

Приложение № 34
к приказу от 30 сентября 2019 г. № 400-1

MOSCOW AVIATION INSTITUTE
(NATIONAL RESEARCH UNIVERSITY)

The Program for Entrance Exam in Mathematics

The first section lists the basic mathematical concepts the knowledge of which should be manifested by the applicant during a written and oral examination.

The second section is a list of basic formulas and theorems, which should be read in preparation for the exam.

The third section shows which skills are required from the applicant.

The program is created on the basis of the Federal State Educational Standards of secondary education and the Federal State Educational Standards of general education and its complexity corresponds to the CSE level in mathematics. Applicants may use the whole amount of means of this course, including the basics of the analysis. However, confident knowledge of only those concepts and their properties, which are listed in this program will be sufficient to solve examination tasks. Objects and facts not studied in secondary school can also be use by the applicant on the condition that he is able to explain and prove them.

I. Basic Concepts

1. Natural numbers (N). Exact division. Prime and composite numbers. The greatest common divisor and least common multiple.

2. Integer (Z), rational (Q) and the actual number (R). Percentages. Module number, degree, root, root arithmetic, logarithm. Sine, cosine, tangent, cotangent number (angle). Arc sine, arc cosine, arc tangent, inverse cotangent of a number.

3. Numeric and literal expressions. Equality and identity.

4. Function, its domain and range of values. Increase, decrease, frequency, even, odd. Maximum and minimum values of the function. Function graph.

5. The linear, quadratic, exponential, logarithmic, trigonometric poly--function.

6. Equations, inequalities, system. Solutions (roots) of the equation, inequality, system. Equivalence.

7. The arithmetic and geometric progressions.

8. The straight line on the plane. Ray, segment, polygon, angle.

9. Triangle. Median, bisector, height.

10. Convex polygon. Square, rectangle, parallelogram, rhombus, trapezoid. Regular polygon. Diagonal.

11. A circumference and circle. Radius, chord, diameter, tangent, secant. Circumference and circle sector. Central and inscribed angles.

12. The lines and planes in space. The dihedral angle.

13. The polyhedron. Cube, parallelepiped, prism, pyramid.

14. The cylinder, cone, ball, sphere.

15. Equality and similarity of figures. Symmetry.

16. Parallelism and perpendicularity of straight lines, planes. Skew lines. The angle between the lines, planes, line and plane.

17. Inscribed and circumscribed figures in the plane and in space. The cross section of a figure with a plane.

18. The value of the angle. The length of the segment, circle and circular arc. The area of a polygon, circle and circle sector. The surface area and volume of a polyhedron, cylinder, cone, ball.

19. Coordinate lines. Numerical intervals. Cartesian coordinates in the plane and in space. Vectors.

II. Basic Formulas and Theorems

Algebra

1. Signs of divisibility on 2, 3, 5, 9, 10.

2. Properties of numerical inequalities.

3. Formulas of brief increase.

4. Properties and chart of linear function.

5. Formula of roots of affected quadratic. Theorem about expansion of square trinomial on linear multipliers. Vieta theorem.

6. Properties and chart of quadratic function.

7. Inequality relating arithmetical mean and geometric mean of two numbers. Inequality for a sum of two mutually reverse numbers.

8. Formulas of general member and sums of n of the first numbers of members of arithmetic progression.

9. Formulas of general member and sums of n of the first members of geometrical progression.

10. Properties of degrees with natural and whole indexes. Properties of arithmetic roots of n -th degrees. Properties of degrees with rational indexes.

11. Properties and graph exponential functions with integer exponent.

12. Properties and graph of the exponential function.

13. Main logarithmic identity. Logarithm of the product, the degree of the ratio. Formula transition to the new base.

14. Properties and graph logarithmic functions.

15. Basic trigonometric identity. Relation between the trigonometric functions of the same argument. Reduction formulas, adding, double and half of the argument, the sum and difference of trigonometric functions. Expression of trigonometric functions through the half tangent of the argument. Convert the product of sines and cosines in the sum. Converting expressions $a\sin z + b\cos z$ using auxiliary argument.

16. The formula for the solution of simple trigonometric equations.

17. The properties of trigonometric functions and their graphs.

Geometry

1. Theorems about parallel lines on a plane.

2. Properties of vertical and contiguous angles.

3. Properties of isosceles triangle.

4. Signs of equality of triangles.

5. Theorem about the sum of internal angles of triangle. Theorem about external angle of triangle. Properties of middle line of triangle.

6. Intercept theorem. Similarity of triangles.

7. Signs of equality and similarity of rectangular triangles. A proportion of segments is in a rectangular triangle. Theorem of Pythagoras.

8. Property of middle perpendicular to the segment. Property of bisector of angle.

9. Theorems about crossing of medians, crossing of bisectrix and crossing of heights of triangle.

10. Property of segments by that the bisector of triangle divides an opposite side.

11. The property of the tangent to the circle. Theorems of the inscribed angles. Theorem of the angle formed by tangent line and chord. Theorems of the angle between two intersecting chords and the angle between two intersecting lines emanating from a single point. Equality of product segments of two intersecting chords. Equality of square tangent to the product of the cross-section at its outer part.

12. Property of the quadrangle entered in a circumference. Property of the quadrangle described near a circumference.

13. Theorem about the circumference entered in a triangle. Theorem about the circumference described near a triangle.

14. Theorems of sines and cosines for a triangle.

15. Theorem about the sum of internal angles of convex polygon.

16. Signs of parallelogram. Properties of parallelogram.

17. Properties of middle line of trapezoid.

18. Formula for the calculation of distance between two points on a coordinate plane. Equalization of circumference.

19. Theorems about parallel lines in space. Sign of parallelism of line and plane. Sign of parallelism of planes.

20. Sign of perpendicularity of line and plane. Theorem about a general perpendicular to two crossing lines. Sign of perpendicularity of planes. Theorem about three perpendiculars.

III. Admission Requirements

On examination in mathematics applicant must be able to:

1) perform (without a calculator) operations on numbers and numerical expressions; convert literal expressions; perform operations on vectors (addition, multiplication by a number, the scalar product); translate different units of measurement values in the other;

2) compare numbers and find their approximate values (without a calculator); prove identities and inequalities for algebraic expressions;

3) solve equations, inequalities, systems and explore their solutions;

4) investigate functions; build the charts of functions and set of points on a coordinate plane, set by equations and inequalities with parameters;

5) depict geometric shapes in the drawing; build section; explore relative position of figures; apply the signs of equality, similarity of figures and their affiliation to a particular species;

6) use the properties of numbers, vectors, functions and their graphs, properties of arithmetic and geometric progressions;

7) use of the properties of geometric figures and their characteristic points, lines and parts, properties of equality, similarity and relative position of figures;

8) use of ratios and formulas containing modules, degree, roots, logarithmic, trigonometric expressions, the angles, lengths, areas, volumes;

9) make equations, inequalities and find the values, from a specification;

10) expound and design a decision logically correctly, full and consistently, with necessary explanations.

At the interview, applicant must additionally be able to:

11) give definitions, formulate and prove assertions (formulas, ratios, theorems, features, properties, etc., mentioned in the second section, on-standing program;

12) analyse the wording of the statements and their proofs;

13) decide tasks on a construction compasses, line; to find the geometrical places of points.