# Mapping the content of FSMQ: Additional Mathematics to GCSE (9‒1) Maths

| **Content** |  | **Assumed knowledge from GCSE (9 – 1) Maths (J560)** | **Level 3 FSMQ: Additional Maths learners should additionally be able to …** |
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| **Algebra (AL)** |
| Algebraic Manipulation | AL1 | Know and use algebraic vocabulary and notation. |  |
| AL2 | Simplify expressions involving algebraic fractions and square roots. |  |
| AL3 | Perform operations with polynomials, including addition, subtraction, multiplication and division.  |  |
| AL4 | Find linear factors of a polynomial. | Use the factor theorem. |
| AL5 | Complete the square of a quadratic polynomial. |  |
| Applications of equations | AL6 | Set up and solve problems leading to linear, quadratic and cubic equations in one unknown, and to simultaneous equations in two unknowns.  |  |
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| Inequalities | AL7 | Manipulate inequalities. |  |
| AL8 | Set up and solve linear algebraically and graphically. | Set up and solve quadratic inequalities algebraically and graphically. |
| AL9 | Illustrate linear inequalities in two variables. |  |
| Recurrence relationships | AL10 | Generate terms of linear and quadratic sequences and special sequences such as triangular, square and cube numbers, Fibonacci and simple arithmetic or geometric progressions. Able to use subscript notation for position to term and term to term rules. | Understand and use notation of recurrence relationships to describe and determine sequences. |
|  | AL11 | Use recurrence relationships in modelling.  |  |
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| **Enumeration (EN)** |
| Binomial expansion | EN1 | Expand products of more than two binomials. | Understand and be able to apply the binomial expansion of where  is a positive integer. |
| Representation | EN2 | Construct and use tree diagrams, two way tables or Venn Diagrams to enumerate outcomes. | Construct and use the binomial distribution to enumerate outcomes. |
| Product Rule | EN3 |  | Use the product rule for counting numbers of outcomes of combined events. |
| Permutations | EN4 |  | Enumerate the number of ways of obtaining an ordered linear subset (permutation) of elements from a set of  distinct objects. |
| Combinations | EN5 |  | Enumerate an unordered subset (combination) of elements from a set of  distinct objects. |
| Applications | EN6 | Solve problems about outcomes, including problems in the context of probability. |  |
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| **Coordinate Geometry (two dimensions only) (CG)** |
| The straight line | CG1 |  | Calculate the distance between two points. |
| CG2 |  | Find the mid-point of a line segment. |
| The co-ordinate geometry of circles | CG3 | Recognise and use the equation of a circle with centre at the origin. | Know and use the equation of a circle , where  is the centre and is the radius of the circle. |
| Graphs | CG4 | Recognise and sketch graphs of exponential functions in the form *y* = *kx* for positive *k* andthe graphs of ,  and  | Sketch and plot linear, polynomial, trigonometric and exponential functions. |
| CG5 | Know, understand and use gradient, intercept, tangent and normal in problems involving points that can be defined by equations and inequalities. |  |
| Applications in linear programming | CG6 |  | Express real situations in terms of linear inequalities. |
| CG7 |  | Use graphs of linear inequalities to solve 2-dimensional maximisation and minimisation problems.  |
| CG8 |  | Know the definition of objective function and be able to find it in 2-dimensional cases. |
| **Pythagoras’ Theorem and Trigonometry (PT)** |
| Ratios of any angles | PT1 | Know the exact values of and for *θ =* 0°, 30°, 45°, 60°and 90°.Know the exact value of for *θ =* 0°, 30°, 45°and 60°. | Use the definitions of ,  and  for any angle and their graphs. |
| PT2 | Know the sine and cosine rules and be able to apply them.  | Apply sine rule to the ambiguous case. |
| Trigonometric identities | PT3 |  | Know and use the identity  . |
| PT4 |  | Know and use the identity .  |
| Trigonometric equations | PT5 | Recognise and sketch the graphs of ,  and .Identify and sketch simple translations and reflections of trig functions.  | Solve simple trigonometric equations in given intervals. |
| Applications in modelling | PT6 | Apply Pythagoras’ Theorem and trigonometry to 2- and 3- dimensional problems. |  |
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| **Calculus (CA)** |
| Differentiation | CA1 |  | Differentiate  where  is a positive integer or 0, and the sum of such functions. |
| CA2 | Know that the gradient function gives the gradient of the curve and measures the rate of change of  with . |  |
| CA3 | Know that the gradient of the function is the gradient of the tangent at that point. |  |
| CA4 | Estimate gradients of graphs. | Find the equation of a tangent and normal at any point on a curve. |
| CA5 | Identify max/min of quadratic using completing the square or symmetry. | Use differentiation to find stationary points on a curve. |
| CA6 |  | Determine the nature of a stationary point. |
| CA7 | Recognise and sketch graphs of: . Sketch graphs of quadratic functions, identifying the turning point by completing the square. | Sketch a curve with known stationary points. |
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| Integration | CA8 |  | Integrate  where  is a positive integer or 0, and the sum of such functions. |
| CA9 |  | Be aware that integration is the reverse of differentiation. |
| CA10 |  | Know what is meant by an indefinite and a definite integral. |
| CA11 |  | Evaluate definite integrals. |
| CA12 |  | Find the area between a curve, two ordinates and the *x*-axis. |
| CA13 |  | Find the area between two curves. |
| Application to kinematics | CA14 | Calculate or estimate gradients in context of distance time graphs and velocity time graphs.Apply the concepts of average and instantaneous rate of changeCalculate or estimate areas in contexts of velocity-time graphs and acceleration time graphs. | Use differentiation and integration with respect to time to solve simple problems involving variable acceleration. |
| CA15 | Select and use kinematic formulae. | Recognise the special case where the use of constant acceleration formulae is appropriate. |
| **Numerical Methods (NM)** |
| Solving equations | NM1 | Find approximate solutions to equations using systematic sign-change methods (for example, decimal search or interval bisection) when there is no simple analytical method of solving them.  | Solve equations approximately by considering the change of sign. |
|  | NM2 |  | Use a simple iterative method to solve equations approximately. |
|  | NM3 |  | Recognise when these numerical methods may fail. |
| Gradients of tangents | NM4 | Estimate gradients of graphs | Use a chord to estimate gradient of a tangent to a curve at a point. |
|  | NM5 |  | Recognise how to improve an estimate for the gradient of a curve at a point. |
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| Area under a curve | NM6 | Estimate areas under lines and curves. | Use rectangular strips to estimate the area between a curve and the *x*-axis. |
|  | NM7 |  | Use trapezium rule to estimate the area between a curve and the *x*-axis. |
|  | NM8 |  | Recognise whether an estimate would be an over or under estimate, and understand how to calculate an improved estimate. |
| Applications of Numerical methods | NM9 | Estimations from graphs and interpretation in context. | Apply numerical methods in context where appropriate. |
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| **Exponentials and logarithms (EL)** |
| Properties of the exponential function | EL1 | Know and use the function and its graph, where *a* is positive. |  |
| Properties of the logarithmic function | EL2 |  | Know and use the definition of  as the inverse of . |
|  | EL3 |  | Understand and use the laws of logarithms. |
| Reduction to linear form | EL4 |  | Convert equations of the form to a linear form using logarithms. |
|  | EL5 |  | Estimate values of  and  or  and  from graphs. |
| Equations involving exponentials | EL6 |  | Solve equations of the form for *a* > 0. |
|  | EL7 |  | Use exponentials and logarithms in problems involving exponential growth and decay. |

# Formulae FSMQ: Additional Mathematics (6993)

Learners will be given the following formulae sheet in each question paper.

**Binomial series
**, for positive integers, *n*,where ****,*r* ≤ *n*

**The binomial distribution**If then 

**Numerical methods**
Trapezium rule: …}, where 

**Kinematics**

Variable acceleration formulae





 and 

Constant acceleration formulae









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