MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
SIMON KUZNETS KHARKIV NATIONAL UNIVERSITY OF ECONOMICS

APPROVED
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PROGRAM OF THE ENTRANCE EXAM IN MATHEMATICS

educational level "bachelor"
(for foreigners and non-citizens)

Kharkiv, 2025

Introduction

The entrance exam in mathematics for foreigners or non-citizens is held for studying at Simon Kuznets Kharkiv National University of Economics in all specialities.

The purpose of entrance exam in mathematics

Assessment of the readiness of applicants in mathematics for competitive selection for higher education.

The entrance exam in mathematics aims to assess the knowledge and skills of participants:

– to construct mathematical models of real objects, processes and phenomena and investigate these models by means of mathematics;

– to carry out mathematical calculations (operations on numbers given in different forms, operations with percentages, forming and solving proportions, approximate calculations, etc.);

– to carry out the transformation of expressions (understanding the value of each element of the expression, finding admissible values of variables, finding the numerical values of expressions for given values of variables, expressing one variable of the equality of two expressions through the other, etc.);

– to plot and analyze graphs of functional dependencies, investigate their properties;

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

– to plot and define geometric shapes in drawings, define their properties and perform geometric constructions;

– to find the quantitative characteristics of geometric shapes (lengths, angles, areas);

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

– to analyze information presented in various forms (graphic, tabular, text, etc.).

Name of section, theme	Knowledge	Subject skills and ways of an educational activity
ALGEBRA AND PRE-CALCULUS		
Section: NUMBERS AND EXPRESSIONS		
Rational numbers, a comparison of rational numbers, operations on rational numbers	– rules of basic operations with integers and rational numbers; – rules of comparing real numbers; – test of a divisibility 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 a degree with natural, integer and rational indicators, their properties	– define types of numbers; – compare real numbers, values of numerical expressions, including such expression containing arithmetic square radicals (or roots) (without using computing steps); – carry out arithmetic operations on real numbers; – carry out actions on degrees with rational indicator; – carry out actions on those approximate
Percentage. Main percentage problems	– definition of a percent; – rules for carrying out of percentage calculations; – formulas of calculation of a simple percent; – formulas of calculation of a compound percent	– find the ratio of numbers as a percentage, a percentage of a number, a number by the value of its percentage; - solve percentage problems using the formula of compound interest
Rational, power, exponential, trigonometric expressions	– definition of the range of admissible values of variables of an expression with variables; – definition of a monomial and a polynomial; – rules of an addition, a subtraction and a multiplication of monomials and polynomials; – formulas of abbreviated multiplication;	– carry out transformations of polynomials, algebraic fractions, expressions containing power, exponential, and trigonometric functions and find their numerical value;

	– definition of an algebraic fraction; – rules for carrying out of arithmetic operations with algebraic fractions; – definition of sine, cosine, tangent of a numerical argument; – the relationship between the trigonometric functions of the same argument; – reducing formulas; – formulas of addition and their consequences	– simplify exponential and trigonometric expressions; – carry out transformations of expressions containing radicals (or roots);
Section: EQUATION AND INEQUALITY, THEIR SYSTEMS		
Linear, quadratic, rational, exponential, trigonometric equations, inequalities. An application of equations, inequalities to solving text problems	– definition of a equation with one variable, the root (solution) of the equation with one variable; – definition of an inequality with one variable, solving an inequality with one variable; – definition of equivalent equations, inequalities and their systems; – methods of solving rational and transcendental equations, inequalities	– solve equations and inequalities of the first and second degrees, equations and inequalities reduced to them; – solve equations and inequalities containing power, exponential and trigonometric functions; – use general methods and techniques (decomposition of an expression into multipliers, a change of a variable, an application of properties of functions) for solving equations, – use graphical method for solving and an investigation of equations, inequalities; – apply equations, inequalities to solve text problems; – solve equations and inequalities containing a variable under the sign of the module

Section: FUNCTIONS		
Linear, quadratic, power, exponential and trigonometric functions, their basic properties. Numerical sequences	– definition of a function; – ways to defining functions, basic properties and graphs of functions given in the name of the theme; – 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; – the formula for the sum of all terms of an infinite geometric progression with the denominator $q < 1$	– find the domain of the definition of a function and the range of a function values; – define a parity (oddness), a periodicity of functions; – plot graphs of elementary functions given in the name of the theme; – set properties of numerical functions according to their graphs or formulas; – use geometric transformation at a plotting of graphs of function; – solve problems using arithmetic and geometric progression
Derivative of a function, geometric and mechanical meaning. Derivatives of elementary functions. Derivative of a sum, a product and a ratio of functions.	– definition of the derivative of function at the point; – mechanical and geometric meaning of the derivative; – table of derivatives of elementary functions; – rules for finding the derivative of the sum, product, quotient of two functions;	– find derivatives of an elementary functions; – find a numerical value of a derivative of function for a given value of the argument; – find the derivative of the sum, product, fraction of the function; – solve problems using the geometric and mechanical meaning of the derivative

Investigation of a function using a derivative. Plotting of function graphs	- sufficient condition for the increasing (decreasing) of the function in the interval; - defining extremum points and extremums of a function; - necessary and sufficient conditions for the extremum of the function; - defining the largest and smallest values of the function	- 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 on a given segment; - investigate functions using derivatives and plot them; - solve applied problems to find the largest and smallest values
Antiderivative and definite integral. Apply a definite integral to the calculation of areas and volumes	- definition of antiderivative, definite integral, curvilinear trapezoid; - table of integrals of elementary functions; - integration rules; - Newton - Leibniz formula	– find the antiderivative using table of integrals of elementary functions; - apply the formula Newton - Leibniz for calculation of the definite integral; - calculate the area of a curvilinear trapezoid using the integral; - solve the simplest applied problems, which are reduced to finding the integral

Section: ELEMENTS OF COMBINATORICS, PROBABILITY THEORY AND ELEMENTS OF STATISTICS		
Permutations (without repetitions), a number of permutations. Arrangements (without repetitions), number of arrangements. Combinations (without repetitions), a number of combinations. The concept of probability of a random event. Newton's binomial formula. The simplest cases of a probability calculation. The concept of statistics. Statistical characteristics of data series	- formulas for calculating the amount of each type of combinations without repetition; - Newton's binomial formula; - a classical definition of the probability of an event, the simplest cases of calculating the probability of events; - determination of statistical characteristics of data series (sample size, mode, median, mean of a random variable)	- calculate the number of permutations, arrangements, combinations; - apply the acquired knowledge to solve the simplest combinatorial problems; - calculate the probabilities of random events in the simplest cases; - apply the rules for calculating the probabilities of the sum and product of events in the process of solving simple problems; - calculate statistical characteristics of data series (sample size, mode, median, mean of a random variable)

GEOMETRY		
Section: PLANIMETRY		
Geometric shapes and their properties. Axioms of planimetry. The simplest geometric shapes on the plane. Triangles, quadrilaterals, polygons, circle and disk.	- axioms of planimetry; - definition of geometric figures on the plane and their properties; - properties of triangles, quadrilaterals and regular polygons; - properties of chords and tangents; - definitions and signs of an equality;	- apply the definitions, properties and features of the geometric figures mentioned in the name of the theme in the process of solving problems for proof, calculation, investigation and construction; - apply the acquired knowledge to solve geometric problems
Polygons inscribed in a circle and described around a circle. Equality of geometric shapes.		- solve triangles; - solve geometric problems
Geometric quantities and their measurements. Length of a segment, circle and its parts. Degree and radian angles. Squares of figures	- measures of length, area of geometric figures; - the value of the angle, measuring angles; - formulas for the length of a circle and its arc; - formulas for calculating the areas of basic geometric figures	- find the lengths of segments, degrees of angles, areas of geometric figures; - calculate the length of a circle and its arcs, the area of a disk
Coordinates and vectors on a plane. Coordinates of points. Coordinates of the midpoint of the segment. Equation of a straight line and a circle. Equal vectors. Vector coordinates. Adding vectors. Multiplying a vector by a number. The angle between vectors. Scalar product of vectors	- equation of a straight line and circle; - formula for calculating the distance between two points and formula for calculating the coordinates of the midpoint of the segment	- use operations on vectors; - apply vectors and coordinates in the process of solving geometric and simple problems

Section: STEREOMETRY		
Geometric shapes. Axioms of stereometry. Mutual placement of lines and planes in space. Polyhedra, their types and properties.	- axioms and theorems of stereometry; - definition of geometric figures in space and their properties; - mutual placement of lines and planes in space	- different geometric figures and their elements on a plane;
Geometric quantities. Distances. Measures of angles between lines and planes.	- definition of distance: from point to plane; - measures of angles between lines and planes;	- determine the distances and degrees of angles in spatial figures; - apply definitions and properties of distances and angles in the process of solving problems;
Coordinates and vectors in space. Coordinates of points. Coordinates of the midpoint of the segment. Equal vectors. Vector coordinates. Adding vectors. Multiplying a vector by a number. The angle between the vectors. Scalar product of vectors.	- formula for calculating the distance between two points and formula for calculating the coordinates of the middle of the segment	- use operations on vectors; - apply vectors and coordinates in the process of solving geometric and simple problems

RECOMMENDED READING

1. Elementary Mathematics (Algebra) : textbook for students of the preparatory department [Electronic resource] / compil. by L. Malyarets, O. Tyzhnenko, O. Gunko, Ie. Misiura et al; Simon Kuznets Kharkiv national university of economics. – E-text data (5,93 МБ). – Kharkiv : S. Kuznets KhNUE, 2019. – 204 p. – Режим доступу : http://repository.hneu.edu.ua/handle/123456789/21503.
2. Elementary Mathematics (Trigonometry and Pre-Calculus) [Electronic resource] : textbook for students of the preparatory department / L. Malyarets, O. Tyzhnenko, O. Gunko, Ie. Misiura et al ; Simon Kuznets Kharkiv national university of economics. – E-text data (3,03 МБ). – Kharkiv : S. Kuznets KhNUE, 2020. – 144 p. – Режим доступу : http://repository.hneu.edu.ua/handle/123456789/23325.
3. Mathematics (Geometry and Vectors) [Electronic resource] : textbook for students of the preparatory department / / L. Malyarets, O. Tyzhnenko, Ie. Misiura et al ; Simon Kuznets Kharkiv national university of economics. – E-text data (3,04 МБ). – Kharkiv : S. Kuznets KhNUE, 2021. – 156 p. – Режим доступу : http://repository.hneu.edu.ua/handle/123456789/26378.
4. Kenneth O. May Elements of Modern Mathematics on Date: – New York: Dover publications inc. (USA) , 2019. – 607 p.
5. Bronshtein I. N. Handbook of mathematics / I. N. Bronshtein, K. A. Semendyaev, G. Musiol, H. Muehlig. – Dresden, Sachsen : Springer, 2015. – 1255 p.
6. Croft A., Davison R. Foundation Maths – Chicago: Pearson Education, 2020. – 640 p.
7. Frempong A. A. Elementary Mathematics & Intermediate Mathematics – Chicago: Yellowtextbooks.com, 2017. – 618 p.
8. Lawson Mark V. Algebra & Geometry: An Introduction to University Mathematics – Boca Raton, Florida: CRC Press, 2021. – 424 p.
9. Gondin W.R. Gondin, Sohmer B. Intermediate Algebra & Analytic Geometry – – London: Elsevier Science, 2014. – 288 p.

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