



NAZARBAYEV
UNIVERSITY

Foundation Year Programme

Entrance Tests

MATHEMATICS SPECIFICATION

NUFYP SET 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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