Cambridge Assessment
Admissions Testing

NAZARBAYEV
UNIVERSITY

Foundation Year Programme

Entrance Tests

MATHEMATICS SPECIFICATION

For

NUFYP SET 2018

V1.0 October 2017

Mathematics

1. Number

1.1 Order, add, subtract, multiply, and divide whole numbers (integers), fractions, decimals, and numbers in index form (division involving cancelling of common factors is assumed, but long division is not required).

1.2 Use the concepts and vocabulary of factor, multiple, common factor, highest common factor, least common multiple, prime number, and prime factor decomposition.

1.3 Use the terms square, positive and negative square root, cube, and cube root.

1.4 Use index laws to simplify and for multiplication and division of integer, fractional, and negative powers.

1.5 Interpret, order, and calculate with numbers written in standard index form.

1.6 Understand equivalent fractions.

1.7 Convert between fractions, decimals, and percentages.

1.8 Understand and use percentage, including repeated proportional change and calculating the original amount after a percentage change.

1.9 Understand and use direct and indirect proportion in numerical questions.

1.10 Use ratio notation including dividing a quantity in a given ratio, and solving related problems (using the unitary method).

1.11 Understand and use number operations, including inverse operations and the hierarchy of operations.

1.12 Use surds and π in exact calculations; simplify expressions that contain surds.

1.13 Approximate to a specified and appropriate degree of accuracy, including rounding to a given number of decimal places or significant figures.

1.14 Know and use approximation methods to produce estimations of calculations.

1.15 Know standard SI units for mass [kilogram], time [seconds], and length [metres]; know and be able to use common prefixes: kilo, deci, centi, and milli.

2. Algebra

2.1 Distinguish between the different roles played by letter symbols.

2.2 Manipulate algebraic expressions by collecting like terms; by multiplying a single term over a bracket; by expanding the product of two linear expressions; by factorising to identify structure and possible simplifications.

2.3 Set up and solve simple equations, including simultaneous equations involving two unknowns.

2.4 Simplify rational expressions by cancelling, or by factorising and cancelling; use the four rules on algebraic rational expressions, including linear and quadratic expressions.

2.5 Factorise the difference of two squares, and both the sum and the difference of two cubes.

2.6 Set up quadratic equations, and solve them by factorising.

2.7 Know the sum and product properties of the roots of a quadratic equation.

2.8 Understand and use the formulae for the roots of a quadratic equation; including the use of the discriminant to determine whether a quadratic equation has two distinct real roots, one repeated real root, or no real roots.

2.9 Set up and use equations to solve algebraic problems involving direct and indirect proportion; this might include questions involving squares, cubes, square roots, and cube roots.

2.10 Derive a formula; substitute into a formula.

2.11 Change the subject of a formula.

2.12 Solve linear inequalities in one or two variables.

2.13 Solve quadratic inequalities.

2.14 Generate terms of a sequence using term-to-term and position-to-term definitions.

2.15 Use linear expressions to describe the n^{th} term of a sequence.

2.16 Use Cartesian coordinates in all four quadrants.

2.17 Recognise equations of straight lines; understand $y = mx + c$ and the gradients of parallel lines. Find the equation of a line given sufficient information.

2.18 Understand how to solve, both algebraically and graphically, simultaneous equations, where one is linear and one is quadratic; this might include questions in which the equations are given in a practical context.

2.19 Recognise and interpret graphs of simple cubic functions, the reciprocal function, and the exponential function $y = k^x$ for integer values of x and simple positive values of k.

2.20 Construct linear functions from real-life problems; interpret graphs modelling real situations.

2.21 Generate points of simple quadratic functions.

2.22 Use index laws in algebra for multiplication and division of integer, fraction, and negative powers.

2.23 Understand and use the notion of a function, and composite function. This includes the understanding and use of the notation $f(g(x))$.

2.24 Interpret and analyse transformations of functions: $y = af(x)$; $y = f(ax)$; $y = f(x) + a$; $y = f(x - a)$. This might include composition of two of these transformations.

3. Geometry

3.1 Recall and use the properties of angle at a point, angles on a straight line, perpendicular lines, and opposite angles at a vertex.

3.2 Understand and use the angle properties of parallel lines, intersecting lines, triangles, and quadrilaterals.

3.3 Calculate and use the sums of the interior and exterior angles of regular polygons.

3.4 Understand and use the properties and definitions of special types of triangles and quadrilaterals [including right-angled triangle, isosceles triangle, equilateral triangle, square, rectangle, parallelogram, and rhombus]; questions may include calculations of areas and perimeters of such shapes.

3.5 Recognise and use reflectional and rotational symmetry of 2-dimensional shapes.

3.6 Understand and use the ideas of congruence and similarity.

3.7 Use Pythagoras' theorem in both 2- and 3-dimensions.

3.8 Use the trigonometric ratios, between 0° and 180°, to solve problems in both two and three dimensions (candidates are not expected to recall trigonometric function values, or use the sine or cosine rules). Knowledge of $\sin^2\theta + \cos^2\theta = 1$ is required.

3.9 Understand the circle theorems:
- the angle subtended at the circumference in a semicircle is a right angle;
- the tangent at any point on a circle is perpendicular to the radius at that point.

3.10 Describe and transform 2-dimensional shapes using single or combined rotations, reflections, translations, or enlargements.

4. Measures

4.1 Calculate perimeters and areas of shapes made from triangles, rectangles, and other shapes.

4.2 Find circumferences and areas of circles, including calculating the lengths of arcs and sectors.

4.3 Calculate the volumes and surface areas of right prisms, pyramids, spheres, cylinders, cones, and solids made from cubes and cuboids, or composites of other solids.

4.4 Use vectors, including the sum of two vectors, algebraically and graphically.

4.5 Understand and use the effect of enlargement for perimeter, area, and volume of shapes and solids.

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