

MINISTRY OF HEALTH OF UKRAINE
ODESSA NATIONAL MEDICAL UNIVERSITY

"APPROVED"
Rector of Odessa National Medical University
acad _____ V.M. Zaporozhan
_____ 09 _____ 2021



MATHEMATICS PROGRAM

for people who want to get a higher education
on the basis of complete general secondary education

Odesa – 2021

The purpose of assessment in mathematics: to assess the degree of preparation of participants in mathematics for the purpose of competitive selection for study at the Odessa National Medical University.

The task of assessment in mathematics is to assess the knowledge and skills of 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 semantic value of each element of the expression, find valid values of variables, find numerical values of expressions for 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 using equations, inequalities and their systems;
- find geometric shapes in drawings and set their properties;
- find the quantitative characteristics of geometric shapes (lengths, angles, areas, volumes);
- solve the simplest combinatorial problems and calculate the probabilities of random events;
- 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 semantic value of each element of the expression, find valid values of variables, find numerical values of expressions for 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 using equations, inequalities and their systems;
- find geometric shapes in drawings and set their properties;
- find the quantitative characteristics of geometric shapes (lengths, angles, areas, volumes);
- solve the simplest combinatorial problems and calculate the probabilities of random events
- analyze the information presented in graphical, tabular, textual and other forms.

The program was discussed and approved at the meeting of the admissions committee of Odessa National Medical University (Minutes № 3 of January 25, 2021)

The program was approved by the order of the rector of Odessa National Medical University № 35 of January 26, 2021.

CONTENT

Title of the section, topic	The student must know	Subject skills and methods of educational activity
ALGEBRA AND THE BEGINNING OF ANALYSIS		
Section: NUMBERS AND EXPRESSIONS		
Real numbers (natural, integer, rational and irrational), their comparison and action with them. Numerical sets and relations between them	properties of actions with real numbers; rules for comparing real numbers; signs of divisibility of natural numbers by 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, whole and rational indicators, their properties; numerical intervals; modulus of a real number and its properties	distinguish types of numbers and numerical intervals; compare real numbers; perform actions with real numbers; use signs of divisibility; - find the incomplete fraction and remainder of the division of one natural number by another; convert a common fraction into a decimal and an infinite periodic decimal fraction into a regular one; round integers and decimal fractions; use module properties to solve problems
Ratios and proportions. Interest. The main tasks for interest. Text tasks	ratio, proportions; the main property of proportion; definition of interest; rules for performing interest calculations	find the ratio of numbers in the form of a percentage, a percentage of a number, a number by the value of its percentage; solve problems on percentage calculations and proportions solve text problems arithmetically
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; abbreviated multiplication formulas; factorization of a polynomial; definition of an algebraic fraction; rules for performing actions with algebraic fractions; definition and properties of	- perform identical transformations of rational, irrational, power, exponential, logarithmic, trigonometric expressions and find their numerical value at given values of variables

	<p>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</p>	
Section: EQUATIONS, INEQUALITIES AND THEIR SYSTEMS		
<p>Linear, quadratic, rational, irrational, exponential, logarithmic, trigonometric equations, inequalities and their systems. Application of equations, inequalities and their systems to solve text problems</p>	<p>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</p>	<p>solve equations and inequalities of the first and second degrees, as well as equations and inequalities reduced to them; solve systems of equations and inequalities of the first and second degrees, as well as those that are reduced to them; solve equations and inequalities containing power, exponent, logarithmic and trigonometric expressions; solve irrational equations and inequalities, as well as their systems; apply general methods and techniques (factorization, variable substitution, application of properties of functions) in the process of solving equations, inequalities and systems; use the graphical method of solving and studying equations, inequalities and systems; apply equations, inequalities and systems to solve text problems; solve equations and inequalities containing a variable under the sign of the module; solve equations, inequalities and systems with parameters</p>
Section: FUNCTIONS		
<p>Linear, quadratic, power, exponent, logarithmic and trigonometric functions, their main properties. Numerical sequences</p>	<p>function definition, definition area, function value range, function graph; ways to set functions, basic properties and graphs of functions specified in the topic title; definition of the function inverse to the given; definition of arithmetic and geometric progressions; formulas of the nth term of arithmetic and geometric</p>	<p>find the domain of definition, the domain of values of the function; to investigate the parity (oddness), the periodicity of the function; build graphs of elementary functions specified in the title of the topic; set the properties of numerical functions given by a formula or graph; use function graph transformations;</p>

	<p>progressions; formulas for the sum of n first terms of arithmetic and geometric progressions; formula for the sum of infinite geometric progression with the denominator $q < 1$</p>	<p>solve problems on arithmetic and geometric progression</p>
<p>Derivative of a function, its geometric and physical meaning. Derivatives of elementary functions. Rules of differentiation</p>	<p>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</p>	<p>find the angular factor and the angle of inclination of the tangent to the graph of the function at the point; find derivatives of elementary functions; find the numerical value of the derivative of the function at a point for a given value of the argument; find the derivative of the sum, product and fraction of two functions; find the derivative of the compound function; solve problems using the geometric and physical content of the derivative</p>
<p>Investigation of a function using a derivative. Construction of function graphs</p>	<p>sufficient condition for the growth (decline) of the function in the interval; extrema of function; definition of the largest and smallest values of the function</p>	<p>find the intervals of monotonicity of the function; find the extremes of the function using the derivative, the largest and smallest values of the function; investigate functions using a derivative and build their graphs; solve applied problems to find the largest and smallest values</p>
<p>Initial and definite integral. Application of a definite integral to the calculation of the areas of curvilinear trapezoids</p>	<p>definition of the initial function, definite integral, curvilinear trapezoid; table of initial functions; rules for finding the original; Newton - Leibniz formula</p>	<p>find the original, using its basic properties; apply the Newton-Leibniz formula to calculate a definite integral; calculate the area of flat figures using the integral; solve the simplest applied problems, which are reduced to finding the integral</p>
<p>Section: ELEMENTS OF COMBINATORICS, THE BEGINNING OF PROBABILITY THEORY AND ELEMENTS OF STATISTICS</p>		
<p>Permutations, combinations, placement (without repetitions). Combinatorial rules of sum and product. Probability of a random event. Selective characteristics</p>	<p>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;</p>	<p>solve the simplest combinatorial problems; calculate the probabilities of random events in the simplest cases; calculate and analyze sample characteristics of data series (sample size, mode, median, mean)</p>

	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; adjacent and vertical angles, angle bisector; properties of adjacent and vertical angles; the property of the angle bisector; parallel and perpendicular lines; perpendicular and inclined, middle perpendicular, distance from point to line; signs of parallel lines; Thales' theorem, Thales' theorem is generalized	- apply the definitions, features and properties of the simplest geometric figures to solve planimetric problems and problems of practical content
Circle	Circles and their elements; central, inscribed angles and their properties; properties of two intersecting chords; tangent to the circle and its properties	- apply the acquired knowledge to solve planimetric problems and problems of practical content
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 middle line of the 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	classify triangles by sides and angles; solve triangles; apply the definitions and properties of different types of triangles to solve planimetric problems and problems of practical content; find the radii of a circle circumscribed around a triangle and a circle inscribed in a triangle
Quadrangle	quadrilateral and its elements; parallelogram and its properties; signs of a parallelogram; rectangle, rhombus, square, trapezoid and their properties;	- apply the definitions, features and properties of different types of quadrilaterals to solve planimetric problems and problems of practical content

	<p>the middle line of the trapezoid and its property; inscribed in a circle and described around the circle quadrilaterals</p>	
Polygons	<p>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</p>	<p>- apply the definitions and properties of polygons to solve planimetric problems and problems of practical content</p>
Geometric quantities and their measurements	<p>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</p>	<p>find the lengths of segments, degrees and radians of angles, areas of geometric shapes; - calculate the length of a circle and its arcs, the area of a circle, a circular sector; use the formulas of the areas of geometric figures to solve planimetric problems and problems of practical content</p>
Coordinates and vectors on the plane	<p>rectangular coordinate system on the plane, the coordinates of the point; a formula for calculating the distance between two points and a formula for calculating the coordinates of the middle of the segment; equation of line and circle; concept of vector, vector length, collinear vectors, equal vectors, vector coordinates; addition, subtraction of vectors, multiplication of a vector by a number; vector decomposition by two non-collinear vectors; scalar product of vectors and its properties; a formula for finding the angle between the vectors given by the coordinates; conditions of collinearity and perpendicularity of vectors given by coordinates</p>	<p>find the coordinates of the middle of the segment and the distance between two points; compose the equation of a line and the equation of a circle; perform actions with vectors; find the scalar product of vectors; apply coordinates and vectors to solve planimetric problems and problems of practical content</p>
Geometric transformations	<p>basic types and content of geometric transformations on the plane (motion, symmetry with respect to a point and with respect to a straight line, rotation, parallel transfer, similarity transformation, homothety); signs of similarity of triangles;</p>	<p>- use the properties of the main types of geometric transformations, signs of similarity of triangles to solving planimetric problems and problems of practical content</p>

	the ratio of the areas of such figures	
Section: STEREOMETRY		
Lines and planes in space	<p>axioms and theorems of stereometry;</p> <p>mutual placement of lines in space, lines and planes in space, planes in space; signs of parallel lines, straight and. planes, planes; parallel design;</p> <p>signs of perpendicularity of a line and a plane, two planes;</p> <p>projection of the slope on the plane, orthogonal projection;</p> <p>direct and inverse theorems about three perpendiculars;</p> <p>the distance from a point to a plane, from a point to a straight line, from a straight line to a plane parallel to it, between parallel lines, between parallel planes, between passing straight lines;</p> <p>a sign of the passing of lines;</p> <p>angle between straight lines, straight line and plane, planes</p>	<p>- apply the definitions, signs and properties of parallel and perpendicular lines and planes to solve stereometric problems and problems of practical content;</p> <p>- find the specified distances and values of angles in space</p>
Coordinates and vectors in space	<p>rectangular coordinate system in space, point coordinates;</p> <p>- formula for calculating the distance between two points and the formula for calculating the coordinates of the middle of the segment;</p> <p>- the concept of vector, vector length, collinear vectors, equal vectors, vector coordinates;</p> <p>- addition, subtraction of vectors, multiplication of the vector by a number;</p> <p>- scalar product of vectors and its properties;</p> <p>formula for finding the angle between the vectors given by the coordinates</p>	<p>find the coordinates of the middle of the segment and the distance between two points; perform actions with vectors; find the scalar product of vectors; apply coordinates and vectors to solve stereometric problems and problems of practical content</p>

CRITERIA FOR EVALUATION OF TASKS IN MATHEMATICS IN 2021

The number of points obtained for tasks **33** (in algebra and the beginnings of analysis), **34** (in geometry) and **35** (in algebra and the beginnings of analysis) depends on the completeness of the solution and the correctness of the answer.

General requirements (recommendations) for performing tasks with a detailed answer:

- the solution must be mathematically literate and complete;
- the methods of solving it, the forms of its recording and the forms of recording the answer may be different;
- if the problem can be solved in several ways, it is enough to give the solution in only one way;
- the maximum number of points is set for solving the problem in which the correct answer is substantiated;
- During the task you can use without proof and references any mathematical facts and statements contained in textbooks and manuals included in the list of textbooks recommended (approved) by the Ministry of Education and Science of Ukraine.

Task **33** of the open form with a detailed answer from algebra and the beginnings of the analysis is evaluated by the criteria as set out in table 1.

Table 1

Content of evaluation	mark
The correct answer is received. All key points of the solution are substantiated	4
The logically correct sequence of solutions is given. Some of the key points of the solution are insufficiently substantiated / Possible 1-2 gross errors or omissions in the calculations, transformations that do not affect the correctness of the further solution / The answer may be incorrect	3
The logically correct sequence of solutions is given. Some of the key points are insufficiently substantiated or not substantiated. There may be 1-2 errors in calculations or transformations that affect the correctness of further solutions. The answer may be incorrect or incomplete (only part of the task is solved correctly)	2
Some of the steps are skipped in the correct order. The key points of the solution are not substantiated. The answer is incorrect or the task is not completely solved	1
The participant did not start solving the problem, or his records do not meet the above criteria	0

Task 34 open form with a detailed answer in geometry is evaluated by the criteria as set out in table 2.

Table 2

Content of evaluation	mark
The correct answer is received. All key points of the solution are substantiated and all the theorems, axioms, etc. necessary for the proof are indicated. The corresponding figure is shown problem solving	4
The logically correct sequence of solutions is given. Some of the key points of the solution are not substantiated enough / Figure no / Possible 1-2 gross errors or omissions in calculations, transformations that do not affect the correctness of the further solution / The answer may be incorrect	3
The logically correct sequence of solutions is given. Some of the key points are insufficiently substantiated or not substantiated. No Figure / Possible 1-2 errors in calculations or transformations that affect the correctness of further solutions. The answer may be incorrect or incomplete (only part of the task is solved correctly)	2
In the correct sequence of solving, some of its stages are omitted.	1
The key points of the solution are not substantiated. The answer is incorrect or the task is not completely solved	0

Task 35 of the open form with a detailed answer from algebra and the beginnings of the analysis is evaluated by the criteria as set out in table 3.


Table 3

Content of evaluation	mark
The correct answer is received. All key points of the solution are substantiated	6
The logically correct sequence of solutions is given. Some of the key points of the solution are not substantiated enough / Possible errors in the calculations or transformations that do not affect the correctness of the answer / The answer may be incorrect or incomplete	5
The logically correct sequence of solutions is given. Some of the key points of the solution may not be sufficiently substantiated / There may be 1-2 minor errors or omissions in the calculations, transformations that do not affect the correctness of the further solution. The answer received may be incorrect or incomplete	4
The logically correct sequence of solutions is given. Some of the key points are not justified enough. There may be 1-2 errors or omissions in calculations or transformations that have little effect on the correctness of further solutions. The answer may be incorrect or incomplete (only part of the task is solved correctly)	3

Content of evaluation	mark
Some steps are skipped in the correct solution sequence. The key points of the solution are not substantiated. There may be errors in calculations or transformations that affect the future solution. The answer received may be incomplete or incorrect	2
There are only a few stages in the solution sequence. The key points of the solution are not substantiated. The answer is incorrect or the task is not completely solved	1
The participant has not started the task, or the records do not meet the above criteria	0

The problem to which the correct answer is given, but the solution **is not given**, is evaluated at **0** points.
Tasks that **do not meet the condition** are evaluated at **0** points.

Executive Secretary of the
Admissions Committee of ONMedU



E.S. Buryachkivsky