GCSE Edexcel Mathematics – Specification (Higher)

1. Number

Structure and calculation
N1 – Ordering positive and negative whole numbers, decimals and fractions and understanding of inequality and equals symbols

N2 – Addition, subtraction, multiplication and division with positive and negative whole numbers, decimals, fractions (improper/proper/mixed number), and understanding of place value

N3 – BIDMAS, reciprocals, and understanding of inverse operations to cancel e.g. fractions

N4 – Understanding of prime numbers, factors, multiples, HCF, LCM, How to write a number as product of prime factors, find HCF and LCM using listing method, product of prime factors, and prime factorisation and Venn Diagrams

N5 – Systematic listing and product rule

N6 – Rules of indices for multiplying, dividing, brackets and being able to find square and cubes including roots

N7- Fractional indices (and how this relates to finding roots). Negative indices.

N8 – Leaving answers in exact form e.g. as a fraction, in terms of Pi and as surds. Be able to simplify surds (use diamond method), add, subtract, multiply and divide with surds, and rationalise the denominator.

N9 – Converting between ordinary numbers and standard form, and being able to complete calculations with and without a calculator (add, subtract, multiply and divide).

Fractions, decimals and percentages
N10 – Convert between fractions and decimals including terminating and recurring

N11 –Work with fractions in ratio problems – be able to convert ratio in to fractions and vice versa

N12 – Fractions and percentages as operators – fractions of (means multiply fraction by amount), percentages as multipliers etc.

Measures and accuracy
N13 – Know basic metric conversions including cm^3 to ml. Know what units are appropriate as measures. Know compound measures (speed, density and pressure) – need to know the formulas and how to use them (use as triangles like SohCahToa). How to combine compound measures (e.g. liquid A and B are mixed to make liquid C – find density of liquid C if given information about volume and density of liquid A and B).

N14 – Estimating answers by rounding to suitable degrees of accuracy first (e.g. 1 significant figure).

N15 – rounding to decimal places and significant figures. Writing error intervals (from rounding and truncation)

N16 – Calculations involving upper and lower bounds

2. Algebra

Notation, vocabulary and manipulation

A1 – Algebraic notation (e.g. number and letter next door to each other are multiplying, using indices to simplify, using fractions instead of division, coefficients as fractions as well as decimals)

A2 –Substitution in to expressions, equations, formulae including scientific formulae

A3 – Know the difference between terms, expression, equation, inequality, identity, formulae and factors

A4 – Simplify expressions by collecting like terms, expanding single and double brackets, factorising in to single brackets, factorising quadratics in to double brackets (including with coefficients greater than 1 such as $2x^2$)

A5 – Rearranging to change the subject of a formula (including when you have to expand and factorise)

A6 – Algebraic proofs

A7 – Functions, including composite/compound functions and inverse functions

Graphs

A8 – Be able to plot and interpret co-ordinates in 4 quadrants and draw axes accurately

A9 – Plot straight line graphs (use or construct table of values first). Understand y=mx +c. Be able to identify parallel lines (same gradient) and perpendicular lines (m_1 x m_2 = -1). Be able to find the gradients and equations of lines from graphs. Be able to find the equation of a line through two given points, or one point and a gradient (including lines parallel and perpendicular to other lines)

A10 – Identify and interpret gradients and intercepts graphically and algebraically (link to real life graphs – e.g. Intercepts could be standing charges)

A11 – Be able to work out and interpret the roots, intercepts, turning points of quadratic graphs (functions) from a graph. To be able to work out the same things using algebra (roots by factorising, turning point by completing the square)

A12 – Be able to recognise, sketch and interpret the following graphs: straight line, quadratic, cubic, reciprocal, exponential, trig graphs (sin, cos, tan)

A13 – Graph transformations

A14 – Real life graphs – being able to plot all types of graphs (table of values) and interpret, such as finding distance, speed or acceleration from interpreting graph

A15 – Calculate or estimate gradients of graphs (e.g. gradient at a point using tangent). Area under graphs including under curved graphs using trapeziums. Be able to interpret distance-time graphs, velocity-time graphs and financial graphs

A16 – Equation of a circle with centre at origin (0, 0). Equation of tangent to circle.

Solving equations and inequalities

A17 – Solving one and two step equations. Solving equations involving brackets. Solving equations involving fractions. Solving equations with unknowns on both sides. Finding solutions from graphs.

A18- Solving quadratic equations including when you have to rearrange first, by factorising, completing the square and using quadratic formulae (you need to know when to use each of these). Solving quadratics from graphs.

A19 – Solving simultaneous equations, including when both linear, when one is linear and one is quadratic and graphically.

A20 – Iteration – ensure you can answer all 3 parts of the question.

A21 – Forming and solving equations from written problems, including simultaneous equations and be able to interpret the answers.

A22 – Solve linear inequalities (including when it is double sided), including being able to represent solutions on a number line and by graphing. Be able to solve quadratic inequalities (remember the little sketch at the end to help write the solution using inequality notation).

Sequences

A23 – Be able to generate/continue a sequence using term-to-term and position-to-term (nth term) rules

A24 – Know the different types of sequences – square and cube numbers, triangular numbers, difference between arithmetic, geometric and Fibonacci sequences. Know about simple geometric progressions, and sequences involving surds.

A25 – Be able to find the nth term rule for linear and quadratic sequences

3. Ratio, proportion and rates of change

R1 – Be able to convert easily between units (time, length, area, volume/capacity, mass) and compound units in numerical and algebraic contexts

R2- Scale factors, including for area and volume, scale diagrams and maps.

R3 – One number as a fraction of another

R4 – Be able to write and simplify ratio

R5 – Share/divide in to a ratio, and ratio in real life contexts

R6 – Express the relationship between two quantities as ratios and fractions

R7 – Understand and use proportion as equality of ratios (link between them)

R8 – Understand link between ratio and fractions and to linear functions

R9 – Percentages – define and interpret – be able to represent percentages as decimals and fractions and use this with multiplication. One number as a percentage of another. Compare using percentages (e.g. convert from fractions first). Be able to use percentages greater than 100% and in real world contexts. Be able to complete non-calculator and calculator (using multipliers) percentage of amounts, percentage increase/decrease, reverse percentages and compound percentages (including finding the missing timeframe or multiplier).

R10 – Direct and inverse proportion – equations and problems, and being able to graph/recognise graphs

R11 – Use compound units – speed/density/pressure/rates of pay/unit pricing

R12 – Compare lengths, area and volume using ratio. Be able to relate these to scale factors and similarity (including trig ratios).

R13 – Deeper understanding of inverse and direct proportion (if x is inversely proportional to y, this is the same as being directly proportional to 1/y). Be able to construct and interpret equations that describe direct and inverse proportion.

R14 – Understanding gradients of lines as rate of change on graphs. Recognise graphs of inverse and direct proportion.

R15 – Gradient at a point on a curve as instantaneous rate of change and be able to apply this (e.g. gradients of chords and tangents), in numerical, algebraic and graphical contexts

R16 – Form, solve and interpret equations for growth and decay problems (including compound interest) and how these relate to iterative processes.

4. Geometry and measure

Properties and constructions
G1 – Understand the terminology: points, lines, vertices, edges, planes, parallel lines, perpendicular lines, right angles, polygons, regular polygons. Know polygons with reflection and/or rotational symmetry. Know the notation used to show lines/angles are equal in length and parallel lines. Know the notation for labelling and referring to sides and angles in triangles (e.g. three letter angle reference). Be able to draw diagrams from written descriptions.

G2 – Compass constructions – perpendicular bisector, angle bisector, construct perpendicular line from/at a given point, construct types of triangles. Know Loci and compass constructions in contextual problems. Know that perpendicular distance from a point to a line is the shortest distance to the line.

G3 – Angle rules – around a point, on a straight line, vertically opposite, parallel lines (alternate, corresponding, co-interior), in a triangle, interior and exterior angles in polygons (formal rule and how to relate to triangles)

G4 – Properties and definitions of: square, rectangle, parallelogram, trapezium, kite, rhombus and different types of triangles. Know other basic polygons.

G5 – Congruent triangles and proofs- - SSS, SAS< ASA, RHS

G6 – Apply angle rules, congruent triangles, similarity and shape properties to conjecture and apply to angles and sides, including Pythagoras, isosceles triangles and simple proofs.

G7 – Transformations – understand that shapes are similar or congruent depending on transformation that has been applied. Know how to reflect, rotate, translate and enlarge shapes (including with negative and fractional scale factors) on axes.

G8 – Be able to describe a series of transformations as a single transformation

G9 – Circles – know the different parts and properties (centre, radius, diameter, chord, circumference, tangent, arc, sector, segment).

G10 – Know and be able to prove circle theorems

G11 – Geometric problems on axes (e.g. plot missing point based on shape properties)

G12 – Know properties of 3D shapes e.g. faces, surfaces, edge, vertices (cube, cuboid, prisms, cylinders, pyramid, cones and spheres)

G13 – Construct and interpret plans and elevations (isometric drawings)

Mensuration and calculation
G14 – Use standard units of measurement (length, time etc.)

G15 – Measure accurately line segments and angles, including maps and scale drawings. Know how to find and use bearings.

G16 – Know the formulae and how to use it for: area of triangles, parallelograms, trapezia; volume of cuboids and prisms (including cylinders).

G17 – Know the formulae for: circumference and area of circles. Be able to calculate perimeter and area of 2D shapes including circles and composite shapes. Be able to calculate surface area and volume of 3D shapes, including spheres, pyramids, cones and composite solids.

G18 – Calculate arc length (and perimeter), missing angles and area of sectors of circles

G19- Be able to understand and apply congruence and similarity (including length, area and volume) in similar shapes

G20 – Right-angled triangles - Pythagoras, Trigonometry (SohCahToa), to be able to find missing lengths/angles in 2 and 3 dimensions.

G21 – Exact trig values/ratio (sin/cos/tan of 0, 30, 45, 60 and 90 degrees)

G22 – Non- right angled triangles – sine and cosine rule for missing sides and angles

G23 – Area of non-right angled triangles – using 1/2absin(c) and be able to find missing sides/angles when given the area.

Vectors
G24 – Describe translations as 2D vectors

G25 – Be able to add/subtract and multiply column vectors. Be able to use and apply vectors on diagrams. Use vectors to construct geometric arguments and proofs.

5. Probability

P1 – Record/describe/analyse frequency of outcomes from probability experiments using **tables and frequency trees**

P2 – Understand terminology – randomness, fairness, bias and equally likely. Be able to apply concepts to calculate **expected outcomes** of future experiments/events

P3 – Relative frequency and theoretical probability – know what these are and how to use them. Use appropriate language and know probability scale 0-1.

P4 – Probability adds to 1, mutually exclusive and independent events.

P5 – Know the impact of repeating trials/experiments on accuracy of probability, and how it gets closer to theoretical probability

P6 – Enumerate sets and combinations of sets systematically, using tables, grids, Venn diagrams and tree diagrams

P7 – Sample space diagrams and finding probabilities

P8 - Independent and dependent events – tree diagrams with and without replacement using numbers and algebra. Know how to construct and use and underlying assumptions.

P9 – Conditional probabilities using expected frequencies with two-way tables, tree diagrams and Venn diagrams (know all the set notation)

6. Statistics

S1 – Know about populations and samples. Know problems with types of sampling. Capture recapture.

S2 – Know types of data. Interpret and construct:
    Categorical data – Tables, bar charts, pie charts, pictograms
    Ungrouped discrete numerical data – vertical line charts
    Tables and line graphs for time series data
    Know when to use each of them
    Frequency polygon

S3 – Construct and interpret diagrams for discrete grouped data and continuous data
    Histograms with equal and unequal class widths
    Cumulative frequency graphs
    Know when and how to use these

S4 – Interpet/analyse/compare the distributions of univariate data sets using:
    Graphical representations - appropriate graphs for the different times of data and box plots
    Measure of central tendency (median, mean, mode and modal class) and measures of spread (range, inter-quartile range and consideration of outliers).

S5 – Apply statistics to describe populations (e.g. comparing means, medians, ranges etc)

S6 – Scatter graphs – use and interpret them for bivariate data. Correlation and that this is not causation. Lines of best fit. Predict from lines of best fit, and interpolation and extrapolation including the strengths/weakness of interpolating/extrapolating.