;* to improve – *improvement;* to imagine – *imagination – imaginable;* to extend – *extensive;* complete *a – to complete – completion;* to include – *to exclude – inclusion;* shape *n – to shape – shapeless;* to move – *movable – immovable;* sun – *sunless;* to refer – *reference;* location – *to locate – local – locally,* size – *sizeless;* between – *betweenness;* dimension – *demensional.*

Exercise 9

Change the following according to the model.

Sp.: I like *to get up* early, (he)

St.: He also likes *getting up* early.

a) 1. He begins *to work* at 9 o'clock, (we). 2. I expect *to see* him, (she). 3. We expect *to go* there today, (I). 4. She continued *to translate* the text, (they).

Sp.: *Do not tell* him about it.

St.: *It's no use telling* him about it.

b) 1. *Do not go* there now. 2. *Do not begin* the experiment to morrow. 3. *Do not speak* to him. 4. *Do not attend* that seminar. 5. *Do not discuss* it with her.

Sp.: I am afraid *to go* there.

St.: Are you really afraid *of going* there?

c) 1. I am afraid *to tell* him this news. 2. He is afraid *to take* his exam. 3. She is afraid *to speak* to him. 4. I am afraid *to begin* the work.

Sp.: *Was* he *able to come* in time?

St.: Yes, he *succeeded in coming* in time.

d) 1. *Was* she *able to present* her thesis? 2. *Were* they *able to publish* that article? 3. *Were* you *able to find* the data? 4. *Will* he *be* *able to solve* the problem? 5. *Will* she *be able to change* the program?

Sp.: It is important *to know* these rules.

St.: Yes, *knowing* these rules is important.

e) 1. It is important *to discuss* the question today. 2. It was necessary *to produce* that information. 3. It will be interesting *to find* that result. 4. It is important to *locate* the point in space.

Sp.: He *multiplied* the numerals and found the product.

St.: He found the product *by multiplying* the numerals.

f) 1. He *drew* a straight line and *cut* the segment. 2. She *performed* the operation of subtraction and found the difference. 3. I *used* a ruler to draw a straight line.

Exercise 10

Follow the speaker as he is reading the text 'The Meaning of Geometry'.

Exercise 11

Listen to the questions. Write down your answers (+ -)

1. Is geometry an old subject? 2. Did geometry begin in England? 3. Were Egyptians mostly concerned with the practical use of geometry? 4. Did the knowledge of Egyptians spread to Greece? 5. Is Euclid's book called *Elements* famous? 6. Does geometry include only the study of the shape and size of objects? 7. Is the idea of a point fundamental in geometry? 8. Can one feel, see, move or hold a point? 9. Has a point any dimensions? 10. Are points represented by dots? 11. Does a line segment include its endpoints?

Exercise 12

Read these words and stress them properly.

expect, dislike, geometry, single, agree, simple, capital, indicate, about, specify, famous, fundamental, property, university, planet, contain, exist, discuss, conclude, knowledge, indefinite, refer, communication, mechanical, dissertation, academy, academic.

Exercise 13

Go back to Exercise 9. Read the words and give Russian equivalents of the words in italics.

Exercise 14

Ask your class-mates questions about the sentences of Exercise 5 you have written at home.

Exercise 15

Listen to your teacher's statements and say whether they are true or false. If you think they are false, say why. Begin your statements with: 'I am afraid you are wrong', 'As far as I know' 'I don't think so'.

Exercise 16

Before you begin working with the text 'Points and Lines' read these words and guess their meaning.

'alphabet n, 'definite *a,* lo'cation, sub'set *n,* to lo'cate, to 'differ (from), 'abstact a.

You can guess the meaning of the words: 'arrow' ['ærou] *n,* 'ray' *n* and 'vertex' *n from the context.*

Read these notes.

1) serve as models – служат в качестве моделей;
2) have in common – имеют общее

Read the text and render it either in Russian or in English.

Points and Lines

1. The world around (вокруг) us contains many physical objects from which mathematicians have developed geometric ideas and these objects can serve as models[1] of the geometric figures. 2. The edge (ребро) of a ruler, or an edge of this page is a model of a line. 3. We have agreed to use the word line to mean straight line. 4. A geometric line is the property these models of lines have in common[2] it has length but no thickness (толщина) and no width; it is an idea. 5. A particle (частица) of dust (пыль) in the air (воздух), or a dot on a piece of paper is a model of a point. 6. A point is an idea about an exact location; it has no dimensions. 7. We usually use letters of the alphabet to name geometric ideas. 8. For example, we speak of the following models of points as point *A*, point *B*. and point C.

.A

.B

.C

9. We speak of the following as line AB or line BA.

10. The arrows on the model above indicate that a line extends indefinitely in both directions. 11. Let us agree to use the following figure to name a line. The symbol $\overleftrightarrow{AB}$ means line $\overleftrightarrow{AB}$. 12. Can you locate a point *C* between A and *B* on the drawing of $\overleftrightarrow{AB}$ above? 13. Could you locate another point between *B* and C? 14. Could you continue this process indefinitely? Why? 15. Because between any two points on a line there is another point. 16. A line consists of (состоит из) a set of points. 17. Therefore, a piece (часть, кусок) of the line is a subset of the line. 18. There are many kinds of subsets of a line. 19. The subset (piece) of $\overleftrightarrow{AB}$ shown below is called a line segment as you might remember from the above.

20. The symbol for line segment *AB* is marked as follows: $\overline{AB}$ (segment AB). 21. You already know that points A and *B* are the endpoints of the segment. 22. A line segment is a set of points consisting of the two endpoints and all of the points on the line between them. 23. Notice that the symbol for a line segment ($\overline{AB}$) contains the letters naming the endpoints, that is, only the endpoints need to be given while naming a line segment.

24. How does a line segment differ from a line? 25. Could one measure the length of a line, of a line segment? 26. You can judge ([dʒʌdʒ] судить) from the above that a *line segment* has definite length but *a line* extends indefinitely in each of its two directions.

27. Another important subset of a line is called a ray. 28. The part of $\overleftrightarrow{AB}$ shown in black (черный) below is ray *AB* and the symbol for it is a one way arrow over $\overline{AB}$.

29. A ray has 'infinite (бесконечный) length and only one endpoint which is called a vertex ['və:təks].

30. Traditionally, the symbol *AB* in geometry might represent a line, a line segment, or a ray. 31. We draw the figure that is to be named above the letters $(\overline{AB}, \overline{AB}, \overline{AB})$ to eliminate (исключить) the possible ambiguity ([,æmbi'gju:iti] двусмысленность).

32. It should be emphasized (['emfəsaiz] подчеркивать) that in the drawings given above you see pictures of a line, a line segment, and a ray and not the geometric ideas they represent. 33. Let us agree that to draw a geometric figure means to draw its picture.

34. Obviously (['ɔbviəsli] очевидно), if a geometric figure, being formed by a set of points, is an 'abstract 'concept, it cannot be seen.

35. Therefore we draw pictures of geometric figures just as we write numerals for numbers.

Exercise 17

Translate these combinations of words.

The location of the given point; the vertex of *MN;* the arrows indicating both directions; definite length; the people around us; the thickness and the width of this geometric object; particles of dust in the air; the edge of this book; does not extend indefinitely; a geometric figure; words consist of letters; sentences consist of words; a piece of good luck; the book contains a lot of pictures; to judge correctly; to differ in many-respects from; to eliminate wars; to avoid the ambiguity; to emphasize certain facts; obvious things.

Exercise 18

Compare the ***ing****-forms in these sentences and translate the sentences.*

1. Measuring land is impossible without special instruments. 2. Measuring the length of a segment one must use a ruler. 3. He is defining the volume of a geometric object. 4. The teacher spoke of defining volumes. 5. Geometry presented practical ways for obtaining information about the size and shape of various objects. 6. Obtaining that information we shall be able to extend our knowledge of space.

Exercise 19

Write questions to which the given sentences are the answers.

1. We use the edge of a ruler for drawing a line. 2. He continued-preparing for the conference. 3. Those particles have much in

common. 4. The direction is shown by the arrow. 5. Dust particles move in all directions in the air. 6. The book consists of six chapters. 7. A particle may serve as a model of the Earth.

Exercise 20

Listen to the speaker as he is reading the words of the text 'Points and Lines' and repeat them.

alphabet, definite, infinite, to differ, abstract, to locate, arrow, ray, vertex, to serve, edge, dust, common, thickness, particle, air, piece, judge, exact, indefinitely, to consist, subset, to contain, black, ambiguity, emphasize *v*, eliminate, obviously, to form.

Exercise 21

Listen and repeat. Guess the meaning of the italicized words.

Alphabet – *alphabetic;* definite – *indefinite a;* judge *v* – *judgement;* infinite – *finite;* to serve – *service;* common – commonly – *uncommon;* air – *airless – to air;* exact – *exactly – exactness;* to contain – *container:* black – *to blacken – blackness;* ambiguity – *ambiguous – inambiguous* obviously – *obvious;* to form – *formal – informal – formality – formalize – to deform – deformity;* object *n* – *object v – objection.*

Exercise 22

Listen to the speaker's questions about the text and write down 'yes' or 'no' answers.

1. Does the world around us contain physical objects? 2. Can these objects serve as models of the geometric figures? 3. Can the edge of a ruler serve as a model of a line? 4. Has a line any thickness? Has it length? 5. Is a point an idea of exact location? 6. Do we usually use letters of the alphabet to name geometric objects? 7. Can you locate as many points as you like between any two points? 8. Is a segment a subset of a line? 9. Does a line segment consist only of two endpoints? 10. Has a line -segment definite length?

Exercise 23

Define the functions of the ***ing****-forms.*

1. Computers, like the one pictured in this book, are capable of solving systems with a hundred or more unknowns, if necessary.

2. They are concerned with applying their knowledge of the subject to solving these problems. 3. Drawing a correct conclusion is not always easy. 4. Seeing, feeling, or moving a point is impossible-since a point has no dimensions. 5. Seeing a straight line we know-it is a geometric figure. 6. We usually use letters of the alphabet for naming geometric ideas. 7. I am naming the point by the capital letter *A*.

Exercise 24

a) Speak on the meaning of geometry;

b) Why do we say that the most fundamental idea of geometry is the idea of a point': Prove it:

c) Speak on points and lines in greater detail.

Exercise 25

Say the following in English (use the Gerund).

1. Мы рассчитываем улучшить систему. 2. Представить такую геометрическую фигуру не трудно. 3. Мы обсуждали включение этой главы. 4. Не зная размеров предмета, нельзя определить его объем. 5. Студенты начали изучение нового текста. 6. Задача состоит в изменении формы. 7. Продолжайте чертить линию в этом направлении.

Lesson 3

Words to be Learned

Exercise 1

Read these international words and guess their meaning.

to deduce [di'dju:s], interior [in'tiəriə] *n*, exterior [eks'tiəriə] n, to classify ['klæsifai], hypotenuse [hai'pɔtinju:z] *n*, start *n*, *v*, base *n*, *v*, 'polygon *n*, parallel ['pærələl] *a*, parallelogram [,pærə'leləgræm] *n*, congruent ['kɔngruənt] *a*, rhombus ['rɔmbəs] *n*, separate ['seprit] a.

Exercise 2

Read these words

originate [ə'ridʒineit]	брать начало	plane	плоскость
angle ['æŋgl]	угол	'middle	1. середина; 2. средний
though [ðou]	хотя	'boundary	граница
acute [ə'kju:t]	острый	equilateral [i:kwi'lætərəl]	равносторонний
lie [lai] (lay [lei], lain [lein])	лежать	isosceles [ai'sɔsili:z]	равнобедренный
leg	1. сторона; 2. катет; 3. ножка (циркуля)	right	1. прямой; 2. правый; 3. правильный
obtuse [əb'tuj:s]	тупой	quadrilateral [,kwɔdri'lætərəl]	четырехсторонний
triangle ['traiæŋgl]	треугольник	rectangle ['rek'tæŋgl]	прямоугольник
dis'tinct	отчетливый	to cross	пересекать
'evident	очевидный	to inter'sect	пересекаться
to occur [ə'kə:]	иметь место, случаться	to en'close	заключать в себе
frequently ['fri:kwəntli]	часто	outside	1. *adv* снаружи; 2. *a* наружный
degree [di'gri:]	1. градус; 2. степень		

Exercise 3

Translate these sentences.

1. It is evident that there is no hope of our finding a proper solution to the problem at present. 2. We insisted on their following the usual procedure. 3. Without having improved on the properties of this material one cannot expect getting better results. 4. I knew

nothing of their having completed the experiment. 5. This results in the product of two or more factors being equal to zero. 6. Besides its being used as an everyday word the term 'work' has a special meaning in mechanics. 7. I did not know anything about your science adviser having spoken at the international congress on mechanics.

Exercise 4

Ask questions to which the given sentences could be the answers.

1. It is possible to deduce, therefore, that between any two points on a line there is another point. 2. Two lines originating from the same point form an angle. 3. The point where these lines originate is called a vertex. 4. An angle of 35° is an acute angle. 5. An angle having 105° is an obtuse angle. 6. A triangle is a closed geometric figure having three sides. 7. A triangle having all sides of equal length is referred to as an equilateral triangle. 8. A triangle containing one right angle is referred to as a right triangle.

Exercise 5

a) *Read the text below without consulting the dictionary;*

b) *After you have read the text, analyze the sentences you find difficult to understand and translate them.*

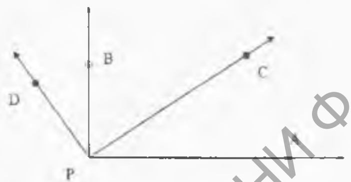
Rays, Angles, Simple Closed Figures

1. You certainly remember that by extending a line segment in one direction we obtain a ray. 2. Below is a picture of such an extension.

3. The arrow indicated that you start at point *M*, go through point *N*, and on without end. 4. This results in what is called ray *MN*, which is denoted by the symbol $\overline{MN}$. 5. Point *M* is the endpoint in this case. 6. Notice that the letter naming the endpoint of a ray is given when first naming the ray.

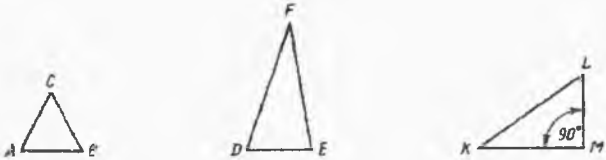
7. From what you already know you may deduce that drawing two rays originating from the same endpoint forms an angle. 8. The common point of the two rays is the vertex of the angle.

9. Angles though open figures, separate the plane into three distinct sets of points: the interior, the exterior, and the angle. 10. The following symbol ∠ is frequently used in place of the word *angle*. 11. The angle pictured above could be named in either of the following ways: a) angle *LMN* (or ∠*LMN*); b) angle *NML* (or ∠*NML*). 12. The letter naming the vertex of an angle occurs as the middle letter in naming each angle. 13. Look at the drawing below.



14. Ray *PA* ($\overline{PA}$) and ray *PB* ($\overline{PB}$) form a right angle, which means that the angle has a measure of 90° (degrees). 15. Since $\overline{PC}$ (except for point *P*) lies in the *interior* of ∠*APB*, we speak of ∠*CPA* being less than a right angle and call it an acute angle with a degree measure less than 90°. 16. Since $\overline{PD}$ (except for point *P*) lies in the exterior of ∠*LAPB*, we say that ∠*APD* is greater than a right angle and call it an obtuse angle with a degree measure greater than 90°. 17. A simple closed figure is any figure drawn in a plane in such a way that its boundary never crosses or intersects itself and encloses part of the plane. 18. The following are examples of simple closed figures. 19. Every simple closed figure separates the plane into three distinct sets of points. 20. The interior of the figure is the set of all points in the part of the plane enclosed by the figure. 21. The exterior of the figure is the set of points in the plane which are outside the figure. 22. And finally, the simple closed figure itself is still another set of points.

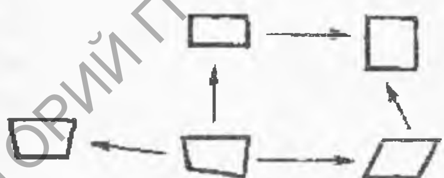
23. A simple closed figure formed by line segments is called a polygon. 24. Each of the line segments is called a side of the polygon.



25. Polygons may be classified according to the measures of the angles or the measure of the sides. 26. This is true of triangles – geometric figures having three sides – as well as of quadrilaterals, having four sides.

27. In the picture above you can see three triangles.

28. ΔABC is referred to as an equilateral triangle. 29. The sides of such a triangle all have the same linear measure. 30. ΔDEF is called an isosceles triangle which means that its two sides have the same measure. 31. You can see it in the drawing above. 32. ΔLMK being referred to as a right triangle means that it contains one right angle. 33. In ΔMKL, $\angle M$ is the right angle, sides MK and ML are called the legs, and side KL is called the hypotenuse. 34. The hypotenuse refers only to the side opposite to the right angle of a right triangle. Below you can see quadrilaterals.



35. A parallelogram is a quadrilateral whose opposite sides are parallel. 36. Then the set of all parallelograms is a subset of all quadrilaterals. Why? 37. A rectangle is a parallelogram in which all angles are right angles. 38. Therefore we can speak of the set of rectangles being a subset of the set of parallelograms. 39. A square is a rectangle having four congruent sides as well as four right angles. 40. Is every square a rectangle? Is every rectangle a square? Why or why not? 41. A rhombus is a parallelogram in which the four sides are congruent. 42. Thus, it is evident that opposite sides of a rhombus are parallel and congruent. 43. Is defining a square as

a special type of rhombus possible? 44. A trapezoidal has only two parallel sides. 45. They are called the bases of a trapezoidal.

Exercise 6

Follow the speaker as he is reading the words. Mind the stress.

'angle, 'vertex, 'measure, 'square, 'follow, 'aspect, 'area, 'system, 'neither, 'valid, 'clear, 'image, 'logic, 'surface, 'certain, a'cute, con'cern, re'fer, con'tain, ex'ist, dis'cuss, as'sume, dis'tinct, di'rect, wi'thin, wi'thout, oc'cur, di'gree, en'close, 'opposite, 'postulate *a,* 'parallel, 'usual, 'special, 'century, 'realize, 'congruent, ex'terior, hy'potenuse, equi'lateral, in'tuitive, in'terior.

Exercise 7

Read these words after the speaker and guess the meaning of the italicized words.

to deduce – *deductive* – *deduction;* to classify – *classification;* congruent – *congruous* – *congruence;* to separate – *separately* – *separation;* to originate – *origin* – *original;* distinct – *distinction* – *indistinct* – *distinctly* – *indistinctly;* triangle – *triangular;* rectangle – *rectangular;* to occur – *occurence;* outside – *inside;* to intersect – *intersection;* base – *baseless;* opposite – *to oppose* – *opposition;* measure – *measurement* – *measurable* – *immeasurable.*

Exercise 8

Listen to the questions and write down your answers (+ -).

1. Do you remember how we form a ray? 2. Do we extend a line segment in two directions when we form a ray? 3. Will two rays originating from the same endpoint form an angle? 4. Do angles separate the plane into 2 distinct sets of points? 5. Is the obtuse angle less than the right angle? 6. Is the right angle greater than the acute angle? 7. Are triangles classified according to the measures of their angles? 8. Can any triangle be referred to as equilateral? 9. Does a right triangle contain three right angles? 10. Are opposite sides of a quadrilateral always parallel?

Exercise 9

Read these words and stress them properly.

origin, triangle, deduce, exterior, opposite, certainly, segment *n,* below, above, define, enclose, special, extend, extension, refer, concern, hypotenuse, parallel, classify, acute, obtuse, equilateral, rectangle, evident, intersect, occur, middle, boundary, distinct.

Exercise 10

Read these groups of words and translate them.

an uncertain position, to direct the investigation, direct methods, formalization of the results obtained, deductive reasoning, the immeasurable greatness, to lessen the importance, the evidence of these facts, the occurrence of such phenomena, the validity of his statement, the acuteness of the situation.

Exercise 11

Listen to your teacher's statements and say whether they are true or false. If you disagree, begin with the words: 'I am afraid, it is wrong', 'As is known'. 'As far as I know'.

Exercise 12

Before you begin working with the text 'Something about Euclidean and Non-Euclidean Geometries' read these words and guess their meaning.

postulate ['pɔstjulit] n, ['pɔstjuleit] *v*, variation, in'tuitively [in'tju:itivli], diagonal [dai'æggənəl] n, ellip'soidal *n*, essentially [i'senʃəli], para'doxical situation, reason ['ri:zən] *n*, pseudospheri-cal [,psjudo'sferikəl], de'ductive, valid.

Read these notes.

1) so-called – так называемый;
2) at least – по крайней мере;
3) conclusions which may be drawn – выводы, которые можно сделать;
4) so far – до сих пор;
5) neither ... nor – ни ... ни;
6) it should be borne in mind – следует помнить;
7) conclusions are just as valid – выводы столь же справедливы;
8) even though – даже хотя.

Read the following text, say into how many logical parts it could be divided and render it either in English or in Russian.

Something about Euclidean and Non-Euclidean Geometries

1. It is interesting to note that the existence of the special quadrilaterals discussed above is based upon the so-called[1] parallel postulate of Euclidean geometry. 2. This postulate is now usually stated as follows: Through a point not on line *L*, there is no more than one line parallel to *L*. 3. Without assuming (не допуская) that there exists at least[2] one parallel to a giver line through a point not on the given line, we could not state the definition the special quadrilaterals which have given pairs of parallel sides. 4. Without the assumption that there exists no more than one parallel to a given line through a point not on the given line, we could not deduce the conclusion we have stated (сформулировали) for the special quadrilaterals. 5. An important aspect of geometry (or any other area of mathematics) as a deductive system is that the conclusion which may be drawn[3] are consequences (следствие) of the assumption's which have been made. 6. The assumptions made for the geometry we have been considering so far[4] are essentially those made by Euclid in Elements. 7. In the nineteenth century, the famous mathematicians Lobachevsky, Bolyai and Riemann developed non-Euclidean geometries. 8. As already stated, Euclid assumed that through a given point not on a given line there is no more than one parallel to the given line. 9. We know of Lobachevsky and Bolyai having assumed independently of (независимо/от) one another that through a given point not on a given line there is more than one line parallel to the given line. 10. Riemann assumed that through a given point not on a given line there is no line parallel to the given line. 11. These variations-of the parallel postulate have led (привели) to the creation (создание) of non-Euclidean geometries which are as internally (внутренне): consistent (непротиворечивы) as Euclidean geometry. 12. However, the conclusions drawn in non-Euclidean geometries are often completely inconsistent with Euclidean conclusions. 13. For example, according to Euclidean geometry parallelograms and rectangles (in the sense (смысл) of a parallelogram with four 90-degree angles) exist; according to the geometries of Lobachevsky and Bolyai parallelograms exist but rectangles do not; according to the geometry of Riemann neither parallelograms nor[5] rectangles exist. 14. It should be borne in mind[6] that the conclusions of non-Euclidean geometry are just as valid[7] as those of Euclidean geometry, even though[8] the

conclusions of non-Euclidean geometry contradict (противоречат) those of Euclidean geometry. 15. This paradoxical situation becomes intuitively clear (ясно) when one realizes (понимаем) that any deductive system begins with undefined terms. 16. Although (хотя) the mathematician forms intuitive images (образы) of the concepts to which the undefined terms refer, these images are not logical necessities (необходимость). 17. That is, the reason for forming these intuitive images is only to help our reasoning (рассуждение) within a certain deductive system. 18. They are not logically a part of the deductive system. 19. Thus, the intuitive images corresponding to the undefined terms straight line and plane are not the same for Euclidean and non-Euclidean geometries. 20. For example, the plane of Euclid is a flat (плоский) surface (поверхность); the plane of Lobachevsky is a saddle-shaped (седлообразный) or pseudo-spherical surface; the plane of Riemann is an ellipsoidal or spherical surface.

Exercise 13

Change these sentences according to the model.

He does not like speaking about it *(she, the man)*

He does not like *her* speaking about it.

He does not like *the man's* speaking about it.

Lesson 4

Words to be Learned

Exercise 1

Read these international words and guess their meaning.

radius *(sing)* ['reidiəs] *n,* radii *(pl)* ['reidiai], symbolize ['simbəlaiz], to fix, diameter [dai'æmitə], chord [kɔ:d] *n,* 'centre *n, v.*

Exercise 2

Read these words.

sharp	острый	circle ['sə:kl]	круг
compass ['kʌmpəs]	циркуль	equidistant ['i:kwi'distənt]	равноудаленный

sheet	лист (бумаги)	arc	дуга
enclose [in'klouz]	1. заключать; 2. окружать	through [θru:]	1. через; 2. сквозь
circumference [sə'kʌnfərəns]	окружность	curve ['kə:v]	*1. n* кривая линия; *2. v* изгибать(ся)
entire [in'taiə]	весь	twice [twais]	дважды
'matter	материя	designate ['dezigneit]	обозначать
'slightly ['slaitli]	слегка	discover [dis'kʌvə]	обнаруживать
ratio ['reiʃiou]	соотношение	path [pa:θ]	путь
fortunately ['fɔ:tʃənətli]	к счастью		

Exercise 3

State the functions and the forms of the Participles. Translate these sentences.

1. Any expression like $x + 5$ or $2x - 3$ containing two or more terms may be called a polynomial which means an expression with many parts. 2. Such quantities as 5, x, $a - 1$, and $n^2 + 1$ are prime, since they are not divisible by any quantities excepting themselves and 1. 3. In problems dealing with abstract numbers, negative answers are just as acceptable as positive ones. 4. Think of this point as lying not on the line.

Exercise 4

Ask questions to which the sentences below could be answers.

1. A circle can easily be drawn with the help of a compass. 2. These points are fixed. 3. The line segment *AR* joins point *A* of the circle with its centre. 4. A circumference is another name for a circle. 5. A circumference encloses part of a plane. 6. Yes, points *A* and *B* representing the opposite points of a circle are equidistant from the center. 7. The diameter of a circle passes through the centre. 8. They considered the matter carefully. 9. The ratio has been slightly changed. 10. Yes, the article is twice as long as his.

Exercise 5

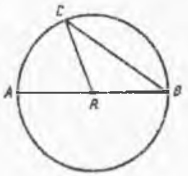
a) Read the text below;

b) Analyze the sentences you find difficult to understand;

c) Read the same text again. Make sure you understand it in detail.

Circles

1. If you hold the sharp end of a compass fixed on a sheet of paper and then turn the compass completely around you will draw a curved line enclosing parts of a plane. 2. It is a circle. 3. A circle is a set of points in a plane each of which is equidistant, that is the same distance from some given point in the plane called the center. 4. A line segment joining any point of the circle with the center is called a radius). 5. In the figure above R is the center and RC is the radius. 6. What other radii are shown? 7. A chord of a circle is a line segment whose endpoints are points on the circle. 8. A diameter is a chord which passes through the center of the circle. 9. In the figure above AB and BC are chorus and AB is a diameter. 10. Any part of a circle containing more than one point forms an arc of the circle. 11. In the above figure, the points C and A and all the points in the interior of $\angle ARC$ that are also points of the circle are called arc AC which is symbolized as $\cup AC$. 12. $\cup ABC$ is the arc containing points A and C and all the points of the circle which are in the exterior of $\angle ABC$. 13. Instead of speaking of the perimeter of a circle, we usually use the term circumference to mean the distance around the circle. 14. We cannot find the circumference of a circle by adding the measure of the segments, because a circle does not contain any segments. 15. No matter how short an arc is, it is curved at least slightly. 16. Fortunately mathematicians have discovered, that the ratio of the circumference (C) to a diameter *(d)* is the same for all circles. This ratio is expressed $\frac{C}{d}$.



17. Since $d = 2r$ (the length of a diameter is equal to twice the length of a radius of the same circle), the following denote the same ratio.

$$\frac{C}{d} = \frac{C}{2r} \text{ since } d = 2r.$$

18. The number C/d or $C/2r$, which is the same for all circles, is designated by π. 19. This allows us to state the following:

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

20. By using the multiplication property of equation, we obtain the following:

$$C = \pi d \text{ or } C = 2\pi r.$$

Exercise 6

Which sentences in the text answer these questions?

1. How can one draw a curved line enclosing part of a plane? 2. In what geometric figure are all the points equidistant from the center? 3. Which line segment passes through the center of the circle? 4. Is a short arc also curved? 5. What have mathematicians discovered about the ratio of the circumference C to the diameter d? 6. Do we usually speak of a perimeter of a circle or do we rather use the term circumference? Why?

Exercise 7

Follow the speaker as he is reading the words. Mind the stress.

'compass, 'circle, 'center, 'figure, 'fortune, 'ratio, 'segment, 'symbol, 'distance, 'cover, 'equal; con'tain, a'bove, al'low, ob'tain, be'cause, de'note; en'close, in'stead, a'round, en'circle, dis'cover; 'radius, 'radii, di'ameter, pe'rimeter, in'terior, ex'terior, 'property.

Exercise 8

Read these words after the speaker and guess the meaning of the italicized words.

radius – *radial;* sharp – *sharply – to sharpen;* center (centre) *n – to center* – central – *centralize – to concentrate;* circle – circular – *to encircle;* fortunately – *fortune n* – unfortunately – *misfortune n;* to discover – discovery – *undiscovered;* to express – *expressive* – expression – *expressionless;* same – *sameness;* to add – addition – *additive;* slightly – *slight a;* part *n, v* – *partly* – *partial;* curve – *curviture.*

Exercise 9

Listen to the questions below and give 'yes' or 'no' answers.

1. Can one draw a circle by using a compass? 2. Are all the points in a circle equidistant from the center? 3. Does a diameter contain two radii? 4. Is the center of the circle one of the endpoints of the radius? 5. Is a chord curved? 6. Is an arc curved? 7. Can a chord serve as a

diameter? 8. Can we find the measure of the circumference by adding the measure of the segments? 9. Does a circle contain any segments? 10. Does the formula $\frac{C}{d}=\pi$ mean the same as $\frac{C}{2r}=\pi$?

Lesson 5

Words to be Learned

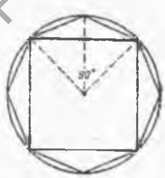
circumference	окружность	concept	понятие
approach	подход	limit	предел
to define	определять	approximation	приближение

Exercise 1

Read the text below.

Circumference of a Circle

1. In traditional approaches (подход) to mathematics, the circumference of a circle has not always been clearly defined. 2. That is, sometimes the circle itself was called the circumference, and at other times, the measure of the distance around the circle was called the circumference. 3. Here we shall define the circumference as the perimeter of the circle, in other words[1], the measure of the entire path (весь путь) formed by the circle. 4. This definition is symbolized by the formula $C=2\pi d$ or the formula $C=2\pi r$. 5. There exist more precise (точные) definitions of a circumference. 6. To arrive at this more precise definition[2], it is necessary to introduce the concept of limits. 7. By using the limit concept, the circumference of a circle may be defined as the limit of the perimeter of an inscribed (вписанного) regular polygon. 8. To illustrate this, we can first inscribe a square in a circle. 9. The sum of the sides of the square will be an approximation of the circumference of the circle. 10. Then, bisecting the central angles, which are subtended (стянуты) by the sides of the square we can inscribe a regular octagon. 11. The sum of the sides of the octagon will be a closer approximation of the circumference. 12. Next, bisecting the central angles subtended by the sides-of the octagon, we can inscribe a regular 16-gon. 13. The sum of the sides of the 16-gon will be an even closer



approximation of the circumference. 14. By a similar process we can then inscribe a regular 32-gon and 64-gon, and so on. 15. Clearly the sum of *n* sides of an inscribed regular *n*-gon can be made to approximate the circumference of the circle as closely (близко) as desired by choosing *n* sufficiently (достаточно) large. 16. Thus the circumference of a circle may be defined as the limit of the perimeter of an inscribed regular *n*-gon as *n* increases.

Exercise 2

Translate these combinations of words.

to introduce new ideas and concepts; clearly defined; unlimited possibilities; the closest approximation; at regular intervals; precise calculations; an approximate number; approximately 5 000 000 people; an irregular octagon; can be illustrated experimentally; the perimeter of the polygon; subtended angles; an inscribed quadrilateral; sufficient time; insufficient information; to bisect an angle; an unusual approach; to approach closely; a traditional understanding.

Exercise 3

Ask questions to the following sentences.

1. This is a traditional approach to the solution of such equations. 2. Having obtained sufficient information the scientists continued research. 3. I insist on his making precise measurements. 4. The entire situation was quite clear. 5. The words 'way' and 'path' sometimes mean the same thing. 6. We are to limit our discussion to only a few questions. 7. Yes, all the foreign delegates have already arrived. 8. Yes, the concepts introduced should be considered in detail.

Exercise 4

Listen to the speaker as he is reading the new words of the text 'Circumference of a Circle'.

formula, traditional, to introduce, limit *n, v,* approximation, approximate *a,* to approximate, to bisect, regular, octagon, to illustrate, to subtend, to inscribe, sufficient, approach *n, v,* closely.

Exercise 5

Listen and repeat. Guess the meaning of the words in italics.

circle – *circular* – *to encircle;* clear – *clearly* – *to clarify;* entire – *entirely;* to exist – *existence* – *existent;* to arrive – *arrival n;*

precise – *precision – precisely;* necessary – *necessity – unnecessary;* limit *n, v – limited – unlimited – limitless – limitation;* regular – *regularly – regularity – Irregular;* to illustrate – *illustration – illustrative;* square – *squared;* to approximate – *approximation – approximately;* octagon – *octagonal;* close – *to disclose – closure – closeness – closely;* sum *n, v – summarize;* similar – *similarly – similarity;* to desire – *undesired – desirable – undesirable;* sufficiently – *sufficient – insufficient.*

Exercise 6

Listen to the questions about the text and write 'yes' or 'no' answers.

1. Can one define the circumference of a circle? 2. Has the circumference of a circle been always clearly defined? 3. Is there only one definition of a circumference? 4. Can we define the circumference as the perimeter of the circle? 5. Is the definition of the circumference symbolized by the formula $C = 2\pi d$? 6. Is the limit concept necessary for a precise definition? 7. Can one inscribe only a limited number of polygons in a circle? 8. Is the radius twice as long as the diameter? 9. Is the diameter twice as long as the radius? 10. Can one continue the process of bisecting the central angle indefinitely? 11. Is the area of the inscribed polygon greater than the area of the circle? 12. Is the area of the circle less than the area of the inscribed polygon?

Exercise 7

Answer your teacher's questions in connection with the text.

Exercise 8

Discuss both texts of the lesson.

Exercise 9

Say the following in English.

иными словами; это определение представлено следующей формулой; существует более точное определение; независимо от того как; путем деления угла пополам; можно легко вписать; дважды в месяц; прийти к заключению; к счастью для математиков; традиционный подход к решению таких задач; это соотношение выражено; поскольку длина диаметра вдвое больше длины радиуса; вместо того, чтобы определять; чтобы проиллюстрировать это, мы можем рассмотреть; периметр круга может быть измерен; с помощью аналогичной процедуры; вписанный правильный *n*-угольник.

Lesson 6

Words to be Learned

Exercise 1

Read these words.

stretch	1. вытягивать(ся); 2. растягивать(ся)	area	площадь
dash	1. черточка, 2. штрих	relationship [ri'leiʃənʃip]	1. взаимоотношение; 2. соотношение
unit ['ju:nit]	1. единица; 2. единица измерения	'credit	1. *n* доверие, вера; 2. заслуга; 3. *v* приписывать (заслугу)

Notes

1) Pythagoras... is credited with – Пифагору... приписывают заслугу;

2) to begin with – изначально, для начала.

Exercise 2

Ask questions using the question-words in brackets.

1. Pythagoras succeeded in stating this relationship, (in what way). 2.You have to stretch these ropes, (why). 3. I know several proofs of this theorem, (who). 4. This region of the area is dashed, (why). 5. Two right triangles are to be constructed in the given region, (how). 6. The sum of the four triangles makes the total area of this square, (why).

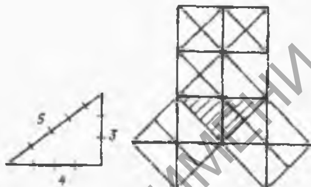
Exercise 3

Read the text below. Analyze the sentences you find difficult to understand and translate them.

The Pythagorean Property

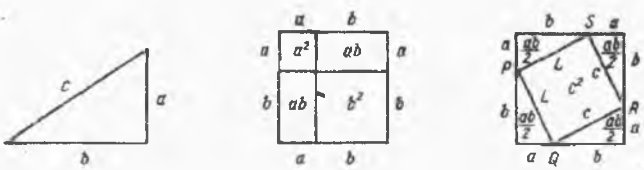
1. The ancient Egyptians discovered that in stretching ropes of lengths 3 units, 4 units and 5 units as shown below, the angle formed

by the shorter ropes is a right angle. 2. The Greeks succeeded in finding other sets of three numbers which gave right triangles and were able to tell without drawing the triangles which ones should be right triangles, their method being as follows. 3. If you look at the illustration you will see a triangle with a dashed interior. 4. Each side of it is used as the side of a square. 5. Count the number of small triangular regions in the interior of each square. 6. How does the number of small triangular regions in the two smaller squares compare with the number of triangular regions in the largest square? 7. The Greek philosopher and mathematician Pythagoras noticed the relationship and is credited with[1] the proof of this property known as the Pythagorean Theorem or the Pythagorean Property. 8. Each side of a right triangle being used as a side of a square, the sum of the areas of the two smaller squares is the same as the area of the largest square.



Proof of the Pythagorean Theorem

9. We should like to show that the Pythagorean Property is true for all right triangles, there being several proofs of this property. 10. Let us discuss one of them. 11. Before giving the proof let us state the Pythagorean Property in mathematical language. 12. In the triangle above, c represents the measure of the hypotenuse, and a and b represent the measures of the other two sides. 13. If we construct squares on the three sides of the triangle, the area-measure will be a^2, b^2 and c^2. 14. Then the Pythagorean Property could, be stated as follows: $c^2 = a^2 + b^2$. 15. This proof will involve working with areas. 16. To prove that $c^2 = a^2 + b^2$ for the triangle above, construct two squares each side of which has a measure $a + b$ as shown above.



17. Separate the first of the two squares into two squares and two rectangles as shown. 18. Its total area is the sum of the areas of the two squares and the two rectangles.

$$A = a^2 + 2ab + b^2.$$

19. In the second of the two squares construct four right triangles. 20. Are they congruent? 21. Each of the four triangles being congruent to the original triangle, the hypotenuse has a measure *c*. 22. It can be shown that *PQRS* is a square, and its area is c^2. 23. The total area of the second square is the sum of the areas of the four triangles and the square *PQRS*. $A = c^2 + 4\left(\frac{1}{2}ab\right)$. 24. The two squares being congruent to begin with[2], their area measures are the same. 25. Henee we may conclude the following:

$$a^2 + 2ab + b^2 = c^2 + 4\left(\frac{1}{2}ab\right);$$

$$(a^2 + b^2) + 2ab = c^2 + 2ab.$$

26. By subtracting *2ab* from both area measures we obtain $a^2 + b^2 = c^2$ which proves the Pythagorean Property for all right triangles.

Exercise 4

Which sentences in the text above answer these questions?

1. Could the ancient Greeks tell without drawing the triangles which ones would be right triangles? 2. Who noticed the relationship between the number of small triangular regions in the two smaller squares and in the largest square? 3. Is Pythagorian Property true for all right triangles? 4. What must one do to prove that $c^2 = a^2 + b^2$ for the triangle under consideration? 5. What is the measure of the hypotenuse if each of the four triangles is congruent to the original triangle?

Exercise 5

Follow the speaker as he is reading the words. Mind the stress.

'method, 'follow, 'region, 'notice, 'credit, 'area, 'useful, 'product, 'either, 'angle, 'square, 'total, 'measure; com'pare, construct, in'volve, ob'tain, re'sult, sup'pose, be'cause, bet'ween, suc'ceed, dis'cover; 'several, 'origin, 'definite, 'radial, 'integer, in'terior, ex'terior, ap'proximate *a*, 'separate *a*.

Exercise 6

Read the words after the speaker. Think of the Russian equivalents of the italicized words.

region – *regional;* total – *totally – totality;* to credit – *to discredit;* to compare – *comparison – comparable – incomparable;* relationship – *interrelation;* to succeed – *success – successful – successfully – unsuccessful;* angle – *angular;* to involve – *involvement;* to conclude – *conclusion;* to notice – *unnoticed.*

Exercise 7

Listen to the questions below and give 'yes' or 'no' answers.

1. Can each side of every triangle be used as the side of a square? 2. Can you inscribe triangular regions in a square? 3. Was Pythagoras a philosopher? 4. Is there only one proof of the Pythagorean Theorem? 5. Is the Pythagorean Property true for all triangles? 6. Is it possible to state the Pythagorean Property in mathematical language? 7. Does the proof of the Pythagorean Property involve working with areas? 8. Is each of the four triangles congruent?

Exercise 8

Read these words and stress them properly.

ancient, Egypt, Egyptian, cover, discover, angle, succeed, without, triangle, illustration, to illustrate, region, compare, comparable, philosopher, several, represent, hypotenuse, involve, total, area, original, congruent, conclude, conclusion, subtract, property, language, follow.

Exercise 9

a) *Speak on the 'Pythagorean Property'. Draw a picture to help you while speaking;*

b) *Could you give some other proof of the same theorem? Try.*

Exercise 10

Before you begin working with the text 'Square Root' read these words and guess their meaning.

'positive, 'negative, 'radical *n,* re'sulting *a,* ir'rational, se'lect. *Read these notes.*

1). is about as near to 4^2 as – примерно так же приближается к 4^2, как ...;

2). in order to make sure – чтобы убедиться ...

Exercise 11

Read the text below and give the gist of it in Russian after you have read it.

Square Root

1. It is not particularly useful to know the areas of the squares on the sides of a right triangle, but the Pythagorean Property is very useful if we can use it to find the length of a side of a triangle. 2. When the Pythagorean Property is expressed in the form $c^2 = a^2 + b^2$, we can replace any two of the letters with the measures of two sides of a right triangle. 3. The resulting equation can then be solved to find the measure of the third side of the triangle. 4. For example, suppose the measures of the shorter sides of a right triangle are 3 units and 4 units and we wish (хотим) to find the measure of the longer side. 5. The Pythagorean Property could be used as shown below:

$$c^2 = a^2 + b^2, \quad c^2 = 3^2 + 4^2, \quad c^2 = 9 + 16, \quad c^2 = 25.$$

6. You will know the number represented by c if you can find a number which, when used as a factor twice, gives a product of 25. 7. Of course, $5 \times 5 = 25$, so $c = 5$ and 5 is called the positive square root (корень) of 25. 8. If a number is a product of two equal factors, then either (любой) of the equal factors is called a square root of the number. 9. When we say that y is the square root of K we merely (всего лишь) mean that $y^2 = K$. 10. For example, 2 is a square root of 4 because $2^2 = 4$. 11. The product of two negative numbers being a positive number, –2 is also a square root of 4 because $(-2)^2 = 4$. 12. The following symbol $\sqrt{\ }$ called a radical sign is used to denote the positive square root of a number. 13. That is $\sqrt{K}$ means the positive square root of K. 14. Therefore $\sqrt{4} = 2$ and $\sqrt{5} = 5$. 15. But suppose you wish to find the $\sqrt{20}$. 16. There is no integer whose square is 20, which is obvious (очевидно) from the following computation. $4^2 = 16$ so $\sqrt{16} = 4$; $a^2 = 20$ so $4 < a < 5$, $5^2 = 25$, so $\sqrt{25} = 5$. 17. $\sqrt{20}$ is greater than 4 but less than 5. 18. You might try to get a closer approximation of $\sqrt{20}$ by squaring some numbers

between 4 and 5. 19. Since $\sqrt{20}$ is about as near to 4^2 as to 5^2, suppose we square 4.4 and 4.5.

$$4.4^2 = 19.36 \qquad a^2 = 20 \qquad 4.5^2 = 20.25$$

20. Since $19.36 < 20 < 20.25$ we know that $4.4 < a < 4.5$ 21. 20 being nearer to 20.25 than to 19.36, we might guess that $\sqrt{20}$ is nearer to 4.5 than to 4.4. 22. Of course, in order to make sure[2] that $\sqrt{20} = 4.5$, to the nearest tenth, you might select values between 4.4 and 4.5, square them, and check the results. 23. You could continue the process indefinitely and never get the exact (точное) value of 20. 24. As a matter of fact, $\sqrt{20}$ represents an irrational number which can only be expressed approximately as rational number. 25. Therefore we say that $\sqrt{20} = 4.5$ approximately (to the nearest tenth).

Exercise 12

Translate these combinations of words.

a positive answer, a negative reaction, to get to the root of the matter, either of these two possibilities, the resulting answer, a good selection of journals, the speed is approximately equal to, the wishes and the possibilities, twice as much, twice as many, the radical elements, the radical sign, the exact time, rational and irrational numbers, valuable information.

Exercise 13

Ask questions to which the sentences below could be answers.

1. The origin of mathematics is rooted in the ancient world. 2. Both positive and negative roots will be dealt with in this chapter. 3. Wishing to know the average speed of the automobile one has to divide the total time by the distance covered. 4. The word wish has the same meaning as the word desire. 5. He illustrated his words with the obvious facts. 6. I merely wished to express the same idea in a different way.

Exercise 14

Listen to the speaker as he is reading the new words of the text 'Square Root'.

positive, negative, radical, resulting, wish, merely, root, square root of, *a* squared (a^2), twice, exact, irrational, approximation, obvious, either, select, particularly.

Exercise 15

Listen and repeat. Guess the meaning of the italicized words.

particularly – *particular;* length – *long;* triangle – *triangular;* to express – *expressive;* to replace – *replacement;* to represent – *representation – representative n;* obvious – *obviously;* approximation – *approximately – approximate a, to approximate;* rational – *irrational – rationalize;* to select – *selection – selective;* definite – *indefinite – indefinitely;* to continue – *to discontinue – continuation – continuous – continuously – continuity;* integer – *integral – integrity – integration;* able – *ability – to enable.*

Exercise 16

Listen to the questions about the text and write 'yes' or 'no' answers.

1. Can we find the measure of the third side of a triangle by applying Pythagorean Property? 2. Is there a number which when, used twice gives a product of 16? 3. Is 2 the square root of 5? 4. Is the product of two negative numbers also a negative number? 5. Is the radical sign used to denote a positive square root? 6. Does the $-\sqrt{20}$ represent a rational number?

Exercise 17

Listen to the following statements and say whether they are true or false. If you think they are false say why. Begin your answer with: 'On the contrary...', I am afraid...'

Exercise 18

Speak on 'The Pythagorean Property' and the 'Square Root'. Work in pairs.

Exercise 19

Say the following in English.

a) 1. Если число представляет собой произведение двух равных сомножителей, тогда любой из этих равных сомножителей называется корнем квадратным этого числа. 2. Когда мы говорим, что *y* есть корень квадратный от *K*, мы всего лишь имеем в виду, что $y^2 = K$. 3. Свойство Пифагора очень полезно для нахождения длины стороны треугольника.

4. Когда свойство Пифагора выражено в форме $c^2 = a^2 + b^2$, мы можем заменить любую из двух букв величиной двух сторон правильного треугольника. В результате решения уравнения мы получим величину третьей стороны треугольника. 5. Используя свойство Пифагора, мы находим корень квадратный либо суммы, либо разности квадратов.

б) мы можем заменить c^2 величиной; предположим, например; говоря это, мы имеем в виду следующее; 20 больше чем 4, но меньше чем 5; мы можем продолжать этот процесс бесконечно.

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