NILE TUITION ACADEMY
Excellence in Further Maths Tuition
niletuitionacademy.co.uk

A-Level Further Maths

Full Specification - Spec Cheat Sheet · Core + all options

AQA Further Maths (7367) | Core + all options | 127 spec points

Every specification point for **Full Specification**, in spec order - tick each one off as you revise. Codes match the official AQA specification. Nothing here is optional.

Compulsory A: Proof

A1	Build on AS/A-Level Mathematics proof; construct rigorous mathematical arguments and proofs.
A2	Use proof by induction to establish results, for example sums of series, divisibility statements and powers of matrices.

Compulsory B: Complex numbers

B1	Solve any quadratic equation with real coefficients; solve cubic and quartic equations with real coefficients.
B2	Add, subtract, multiply and divide complex numbers given in the form x + iy, where x and y are real.
B3	Understand and use the complex conjugate; know that non-real roots of a real-coefficient polynomial occur in conjugate pairs.
B4	Use and interpret the Argand diagram; represent complex numbers as points and as vectors.
B5	Work with the modulus and argument of a complex number; know the definition |z| and arg(z) and the relationship to the Cartesian form.
B6	Convert between Cartesian form and modulus-argument (polar) form; write a complex number as r(cos t + i sin t).
B7	Multiply and divide complex numbers in modulus-argument form, including the effect on moduli and arguments.
B8	Construct and interpret loci in the Argand diagram, such as |z - a| = r and arg(z - a) = t, and regions defined by inequalities.
B9	Understand de Moivre's theorem and apply it to trigonometric identities and to roots of complex numbers.
B10	Know and use the exponential form e^(i t) = cos t + i sin t for a complex number.
B11	Find the n distinct nth roots of a non-zero complex number and know they form the vertices of a regular polygon in the Argand diagram.
B12	Use complex roots of unity to solve geometric and other problems.

Compulsory C: Matrices

C1	Add, subtract and multiply conformable matrices; multiply a matrix by a scalar.
C2	Understand and use zero and identity matrices.
C3	Use matrices to represent linear transformations in 2-D; successive transformations; single transformations in 3-D (limited to reflection in a coordinate plane and rotation about a coordinate axis).
C4	Find invariant points and invariant lines for a linear transformation.
C5	Calculate determinants of 2x2 and 3x3 matrices and interpret them as scale factors, including the effect on orientation.

C6	Understand and use singular and non-singular matrices; properties of inverse matrices.
C7	Calculate and use the inverse of a non-singular 2x2 matrix and a non-singular 3x3 matrix.
C8	Solve three linear simultaneous equations in three variables by use of the inverse matrix.
C9	Interpret geometrically the solution and non-existence of solutions of three simultaneous linear equations.

Compulsory D: Further algebra and functions

D1	Understand and use the relationships between the roots and coefficients of polynomial equations up to quartic equations.
D2	Form a polynomial equation whose roots are a linear transformation of the roots of a given polynomial equation.
D3	Understand and use the method of differences for the summation of series, including the use of partial fractions.
D4	Find the Maclaurin series of a function, including the general term where it can be found.
D5	Recognise and use the Maclaurin series for e^x, ln(1 + x), sin x, cos x and (1 + x)^n, including the interval of validity.

Compulsory E: Further calculus

E1	Evaluate improper integrals where either the integrand is undefined at a value in the range of integration or the range of integration extends to infinity.
E2	Understand and evaluate the mean value of a function over a given interval.
E3	Integrate using partial fractions extended to denominators with a repeated and/or a quadratic factor.
E4	Differentiate inverse trigonometric functions.
E5	Integrate functions of the form (a^2 - x^2)^(-1/2) and (a^2 + x^2)^(-1) and be able to choose trigonometric substitutions to integrate associated functions.
E6	Derive formulae for and calculate volumes of revolution about both the x-axis and the y-axis.
E7	Understand and use the formula for arc length, including in Cartesian, parametric and polar form.
E8	Understand and use the formula for the surface area of a surface of revolution, including in Cartesian, parametric and polar form.

Compulsory F: Further vectors

F1	Understand and use the vector and Cartesian forms of an equation of a straight line in 3-D.
F2	Understand and use the vector and Cartesian forms of the equation of a plane.
F3	Calculate the scalar product and use it to express the equation of a plane and to calculate the angle between two lines, the angle between two planes and the angle between a line and a plane.
F4	Check whether vectors are perpendicular by using the scalar product.
F5	Find the intersection of a line and a plane; calculate the perpendicular distance between two lines, from a point to a line and from a point to a plane.

Compulsory G: Polar coordinates

G1	Understand and use polar coordinates and be able to convert between polar and Cartesian coordinates.
G2	Sketch curves with r given as a function of t, including use of trigonometric functions.
G3	Find the area enclosed by a polar curve using the integral one half of the integral of r squared with respect to t.

Compulsory H: Hyperbolic functions

H1	Understand the definitions of hyperbolic functions sinh x, cosh x and tanh x, including their domains and ranges, and be able to sketch their graphs.
H2	Differentiate and integrate hyperbolic functions.
H3	Understand and be able to use the definitions of the inverse hyperbolic functions and their domains and ranges.
H4	Derive and use the logarithmic forms of the inverse hyperbolic functions.
H5	Integrate functions of the form (x^2 + a^2)^(-1/2) and (x^2 - a^2)^(-1/2) and be able to choose substitutions to integrate associated functions.

Compulsory I: Differential equations

I1	Find and use an integrating factor to solve first order linear differential equations and recognise when it is appropriate to do so.
I2	Find both general and particular solutions of differential equations and use boundary conditions to find particular solutions.
I3	Use differential equations in modelling in kinematics and in other contexts.
I4	Solve differential equations of the form y'' + a y' + b y = 0 where a and b are constants, by using the auxiliary equation.
I5	Solve differential equations of the form y'' + a y' + b y = f(x) where a and b are constants, by solving the homogeneous case and adding a particular integral to the complementary function.
I6	Understand and use the relationship between the cases when the discriminant of the auxiliary equation is positive, zero and negative, and the form of the solution.
I7	Solve the equation for simple harmonic motion x'' = -k^2 x and relate the solution to the motion.
I8	Model damped oscillations using second order differential equations and interpret the solutions for light, critical and heavy damping.
I9	Analyse and interpret models of situations with one independent variable and two dependent variables as a pair of coupled first order simultaneous equations, and be able to solve them, for example for predator-prey models.

Compulsory J: Trigonometry

J1	Understand and use the definitions of the inverse trigonometric functions, their domains and ranges, and be able to sketch their graphs.

Compulsory K: Numerical methods

K1	Use numerical methods to find approximate solutions, including the use of the mid-ordinate rule and Simpson's rule for integration.

Option: Mechanics - MA Dimensional analysis

MA1	Find the dimensions of a quantity in terms of mass, length and time (M, L, T).
MA2	Use dimensional analysis to find the units of a quantity in terms of base SI units.
MA3	Use dimensional analysis to check the consistency of, predict the form of, or determine missing exponents in physical equations.

Option: Mechanics - MB Momentum and collisions

MB1	Understand and use the definition of impulse as the change in momentum, in one and two dimensions.
MB2	Understand and use conservation of momentum in two dimensions, including the use of vectors.

MB3	Understand and use Newton's experimental law and the coefficient of restitution for direct impacts and for impacts with a fixed surface.
MB4	Understand and use the idea of successive impacts and apply conservation of momentum and the restitution law.
MB5	Understand and use oblique impact of a smooth sphere with a fixed smooth surface and oblique impact of smooth spheres, including the impulse and the change in kinetic energy.
MB6	Calculate the loss of kinetic energy due to an impact.

Option: Mechanics - MC Work, energy and power

MC1	Understand and use the work done by a force, including the work-energy principle, for a variable force.
MC2	Understand and use the definitions of gravitational potential energy, kinetic energy and elastic potential energy.
MC3	Understand and use the principle of conservation of mechanical energy and the work-energy principle in problems involving variable forces.
MC4	Understand and use the definition of power as the rate of doing work, including for a vehicle moving against a resistance.

Option: Mechanics - MD Circular motion

MD1	Understand and use angular speed and the relationships v = r w and a = r w^2 = v^2 / r for motion in a circle.
MD2	Model motion in a horizontal circle with constant speed, including the conical pendulum and motion on a banked surface.
MD3	Understand and use the equations of motion for a particle moving in a vertical circle, including conditions for completing the circle or leaving the surface.
MD4	Solve problems involving motion in a vertical circle for a particle on a string, on the inside or outside of a surface, and on a rod.

Option: Mechanics - ME Centres of mass and moments

ME1	Find the centre of mass of a system of particles and of a composite body by symmetry and by moments.
ME2	Find the centre of mass of a uniform lamina, including by integration, and of a uniform arc, sector and solid of revolution.
ME3	Use the position of the centre of mass to solve problems involving the equilibrium of a rigid body, including suspension and the point of toppling or sliding.

Option: Mechanics - MF Further kinematics

MF1	Understand and use velocity and acceleration as derivatives with respect to time when displacement is a function of time, in one and two dimensions, using vectors.
MF2	Understand and use calculus to model motion where acceleration is a function of time, of velocity or of displacement, in a straight line.
MF3	Set up and solve differential equations to model rectilinear motion under a variable force.

Option: Statistics - SA Discrete random variables and expectation

SA1	Understand and use the expectation and variance of a discrete random variable, including E(aX + b) and Var(aX + b).
SA2	Understand and use the expectation and variance of a linear function of independent random variables, and of sums and differences of independent random variables.
SA3	Use the discrete uniform distribution as a model, including its mean and variance.

Option: Statistics - SB Poisson distribution

SB1	Understand the conditions under which a Poisson distribution is a suitable model and use the Poisson distribution to calculate probabilities.
SB2	Understand and use the mean and variance of the Poisson distribution.
SB3	Understand and use the sum of independent Poisson distributions as a model.

Option: Statistics - SC Continuous random variables

SC1	Understand and use a probability density function for a continuous random variable, including verifying that a function is a valid density function.
SC2	Find the mean, variance, median, quartiles and mode of a continuous random variable from its probability density function.
SC3	Understand and use the cumulative distribution function and the relationship between it and the probability density function.
SC4	Understand and use the continuous uniform (rectangular) distribution as a model, including its mean and variance.

Option: Statistics - SD Hypothesis testing and confidence intervals

SD1	Understand and apply the distribution of the sample mean of a sample drawn from a normal distribution with known variance.
SD2	Carry out a hypothesis test for the mean of a normal distribution with known variance.
SD3	Construct and interpret a confidence interval for the mean of a normal distribution with known variance.
SD4	Carry out a hypothesis test for the mean of a Poisson distribution using a suitable approximation or exact probabilities.

Option: Statistics - SE Chi-squared tests for contingency tables and goodness of fit

SE1	Understand and use the chi-squared statistic as a measure of goodness of fit between observed and expected frequencies.
SE2	Carry out a goodness of fit test for given discrete and continuous distributions, including the discrete uniform, binomial, Poisson and continuous uniform, calculating expected frequencies and degrees of freedom.
SE3	Carry out a chi-squared test for independence in a contingency table, including determining degrees of freedom and pooling classes where expected frequencies are small.

Option: Discrete - DA Graphs

DA1	Understand and use the language of graphs, including vertices, edges, degree, walks, trails, paths, cycles, connectedness, trees, simple graphs and bipartite graphs.
DA2	Understand and use the handshaking lemma relating the sum of vertex degrees to the number of edges.
DA3	Understand and use adjacency matrices and distance matrices to represent a graph or network.
DA4	Understand and use the terms Eulerian and semi-Eulerian and the conditions for a graph to be Eulerian or semi-Eulerian; understand the terms Hamiltonian and planar.

Option: Discrete - DB Networks and minimum spanning trees

DB1	Find a minimum spanning tree of a network using Kruskal's algorithm.
DB2	Find a minimum spanning tree of a network using Prim's algorithm in graphical form and from a distance matrix.
DB3	Find a shortest path between two vertices in a network using Dijkstra's algorithm.

Option: Discrete - DC Route inspection and the travelling salesperson problem

DC1	Solve the route inspection (Chinese postman) problem for a network with up to four odd vertices, finding the shortest closed route that traverses every edge.
DC2	Understand the travelling salesperson problem and the difference between the classical and practical versions.
DC3	Use a minimum spanning tree to find a lower bound for the travelling salesperson problem.
DC4	Use the nearest neighbour algorithm to find an upper bound for the travelling salesperson problem.

Option: Discrete - DD Algorithms and sorting

DD1	Understand and use the idea of an algorithm and be able to trace, implement and interpret algorithms given in words or as flow charts.
DD2	Carry out and interpret bubble sort and quick sort algorithms on a list.
DD3	Understand and use the order of an algorithm and compare the efficiency of algorithms in terms of their order.
DD4	Carry out bin packing using first-fit, first-fit decreasing and full-bin strategies and understand the heuristic nature of these methods.

Option: Discrete - DE Critical path analysis

DE1	Construct and interpret an activity network using activity-on-node, including the use of dummy activities and precedence tables.
DE2	Carry out a forward and backward pass to find early and late event times and determine the critical activities and the critical path.
DE3	Calculate the total float of an activity and understand its meaning.
DE4	Construct and interpret Gantt (cascade) charts and resource histograms, and carry out resource levelling.

Option: Discrete - DF Linear programming

DF1	Formulate a problem as a linear programming problem in two variables, identifying the objective function and constraints.
DF2	Solve a two-variable linear programming problem graphically, using the objective line (ruler) method or the vertex method.
DF3	Find optimal integer solutions to a linear programming problem where appropriate.
DF4	Use the simplex algorithm and simplex tableaux to solve maximisation problems subject to constraints of the form less than or equal to, including the interpretation of slack variables.

Option: Discrete - DG Game theory and network flows

DG1	Understand and use pay-off matrices for two-person zero-sum games; identify play-safe strategies and stable solutions (saddle points).
DG2	Reduce a pay-off matrix using dominance arguments and find an optimal mixed strategy for a game with no stable solution by converting to a linear programming problem.
DG3	Understand and use the language of flows in a network, including sources, sinks, capacities, cuts and the value of a flow.
DG4	Use the maximum flow minimum cut theorem and the flow augmentation method to find the maximum flow through a network.