

The Ministry of Education and Science of Ukraine
Kharkiv National Automobile and Highway University

APPROVED by

The Head of the Admission Committee,
rector _____ Victor BOHOMOLOV
28 march 2025

PROGRAMME

OF THE ADMISSION EXAM

on the discipline "Mathematics" for admission to studies at the "bachelor"
educational level of foreign citizens and stateless persons

Kharkiv – 2025

The admission exam programme_for the subject “Mathematics” is based on the Mathematics Programs for general education institutions:

- 1) model curriculum for pupils of grades 5-6 of the general secondary education order of the Ministry of Education and Science of Ukraine №795 of 12.07.21, authors Merzlyak A.G., Nomirovsky D.A., Pikhtar M.P., Rublev B.V., Semenov V.V., Yakir M.S;
- 2) model curriculum “Algebra. Grades 7-9” for general secondary education institutions, order of the Ministry of Education and Science of Ukraine №795 of 12.07.21, authors Merzlyak A.G., Nomirovsky D.A., Pikhtar M.P., Rublev B.V., Semenov V.V., Yakir M.S;
- 3) model curriculum for general secondary education institutions “Geometry. Grades 7-9” for general secondary education institutions, Order of the Ministry of Education and Science of Ukraine No. 795 of 12.07.21, authors Merzlyak A.G., Nomirovsky D.A., Pikhtar M.P., Rublev B.V., Semenov V.V., Yakir M.S;
- 4) Mathematics curricula for grades 10-11 of secondary schools, approved by Order of the Ministry of Education and Science of Ukraine No. 1407 of October 23, 2017; as well as the Program of the National Multisubject Mathematics Test.

BASIC SKILLS

Applicants must KNOW:

1. real numbers and actions with them.
2. rational, irrational, exponent, exponential, logarithmic, trigonometric expressions and their transformations.
3. rational, irrational, exponent, exponential, logarithmic, trigonometric equations, inequalities and their systems. application of equations, inequalities and their systems to solving text problems.
4. linear, quadratic, exponent, exponential, logarithmic, trigonometric, inverse trigonometric functions, their properties and graphs.
5. arithmetic and geometric progression and their properties.
6. derivatives of elementary functions, differentiation rules.
7. primitive elementary functions.
8. definite integral (concept, Newton-Leibnitz formula, application of the definite integral to the calculation of flat figures areas).
9. elements of combinatorics (sum and product rules, compounds without repetitions).
10. beginnings of probability theory (classical definition of the probability of a random event, combinatorial method of calculating classical probabilities).
11. elements of mathematical statistics (sample characteristics of data series).
12. planimetry:
 - the simplest geometric shapes and their properties;
 - circle and disk;
 - triangles (types of triangles and their properties; signs of equality; median, bisector, height and their properties; a circle circumscribed around a triangle and inscribed in a triangle);

- quadrilaterals (parallelogram, rhombus, square, trapezium and their properties; quadrilaterals inscribed in a circle and circumscribed around a circle);
- regular polygons and their properties;
- geometric quantities and their measurements;
- coordinates and vectors on the plane (distance between two points, coordinates of the midpoint of a segment, equations of a straight line and a circle, concept of a vector and its length, conditions of collinearity and perpendicularity of vectors given by coordinates, scalar product of vectors and its properties);
- geometric transformations (signs of similarity of triangles, ratio of areas for similar figures).

13. stereometry:

- a straight line and a plane in space;
- polyhedra and their elements, main types of polyhedra (prism, parallelepiped, pyramid, truncated pyramid);
- solids and surfaces of revolution and their elements; the main types of solids and surfaces of revolution (cylinder, cone, truncated cone, ball, sphere);
- combinations of geometric bodies;
- formulas for calculating surface areas and volumes of polyhedra as well as solids of revolution;
- coordinates and vectors in space.

Applicants must BE ABLE to:

1. Perform arithmetic operations.
2. Use known formulas and rules to convert rational, irrational, exponent, exponential, logarithmic, and trigonometric expressions.
3. Solve rational, irrational, exponential, logarithmic and trigonometric equations, inequalities and their systems. Solve text problems using equations, inequalities and their systems.
4. Calculate derivatives and primitives of elementary functions. Investigate functions for monotonicity in the simplest cases; find the extremum point, the largest and smallest value of the function on a segment.
5. Solve the simplest combinatorial and probability problems.
6. Solve planimetric and stereometric problems for finding geometric quantities (lengths, angles, areas, volumes).
7. Perform operations on vectors and use the properties of these operations.

Applicants must HAVE AN IDEA about the application of mathematics to the construction and research of mathematical models of real objects, processes and phenomena.

ALGEBRA AND THE BEGINNINGS OF ANALYSIS

I. NUMBERS AND EXPRESSIONS

1. Natural numbers. Simple and complex numbers. Signs of divisibility. Divisor, multiple. The greatest common denominator. Least common multiple.
2. Whole, rational and real numbers and actions with them. The n -th root and arithmetic n th root, properties of roots. Exponentiation with natural, whole and rational exponents, properties of exponentiation. Numeric spaces. Modulus of a real number and its properties. Relations, proportions. Percentages. Interest problems.
3. Rational, irrational, exponent, exponential, logarithmic, trigonometric expressions and their transformations. Range of valid variable values. Identities, identical transformations. Monomials and polynomials. Factorization of a polynomial. Rules for performing operations with algebraic fractions. Logarithms (definition and properties, basic logarithmic identity). Sine, cosine, tangent, cotangent of a numerical argument. Trigonometric identities. Summary formulas. Addition formulas and their consequences.

II. EQUATIONS, INEQUALITIES AND THEIR SYSTEMS

1. An equation with one variable, the root (solution) of the equation. Inequality with one variable, solution of the inequality. System of equations with two variables, solution of the system. Equivalent equations, inequalities and their systems.
2. Methods of solving rational, irrational, exponential, logarithmic, trigonometric equations, inequalities and their systems.
3. Application of equations, inequalities and their systems to solving text problems.

III. FUNCTIONS

1. Linear, quadratic, power, exponential, logarithmic, trigonometric inverse trigonometric functions, their properties and graphs. Converting graphs.
2. The concept of numerical sequence. Arithmetic and geometric progressions. Formulas of the n th term and the sum of the first n terms of arithmetic and geometric progressions. The formula for the sum of an infinite geometric progression with a denominator $|q| < 1$.
3. The derivative of a function, its geometric and physical meaning. Derivatives of elementary functions. Rules for finding the derivative sum, difference, product, quotient of two functions. The derivative of a composite function.
4. Study of the function using the derivative. Construction of graphs of functions (sufficient conditions for the growth and decline of the function on the interval, extrema of the function, the largest and smallest value of the function on the segment).
5. Primitive and definite integral. Definition of primitive function. Primitive elementary functions. The concept of a definite integral. Newton-Leibnitz formula. Application of the definite integral to the calculation of the flat figures areas.

IV. ELEMENTS OF COMBINATORICS. THE BEGINNINGS OF PROBABILITY THEORY AND ELEMENTS OF STATISTICS

1. Elements of combinatorics. Sum and product rules. Compounds without repetitions (placement, permutations, combinations).
2. Beginnings of probability theory. The classical definition of a random event probability. Combinatorial method of calculating classical probabilities.
3. Elements of mathematical statistics. Determination of sampling characteristics of data series (sample size, mode, median, average value). Graphical, tabular, textual forms of presentation of statistical information.

GEOMETRY

V. PLANIMETRY

1. The simplest geometric shapes and their properties. Point, line, segment, broken, angle. Angle bisector and its properties. Parallel and perpendicular lines. Signs of parallelism of lines. Middle perpendicular. Thales' theorem.
2. Circle and disc; their elements. Central, inscribed angles and their properties. Properties of two intersecting chords. Tangent to the circle and its properties.
3. Triangles, their types and main properties. Signs of triangles' equality. Median, bisector, height of a triangle and their properties. The middle line of a triangle and its properties. A circle circumscribed around a triangle and a circle inscribed in a triangle. Theorem of Pythagoras. Proportional segments of a right triangle. The ratio between the sides and angles of a right triangle. Theorems of sines and cosines.
4. Quadrilateral and its properties. Parallelogram, properties and signs of a parallelogram. Rectangle, rhombus, square, trapezoid and their properties. The middle line of a trapezoid and its property. Quadrilaterals inscribed in a circle and circumscribed around the circle.
5. Polygons and their elements. A regular polygon and its properties. Polygons inscribed in a circle and circumscribed around the circle.
6. Geometric quantities and their measurements. The length of a line segment, a circle and its arc. Measuring angles. Perimeter of a polygon. Formulas for calculating the area of a triangle, parallelogram, rhombus, square, trapezoid, regular polygon, circle, circular sector.
7. Coordinates and vectors on the plane. Rectangular coordinate system, point coordinates. The distance between two points. Coordinates of the segment middle. Equations of a line and a circle. The concept of a vector, the length of a vector. Equal and collinear vectors. Actions with vectors. Conditions of collinearity and perpendicularity of vectors specified by coordinates. Scalar product of vectors and its properties.
8. Geometric transformations. Types and content of geometric transformations on the plane. Signs of triangles' similarity. The ratio of the areas of similar figures.

VI. STEREOOMETRY

1. Lines and planes in space. Signs of parallelism of straight lines, straight line and plane, planes. Signs of perpendicularity of a line and a plane, two planes. Projection of the inclined plane. Theorems about three perpendiculars (straight and inverted). The distance from a point to a straight line, from a straight line to a parallel plane, between parallel lines (planes). The angle between lines, a line and a plane. Dihedral angle, linear angle of a dihedral angle.

2. Polyhedra and their elements. The main types of polyhedra (prism, parallelepiped, pyramid, truncated pyramid).

3. Solids and surfaces of revolution; their elements. The main types of solids and surfaces of revolution (cylinder, cone, truncated cone, ball, sphere).

4. Sections of polyhedra and solids of revolution in a plane.

5. Combinations of geometric bodies.

6. Formulas for calculating surface areas, volumes of polyhedra and solids of revolution.

7. Coordinates and vectors in space.

LITERATURE

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EVALUATION SYSTEM OF THE TASK PERFORMANCE RESULTS BY THE APPLICANTS

Each task of the written admission exam in mathematics contains 20 closed-type test multiple choice tasks (with the choice of one correct answer from three options).

Evaluation of the test task results is carried out by awarding 5 points for each correctly chosen answer.

After checking the test task, the members of the examination committee determine the amount of points scored on a scale from 100 to 200.

The maximum number of points that an applicant can receive based on the results of the written interview task in mathematics is 200 points.

If, while completing 20 test tasks of the admission exam, the applicant did not choose any correct answer, he receives an «unsatisfactory» grade (failed).

The programme was reviewed and approved at a meeting of the Higher Mathematics Department, minutes № 9 dated on March, 14 2025.

Head of the Subject Committee
on Mathematics, ass. prof.

Oleksandr VYSHNEVETSKIY

к

Approved:

Vice-head of the Admission
Committee, prof.

Illia DMYTRIIEV