

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
STATE HIGHER EDUCATIONAL INSTITUTION
BANKING UNIVERSITY**

APPROVED

**The Head of the Admission Committee,
Rector of the Banking University**



A. Kuznyetsova

March 11, 2020

**PROGRAMME
OF ENTRANCE TESTING
on the Mathematics
for competitive selection of foreigners and stateless persons
to obtain a Bachelor's degree
in the program subject area 051 Economics, 071 Accounting and Taxation,
072 Finance, banking and insurance, 073 Management,
121 Software engineering, 122 Computer sciences, 125 Cyber Security,
232 Social welfare
(full-time and part-time forms of studies)**

Kyiv 2020

Compiler:

Hirna O., PhD, Associate Professor of the Department of Economics and Information Technology, Lviv institute SHEI “Banking University”

Reviewer:

Nyemkova O., PhD, Associate Professor, Associate Professor of Information Technology Security Department, Lviv Polytechnic National University

Examined and confirmed at the meeting of the Department of Economics and Information Technology of Lviv institute SHEI “Banking University”
on February 27, 2020 (Minutes № 7)

Considered and approved at the meeting of Admission Committee of Banking University on March 11, 2020 (Minutes № 04)

INTRODUCTION

The programme for competitive selection of those who enter Banking University (testing) is drawn up, taking into account the objectives, requirements and content of learning mathematics at school, incorporated in the State Standard of education and current programme on Mathematics for 11-year old schooling.

The purpose of the application of competitive selection for the entrants to the University in mathematics is to identify the level of obtained knowledge and skills defined by the standards of the comprehensive educational institutions.

The task of the programme is the formation of the entrants' knowledge and skills:

- building mathematical models of real objects. Processes, phenomena and exploring these patterns by means of mathematics;

- performing mathematical calculations (performing actions with numbers, listed in various form, with interest. composing and solving the aspect ratio, approximate calculations, etc.);

- performing the conversion expressions (understanding the content value of each element of the expression, finding the valid variables, finding the numerical values of expressions in the given values of the variables, etc.);

- building and analyzing graphs of simple functional dependencies, exploring their properties;

- solving equations, inequalities and their systems, solving the text problems using equations, inequalities and their systems;

- finding on the pictures geometric shapes and identifying the properties;

- defining the quantitative characteristics of geometric figures (length, magnitude of angles, area, volume);

- solving the easiest complex tasks and calculating probability of random events;

- analyzing the information that is filed in graphic, tabular, textual and other forms.

The programme covers theoretical and applied issues, knowledge of which is essential in the study of Mathematics and consists of the following sections:

Algebra and Basics of Analysis:

1. Number and Mathematical Expressions
2. Equations, Inequalities and their Systems
3. Functions
4. Elements of Combinatorics, Probability Theory, principles and elements of Statistic

Geometry:

1. Plane Geometry
2. Stereometric

CRITERIA FOR EVALUATING TEST TASKS

Tests on Mathematics for competitive selection of foreigners and stateless persons to Banking University to obtain a Bachelor's degree in the program subject area 051 Economics, 071 Accounting and Taxation, 072 Finance, banking and insurance, 073 Management, 121 Software engineering, 122 Computer sciences, 125 Cyber Security, 232 Social welfare for full-time and part-time form of study consist of twenty-five test items.

Each correct answer is estimated at **8** points. Each wrong answer is estimated at **zero** point. Maximum score is **200**. Minimum score for successful passing the exam should be at least **100**.

ALGEBRA AND BASICS OF ANALYSIS

Section 1. NUMBERS AND EXPRESSION

Theme 1. Real numbers (natural, integer, rational and irrational), properties of real numbers, comparing them and dealing with them. Sets. Operation with sets

Properties of real numbers. The rules for comparison of real numbers, the peculiarities to divide natural numbers by 2, 3, 5, 9, 10. The rules of rounding the integer numbers and decimal fractions. Cartesian coordinate system. Interval. Absolute value and its properties. Exponentiation. Rational exponents. Definition of the n th root of number and arithmetic n th root of number. Properties of the root. Definition of degree with an integer and rational indicators, their properties.

References: 2, 3, 6, 7, 8, 9

Theme 2. Rations and proportions. Percent

Rations. Proportions. The basic properties of proportions. Definition of percent. Text problems.

References: 2, 3, 6, 7, 8, 9

Theme 3. Rational, irrational, exponential, rational exponents, logarithmic, trigonometric expressions and their conversion

Monomials and Polynomials. Algebraic transformations. Factoring. Factor theorems. Expanding. Rationalizing denominators. The most important rules of exponentiation. The definition and properties of logarithm. decimal and natural logarithms. The basic logarithmic identity.

Angles. Geometric and trigonometric definitions. Measurement of angles: degree and radian. Unit circle. Definition of sine, cosine, tangent and cotangent. The fundamental trigonometric identity. Sines and cosines for special angles. Addition formulas for sine and cosine. Subtraction formulas for sine and cosine. Application of addition formulas for sine and cosine. Double- and half- angle formulas for sine and cosine. Trigonometric identities for tangent and cotangent.

References: 2, 3, 6, 7, 8, 9

Section 2. EQUATIONS, INEQUALITIES AND THEIR SYSTEMS

Theme 1. Linear, quadratic, rational, exponential, logarithmic and trigonometric equations, inequalities and their systems

Using equations, inequalities and their systems to solve text tasks. Properties of equations and inequalities. Equation with one variable. Linear equations. Linear inequalities. Quadratic equation. Quadratic inequalities. Definition of the roots of the equation with one variable. Inequalities with one variable. The systems of equations

or inequalities. Definition of the roots of the equations or inequalities. Methods to solve rational, exponential, logarithmic and trigonometric equations and inequalities.

References: 2, 3, 6, 7, 8, 9

Section 3. FUNCTIOS

Theme 1. Linear, quadratic, rational, exponential, logarithmic and trigonometric functions

Definition of the function. Domain and range. Graphs of some algebraic functions: linear function, quadratic function, the graph of cubic parabola, hyperbola. Symmetry of functions. Exponential functions. Logarithmic functions. Inverse trigonometric functions.

References: 2, 3, 6, 7, 8, 9

Theme 2. Discrete algebra

Mathematical induction principle. Arithmetic progression. Common difference. The formula for the sum of an arithmetic progression. Geometric progression. Common ratio. The formula for the sum of an infinite geometric progression with common ratio $|q| < 1$. Binomial theorem.

References: 2, 3, 6, 7, 8, 9

Theme 3. Derivative of the function

The average rate of change of a function. The instantaneous rate of change of a function. Geometric and physical content derivative of the function. Differentiation rules (derivative of a sum, derivative of a difference, derivative of a product, derivative of a ratio of the functions). A common table of derivatives. Intervals of increasing and decreasing of a function. Maxima and Minima of Functions. Global maximum (minimum).

References: 2, 3, 6, 7, 8, 9

Theme 4. Indefinite and definite integrals

Definition a primitive of a function. Indefinite integral. Properties an indefinite integral. A table of common integrals. Definite integrals. Properties a definite integral. Newton`s-Leibniz formula.

References: 2, 3, 6, 7, 8, 9

Section 4. ELEMENTS OF COMBINATORICS, BASICS OF PROBABILITY THEORY AND ELEMENTS OF STATISTICS

Theme 1. Basics of probability theory and statistics

Permutations, combinations, placement. Combinatorial rules and the amount of product, classic definition of probability of random events, the easiest cases to calculate to probability of events, the definition of selected properties for a number of data graphic, tabular, text and other forms of submission of statistical information.

References: 9

GEOMETRY

Section 1. PLANE GEOMETRY

Theme 1. Simple geometric shapes on a plane

Basic terms of geometry: points, line, planes, locus, segments, chord, diameter, bisector. Types of angles, Perpendicular lines. Parallel lines. Postulates. Simple theorems.

References: 1, 4, 5

Theme 2. Circle

Circle and its elements: center, radius, chord, diameter, secant. Congruent circles. Concentric circles. Point of tangency. Angles and segments.

References: 1, 4, 5

Theme 3. Triangles

Types of triangles and their main properties. Simple theorems about congruent of triangles. Median. Altitud. Foot. Similar triangles. Right triangles. The Pythagorean theorem. Special right triangles. Geometric inequalities. Formulas based on trigonometry.

References: 1, 4, 5

Theme 4. Quadrilateral

Squar, rectangle. parallelogram, rhombus, trapezoid and their properties. The middle line of the trapezoid. Inscribed and described circles around quadrangles.

References: 1, 4, 5

Theme 5. Polygon

Convex polygon. Equilateral polygon. Equiangular polygon. Regular polygon. Inscribed and described circles around polygon. The perimeter of the polygon.

References: 1, 4, 5

Theme 6. Vector

Cartesian coordinate system. Coordinates of a point, the formula to calculate the distance between two points. Formula to calculate the coordinates of the midpoint. The concept of a vector, collinear vector, equal of the vectors, addition and multiplication of the vectors. Multiplication of a vector by a number. Decomposition of a vector. Scalar product of vectors and its properties. The formula to finding the angle between vectors. The conditions collinearity and perpendicularity of vectors given by coordinates.

References: 1, 4, 5

Section 2. STEREOMETRIC

Theme 1. Line and plane in space

Axioms and theorems of solid geometry. Straight line and plane in space. Properties of parallel lines, line and plane, two planes. Properties of perpendicularity lines, line and plane, two planes. Direct and inverse theorem on three perpendiculars. The distance from point to straight line, from point to plane. Straight to the parallel planes, between parallel lines, between parallel planes, crossing straight lines. The angle between lines, between line and plane, planes.

References: 1, 4, 5

Theme 2. Polyhedrons, solids and surfaces of rotation

The dihedral angle, linear angle of dihedral angle. Polyhedrons and their elements. The main types of polyhedrons: prism, parallelepiped, pyramid. Solids and surfaces of revolution and their elements. The main types of solids and surfaces of revolution: cone, truncated cone, field, section of polyhedrons and solids of

revolution plane. Combination of geometric solids, Surface area, volumes of polyhedrons and solids of revolution.

References: 1, 4, 5

Theme 3. Cartesian coordinate system in the space. Coordinates of a point, the formula to calculate the distance between two points in the space. Formula to calculate the coordinates of the midpoint. The concept of a vector, collinear vector, equal of the vectors, addition and multiplication of the vectors. Multiplication of a vector by a number. Decomposition of a vector. Scalar product of vectors and its properties. The formula to finding the angle between vectors. The conditions collinearity and perpendicularity of the vectors given by coordinates.

References: 1,4,5

TEST ITEMS

№	TEST ISSUES
1.	<p>Find the corner coefficient of the tangents line to the graph of the function $f(x) = \sin^2 x$ at a given point $x_0 = \frac{\pi}{4}$.</p> <p>A. -1; B. 1; C. 0; D. other</p>
2.	<p>Calculate $\log_3 \frac{1}{2} - \log_{\frac{1}{3}} 2 + \log_{\frac{1}{2}} \frac{1}{8}$.</p> <p>A. 1; B. 2; C. 3; D. other.</p>
3.	<p>Calculate the sum of the squares of all roots of the equation $2^{2x} - 5 \cdot 2^{x-1} + 1 = 0$.</p> <p>A. 0; B. 1; C. 2; D. other.</p>
4.	<p>Solve the equation $\sqrt{x+2} + \sqrt{x^2-4} = 0$.</p> <p>A. 2; B. -2; C. ± 2; D. other.</p>
5.	<p>Find the ordinate of the vertex of the parabola $y = x^2 + 8x$.</p> <p>A. -4; B. 0 C. -16; D. other.</p>
6.	<p>Calculate the smallest integer solution of the inequality $2 - \frac{x-3}{x-2} > \frac{x-2}{x-1}$.</p> <p>A. 3; B. 1; C. -2; D. other.</p>
7.	<p>Find the largest integer solution of the inequality $\left(\frac{2}{5}\right)^x > 2,5$.</p> <p>A. 0; B. -5; C. -2; D. other.</p>
8.	<p>The sides of a rectangular triangle form the arithmetic progression, and its area equals 6. Calculate the hypotenuse of this triangle.</p> <p>A. 4; B. 5; C. 3; D. other.</p>

№	TEST ISSUES
9.	<p>Calculate $x+y$, if $\begin{cases} x+y=1 \\ 2x-y=3 \end{cases}$</p> <p>A. 1; B. -1; C. 3; D. other.</p>
10.	<p>Calculate a derivative of the function $y = \frac{2x-3}{x+4}$ in the point $x=-3$.</p> <p>A. 0; B. 11; C. -12; D. other.</p>
11.	<p>Find the smallest positive integer value of the domain of the function $y = \sqrt{x^2 - 2x - 3}$.</p> <p>A. 1; B. 3; C. 2; D. other.</p>
12.	<p>Midline of trapezoid equals 10 cm and divides its area in the ratio 3:5. Find the sides of trapeze bases.</p> <p>A. 5 cm and 15 cm; B. 3 cm and 17 cm; C. 4 cm and 16 cm; D. other.</p>
13.	<p>Find the smallest integer solution of the inequality $\sqrt{x^2 - 9} \geq 4$.</p> <p>A. 1; B. 5; C. 0; D. other.</p>
14.	<p>Calculate a scalar product of the vectors $\vec{a}(0;3;4)$ and $\vec{b}(-1;0;3)$.</p> <p>A. -1; B. 3; C. 12; D. other.</p>
15.	<p>Find a intersecting point of the lines $y = 2x + 1$ and $y = 5x - 2$?</p> <p>A. (1; 3); B. (-2; 3); C. (-1; 3); D. other.</p>
16.	<p>Solve the equation $\log_2(x^2 - 16) = 3$.</p> <p>A. 5; B. -5; C. ± 5; D. other.</p>
17.	<p>Calculate the sum of the roots of the equation $\sqrt{12-x} = x$.</p> <p>A. 3; B. -1; C. 0; D. other.</p>

№	TEST ISSUES
18.	<p>Calculate the smallest integer value of the domain of the function $y = \frac{1}{\sqrt[5]{1-x^2}}$.</p> <p>A. 5; B. 3; C. 2; D. other.</p>
19.	<p>Find the fifth element of the geometrical progression (a_n), if $b_1=0,4, b_2=1,2$.</p> <p>A. 0,34; B. 4,43; C. 32,4; D. other.</p>
20.	<p>Calculate the minimum point of the function $y = 2x^3 - 15x^2 + 24x + 3$.</p> <p>A. 0; B. 4; C. -1; D. other.</p>
21.	<p>Calculate 12 % of a number $\frac{3}{4} - \frac{1}{6} + \frac{1}{3}$.</p> <p>A. 0,11; B. 0,4; C. 0,14; D. other.</p>
22.	<p>Calculate $\sin 0 + \cos 0 + \sin \frac{\pi}{4} \cos \frac{\pi}{4}$.</p> <p>A. 0,5; B. 1,5; C. 1; D. other.</p>
23.	<p>Solve of the equation $\sin 2x = 0$, which belongs to the interval $(0^\circ; 180^\circ)$. Provide the answer in degrees.</p> <p>A. 120°; B. 45°; C. 90°; D. other.</p>
24.	<p>Calculate the largest value of the function $y = x^2 - 2x$ on the interval $[-1; 4]$.</p> <p>A. 2; B. 8; C. 25; D. other.</p>
25.	<p>Calculate the largest root of the inequality $x-2 \leq 1$.</p> <p>A. 3; B. 2; C. 1; D. other.</p>

RECOMMENDED LITERATURE

1. Bevz H.P. ta inshi. Heometriya: pidruchnyk dlya 10-11 kl. zahal'noosvitnikh navchal'nykh zakladiv. – K.:, 2004. – 224 s.
2. Nelin YE.P. Alhebra i pochatky analizu: Dvorivnevyy pidruchnyk dlya 10 klasu zahal'noosvitnikh navchal'nykh zakladiv. – KH.: Svit dytynstva,2004. – 432 s.
3. Nelin YE.P. Alhebra i pochatky analizu: Dvorivnevyy pidruchnyk dlya 11 klasu zahal'noosvitnikh navchal'nykh zakladiv. – KH.: Svit dytynstva,2005. – 392 s.
4. Tadeyev V.O. Heometriya 10 klas: Pidruchnyk. – Ternopil': Navchal'na knyha – Bohdan. 2003.–384 s.
5. Tadeyev V.O. Heometriya 11 klas: Pidruchnyk. – Ternopil': Navchal'na knyha – Bohdan. 2004.–480 s.
6. Shkil' M.I., Kolesnyk T.V., Khmara T.M. Alhebra i pochatky analizu: Pidruchnyk dlya 10 klasu z pohlyblenym vyvchennyam matematyky v serednikh zakladakh osvity. – K.:Osvita, 2004. – 318 s.
7. Shkil' M.I., Kolesnyk T.V., Khmara T.M. Alhebra i pochatky analizu: Pidruchnyk dlya 11 klasu z pohlyblenym vyvchennyam matematyky v serednikh zakladakh osvity. – K.:Osvita, 2001. – 311 s.
8. Shkil' M.I., Slyepkan' Z.I., Dubnychuk O.S. Alhebra i pochatky analizu: Pidruchnyk dlya 10 klasu zahal'noosvitnikh navchal'nykh zakladiv. – K.:Zodiak – EKO, 2002. – 272 s.
9. Shkil' M.I., Slyepkan' Z.I., Dubnychuk O.S. Alhebra i pochatky analizu: Pidruchnyk dlya 11 klasu zahal'noosvitnikh navchal'nykh zakladiv. – K.:Zodiak – EKO, 2006. – 384 s.