Federal State-Funded Educational Institution
«THE RUSSIAN PRESIDENTIAL ACADEMY OF NATIONAL ECONOMY AND PUBLIC ADMINISTRATION»

School of Public Policy

Approved
by the meeting of the Admission Committee
of Mathematics
Record № 49, November 11, 2015

Vice-rector of the Academy
M.N. Nazarov

«11» 12 2015 г.

Program for entrance test in Mathematics administered by the Academy for foreigners

38.03.02 Management
(code and name of educational program specialization)

Global Governance and Leadership
professional direction

Bachelor
qualification

Full-time
mode(s) of study

(Language of instruction: English)

Moscow 2015

Program for entrance test in Mathematics administered by the Academy

At the entrance test an applicant must show:

- clear knowledge of mathematical definitions and theorems, required by the program, and the ability of their practical application;
- ability to accurately and concisely express mathematical ideas in a written statement;
- good command of mathematical knowledge and skills, required by the program, the ability to apply them to problem-solving.

The minimum number of points obtained as a result of admission test, confirming the successful completion of the admission test - 51 points.

Basic skills

An applicant must be able:

To carry out arithmetic operations with fractions and decimals; to round them and the results of calculations with the required precision.

To operate with polynomials, fractions, including those containing variables, expressions with exponential, logarithmic and trigonometric functions.

To draw graphs for linear, quadratic, exponential, logarithmic and trigonometric functions.

To solve equations and inequalities of the first- and second-degree, equations and inequalities leading to them; to solve systems of equations and inequalities and those leading to them. This includes elementary equations and inequalities, containing exponential, logarithmic and trigonometric functions.

To solve problems by composing equations and systems of equations. To apply geometrical ideas to solving algebraic problems, and employ algebra and trigonometry methods solving geometrical ones.

To carry out operations with vectors on the plane (addition and multiplication of vectors, multiplying a vector by a number), and to use the properties of such operations.

To use the concept of the derivative while analyzing functions for increasing (decreasing), extrema and drawing graphs.

ELEMENTARY MATHEMATICS

Arithmetic, algebra and elementary analysis

- Natural numbers (N). Prime and non-prime numbers. Factor. Multiple. The highest common factor. The lowest common multiple. The evidence of divisibility for 2,3,5,9,10. Whole numbers (Z). Rational numbers (Q), addition, subtraction, multiplication, division. Ordering numbers.
- Real numbers, their representation as decimals. Ordering numbers on the number line. The absolute value of a real number, its geometrical meaning.
- Number expressions. Expressions with variables. Formulas for shortcut multiplication (including cubes).
- Powers with whole and rational exponents. Arithmetic roots.
- Logarithms. The properties of logarithms. Logarithms of a product, a quotient and a power.
- Monomials and polynomials. Polynomials with one variable. Real roots of a polynomial as seen in a quadratic trinomial.
- Function. Methods of defining a function. Domain and range of a function. Graphs of functions. Increase, decrease of functions, even, odd and periodic functions. Sufficient conditions of increasing/decreasing of the function on an interval. The concept of the extremum of the function. A necessary condition for extremum (Fermat's theorem). Sufficient condition of extremum. The maximum and the minimum on an interval of a function.
- Definition and properties of: linear function, quadratic function $y=ax+bx+c$, exponential function $y=ax^n$ $(n \in N)$, $y+k/x$, exponential function $y=a^x$ $a>0$, logarithmic function, trigonometric function $y=\sin x$, $y=\cos x$, $y= tg\ x$, $y= ctg\ x$, arithmetic root $y= \sqrt{x}$.
- Equation. Roots of an equation. The concept of equivalent equations. The formula of the quadratic equation roots. Discriminant. Factoring a quadratic trinomial into linear terms. Vieta's theorem.
- Numerical inequalities. Properties of inequalities. Solving inequalities. The concept of equivalent inequalities.
- Systems of equations and inequalities. Solving systems of equations, inequalities. Solving equations, inequalities with parameters.
- Arithmetic and geometric sequences. The formula for the ***n**-th* term and for the sum of the ***n*** number of first terms of an arithmetic sequence. The formula for the ***n**-th* term and for the sum of ***n*** number of the first terms of a geometric sequence.
- Solving equations of the type: $\sin x = a(|a|\leq 1)$; $\cos x = a\ (|a|\leq 1)$; $tg\ x = a$, $(a \in \mathbf{R})$; $ctg\ x = a$, $(a \in \mathbf{R})$.
- Correlations between trigonometric functions of one and the same argument.
  Sine, cosine and tangent of the sum and the difference of two arguments (formulas).
  The trigonometric functions of double argument and half the argument. Reduction formulas.
  Conversion of trigonometric functions such as $\sin x \pm \sin y$; $\cos x \pm \cos y$; $tg\ x \pm tg\ y$ to the product of their sums. Conversion of the product such as $\sin x \cdot \cos y$; $\cos x \cdot \cos y$ into the sums. Formula of additional argument.

- Derivatives of the functions $y = \sin x$, $y = \cos x$, $y = tg\, x$, $y = a^n$, $y = x^n$ ($n \in Z$), $y = \ln x$.

Basic formulas and theorems of algebra and analysis

- Properties of the function $y = kx + b$ and its graph.
- Properties of the function $y = k / x$ and its graph.
- Properties of the function $y = ax\ 2 + bx + c$ and its graph.
- Properties of quadratic trinomial roots, its factoring into linear factors.
- Properties of numerical inequalities.
- Logarithm of a product, of an exponent, of a quotient.
- Definition and properties of functions $y = \sin x$, $y = \cos x$ and their schedules.
- Definition and properties of the function $y = tg\, x$ and its graph.
- Definition and properties of the function $y = ctg\, x$ and its graph.
- Solving the equations such as $\sin x = a$ ($|a| \leq 1$); $\cos x = a$ ($|a| \leq 1$); $t\, gx = a$, ($a \in R$); $ctg\, x = a$, (and $\in R$).
- Reduction formulas.
- Correlations between the trigonometric functions of the same argument.
- Trigonometric functions with a dual argument.
- Derivative of a sum of two functions.

ADMISSION REQUIREMENTS

At the exam in mathematics the candidate must demonstrate the ability to:

- carry out (without a calculator) operations with numbers and numerical expressions; transform expressions with variables; operate with vectors (addition, multiplication by a number, scalar product); convert units of measurement.
- compare numbers and find their approximate values (without a calculator); to carry out operations with identities and inequalities with variables;
- solve equations, inequalities, systems (including those with *e* parameters) and evaluate their solutions;
-evaluate functions; draw graphs of functions and scatter plot diagrams on the coordinate plane defined by the equations and inequalities;
- use properties of numbers, vectors, functions and their graphs, properties of arithmetic and geometric sequences;
- use ratios and formulas containing absolute value numbers, exponents, radicals, logarithmic, trigonometric expressions, the angle values, lengths, square measures, cubic measures;
- create equations, inequalities, and to find the values based on the given problem;
- present and format solutions in a logically correct, complete and consistent manner, with the necessary explanations.