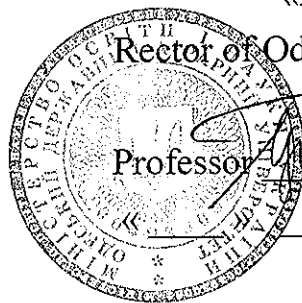MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
ODESA STATE AGRARIAN UNIVERSITY

«APPROVED»
Rector of Odesa State Agrarian University

Professor Mykhailo BROSHKOV
_____ 2021

PROGRAM
entrance exam in mathematics
to obtain a Bachelor's degree
on the basis of complete general secondary education

ODESA 2021

The program in mathematics of entrance examination on the basis of full general secondary education for training for a bachelor's degree is developed:

Doctor of Technical Sciences, Professor Lydia Vikulina.

INTRODUCTION

The purpose of the entrance exam in mathematics Assess the degree of preparation of participants in mathematics testing for the purpose of competitive selection for higher education.

Tasks of external independent evaluation in mathematics is to assess the knowledge and skills of the participants:

- to build mathematical models of real objects, processes and phenomena and to study these models by means of mathematics;

- perform mathematical calculations (perform actions with numbers given in different forms, actions with percentages, compose and solve problems on proportions, approximate calculations, etc.);

- perform expression transformations (understand the meaning of each element of an expression, find valid values of variables, find numerical values of expressions at given values of variables, etc.);

- to build and analyze graphs of the simplest functional dependences, to investigate their properties;

- solve equations, inequalities and their systems, solve text problems with the help of equations, inequalities and their systems;

- find geometric shapes in pictures and set their properties;

- find quantitative characteristics of geometric figures (lengths, sizes of angles, areas, volumes);

- solve the simplest combinatorial problems and calculate the probabilities of random events;

- analyze information presented in graphic, tabular, textual and other forms.

I. BASIC PART OF THE PROGRAM
ALGEBRA AND THE BEGINNING OF ANALYSIS
Section: Numbers and expressions

Real numbers (natural, integers, rational and irrational), their comparison and actions with them.

Numerical sets and relations between them:
- properties of actions with real numbers;
- rules for comparing real numbers;
- rules of divisibility of natural numbers on 2, 3, 5, 9, 10;
- rules for rounding integers and decimal fractions;
- definition of the root of the n-th degree and the arithmetic root of the n-th degree;
- properties of roots;
- definition of degree with natural, integer and rational indicators, their properties;
- numerical intervals;
- modulus of a real number and its properties

Ratios and proportions. Interest. The main tasks for interest:
- ratio, proportions;
- the main property of proportion;
- definition of interest;
- rules for performing interest calculations.
Text tasks

Rational, irrational, power, exponent, logarithmic, trigonometric expressions and their transformations:
- definition of the range of admissible values of variables of expression with variables;
- definition of identically equal expressions, identical transformation of expression, identity;
- definition of monomial and polynomial;
- rules of addition, subtraction and multiplication of monomials and polynomials;
- formulas of abbreviated multiplication;
- factorization of a polynomial;
- definition of an algebraic fraction;
- rules for performing actions with algebraic fractions;
- definitions and properties of logarithm, decimal and natural logarithms;
- basic logarithmic identity;
- definition of sine, cosine, tangent, cotangent of a numerical argument;
- basic trigonometric identity and its consequences;
- summary formulas;
- addition formulas and their consequences.

Section: Equations, inequalities of their system
Linear, quadratic, rational, irrational, exponential, logarithmic, trigonometric equations, inequalities and their:

- equation with one variable, definition of the root (solution) of the equation with one variable;
- inequality with one variable, definition of the solution of inequality with one variable;
- definition of the solution of the system of equations with two variables and methods of their solutions;
- equivalent equations, inequalities and their systems;
- methods for solving rational, irrational, exponential, logarithmic, trigonometric equations and inequalities.

Application of equations, inequalities and their systems to solve text problems.

Section: Functions.

Linear, quadratic, power, exponent, logarithmic and trigonometric functions, their main properties. Numerical sequences:
- function definition, domain, function value range, function graph;
- ways to set functions, basic properties and graphs of functions specified in the title of the topic;
- definition of the function inverse to the given;
- definition of arithmetic and geometric progressions;
- formulas of the n-th term of arithmetic and geometric progressions;
- formulas for the sum of n first terms of arithmetic and geometric progressions;
- formula for the sum of infinite geometric progression with common ratio $|q| < 1$.

Derivative of a function, its geometric and physical meaning. Rules of differentiation:
- the equation of the tangent to the graph of the function at the point;
- definition of the derivative function at a point;
- physical and geometric meaning of the derivative;
- table of derivatives of elementary functions;
- rules for finding the derivative of the sum, product, fraction of two functions;
- rule for finding the derivative of a compound function

Investigation of a function using a derivative. Construction of function graphs:
- sufficient condition for the increasing (deccreasing) of the function in the interval;
- extremums of the function;
- definition of the largest and smallest values of the function

Initial and definite integral. Application of a definite integral to the calculation of the areas of curvilinear trapezoids:
- definition of the initial function, definite integral, curvilinear trapezoid;
- table of initial functions; - rules for finding the original;
- Newton-Leibniz formula

Section: Elements of combinatorics, the beginnings of probability theory and elements of statistics

Permutations, combinations, placement (without repetitions). Combinatorial rules of sum and product. Probability of a random event. Selective characteristics:
- definition of permutation, combination, placement (without repetitions);
- combinatorial rules of sum and product;
- classical definition of the probability of an event, the simplest cases of calculating the probability of events;
- definition of sample characteristics of data series (sample size, mode, median, average value);
- graphic, tabular, textual and other forms of presentation of statistical information

GEOMETRY
Section: Planimetry

The simplest geometric figures on the plane and their properties:
- the concept of point and line, ray, segment, broken, angle;
- axioms of planimetry;
- supplementary and vertical angles, angle bisector;
- properties of supplementary and vertical angles;
- the property of the angle bisector;
- parallel and perpendicular lines;
- perpendicular and oblique, middle perpendicular, distance from point to line;
- signs of parallel lines;
- Thales 'theorem, Thales' theorem is generalized

Circle and circumfarence:
- Circle, circumfarence and their elements;
- central, inscribed angles and their properties;
- properties of two intersecting chords;
- tangent to the circle and its properties

Triangles:
- types of triangles and their main properties;
- signs of equality of triangles;
- median, bisector, height of a triangle and their properties;
- theorem on the sum of the angles of a triangle;
- the inequality of the triangle;
- the median line of a triangle and its properties;
- a circle circumscribed around a triangle and a circle inscribed in a triangle;
- Pythagorean theorem, proportional segments of a right triangle;
- the relationship between the sides and angles of a right triangle;
- sine theorem;
- cosine theorem

Quadrangle:
- quadrilateral and its elements;
- parallelogram and its properties;
- signs of a parallelogram;
- rectangle, rhombus, square, trapezoid and their properties;
- the middle line of the trapezoid and its property;
- inscribed in a circle and described around the circle quadrilaterals

Polygons:
- polygon and its elements, convex polygon;
- the perimeter of the polygon;
- the sum of the angles of a convex polygon;
- regular polygon and its properties;
- polygons inscribed in a circle and described around a circle

Geometric quantities and their measurements:
- the length of the segment, circle and its arc;
- the magnitude of the angle, measuring angles;
- the perimeter of the polygon;
- formulas for calculating the area of a triangle, parallelogram, rhombus, square, trapezoid, regular polygon, circle, circular sector

Coordinates and vectors on the plane:
- rectangular coordinate system on the plane, the coordinates of the point;
- formula for calculating the distance between two points and formula for calculating the coordinates of the middle of the segment;
- equation of line and circle;
- vector concept, vector length, collinear vectors, equal vectors, vector coordinates;
- addition, subtraction of vectors, multiplication of a vector by a number;
- vector decomposition by two nonlinear vectors;
- scalar product of vectors and its properties;
- formula for finding the angle between the vectors given by the coordinates;
- conditions of collinearity and perpendicularity of vectors given by coordinates

Geometric transformations:
- basic types and content of geometric transformations on a plane (motion, symmetry about a point and about a straight line, rotation, parallel transfer, similarity transformation, homothety);
- signs of similarity of triangles;
- the ratio of the areas of similar figures

Section: Stereometry

Lines and planes in space:
- axioms and theorems of stereometry;
- mutual placement of lines in space, lines and planes in space, planes in space;

- signs of parallel lines, lines and planes, planes;
- parallel design;
- signs of perpendicularity of a line and a plane, two planes;
- projection of the oblique on the plane, orthogonal projection;
- direct and inverse theorems about three perpendiculars;
- distance from a point to a plane, from a point to a straight line, from a straight line to a parallel plane, between parallel lines, between parallel planes, between passing

Polyhedra, bodies and surfaces of rotation:
- dihedral angle, linear angle of dihedral angle;
- polyhedra and their elements, main types of polyhedra: prism, parallelepiped, pyramid, truncated pyramid;
- bodies and surfaces of rotation and their elements, main types of bodies and surfaces of rotation: cylinder, cone, truncated cone, sphere, sphere;
- sections of polyhedra and bodies of rotation by a plane;
- combinations of geometric bodies;
- formulas for calculating surface areas, volumes of polyhedra and bodies of rotation

Coordinates and vectors in space:
- rectangular coordinate system in space, point coordinates;
- formula for calculating the distance between two points and formula for calculating the coordinates of the middle of the segment;
- vector concept, vector length, collinear vectors, equal vectors, vector coordinates;
- addition, subtraction of vectors, multiplication of a vector by a number;
- scalar product of vectors and its properties;
- formula for finding the angle between the vectors given by the coordinates;
- conditions of collinearity and perpendicularity of vectors given by coordinates

3. CRITERIA FOR EVALUATION OF ENTRANTS 'KNOWLEDGE

The content of the tasks on the entrance test corresponds to the program in mathematics for secondary schools and the program of external testing in mathematics. The option contains 30 tasks . The complexity of test questions is determined by the number of logical steps that the applicant must perform in the process of solving them.

There are several possible answers to each test question. The entrant must choose and circle the answer, which, in his opinion, corresponds to the correct solution of the problem or write in a free cell his answer.

Tasks 1-24 are considered completed when there is a correct answer.

Tasks 25-30 must be justified. A task is considered completed when there are no errors in the solution and all the main points of the solution are provided.

150 minutes are allotted for math tasks.

Question	The weight of one question in points	
1-16	5	80
17-24	7	56
25- 28	10	40
29-30	12	24
		.
The highest number of points you can get		200