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**Subject Knowledge Self-Assessment:**

**Mathematics**

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| Name: | Route: |
| Placement A: | Placement B: |

The subject knowledge specified in the table below is considered by an expert group, subject associations, teachers and academics, to be the minimum necessary for trainees to take full advantage of the training offered and to produce teachers capable of teaching a rigorous course and in the secondary phase leading to a high-status qualification in mathematics (Teaching Agency 2012)

For a secondary specialist this subject knowledge may be demonstrated by the applicant having a degree with a significant content in mathematics or the equivalent - possibly gained through industrial or school-based experience. In the comments section please give a brief justification of why you have graded yourself as you have.

The self-assessment requires you to reflect upon your own personal strengths knowledge and skills of using the range and content then on your experience of enabling pupils to grasp these key elements. You will be asked to self-assess your knowledge and skills and experience using the following grading:

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| 1 = Significant area of strength | 2 = A firm grasp of this aspect | 3 = A developing understanding | 4 = limited grasp of this area |

At the end of each term discuss with your subject mentor the development of your subject knowledge and pedagogy and re-grade and add additional justification.

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| **Key Stage 3** | **Personal knowledge and Skills** | **Experience of developing Pupil knowledge and skills** |
| **1-4** | **Justification** | **1-4** | **Justification** |
| **Number, Ratio, and Proportion** | Know the properties and representations of integer, rational, and irrational numbers, including powers and roots  |  |  |  |  |
| Apply the four operations to manipulations and calculations including fractions, decimals, percentages and understanding inverses  |  |  |  |  |
| Know and apply rounding and accuracy methods including interval notation and error calculations |  |  |  |  |
| Interpret and compare numbers written in Standard Form |  |  |  |  |
| Know and apply notation and methods relating to ratio and proportion |  |  |  |  |
| Understand that a multiplicative relationship between two quantities can be expressed as a ratio or a fraction |  |  |  |  |
| Relate the language of ratios and the associated calculations to the arithmetic of fractions and linear functions |  |  |  |  |
| Solve problems including percentage change and simple interest in financial maths |  |  |  |  |
| Know and convert between related standard units including compound measures such as speed, density, and unit pricing |  |  |  |  |
| Use scale factors, scale diagrams and maps  |  |  |  |  |
| Construct and solve direct and inverse proportion problems using algebraic representations  |  |  |  |  |
| **Algebra** | Understand algebra as generalised arithmetic |  |  |  |  |
| Apply methods of algebraic manipulation including substitution, rearranging, simplifying, solving, factorising, and expanding |  |  |  |  |
| Be able to construct and solve linear equations, formulae, expressions, and identities |  |  |  |  |
| Recognise, plot, and sketch linear and quadratic functions |  |  |  |  |
| Understand, calculate, and interpret gradient and y-intercept |  |  |  |  |
| Construct, use and interpret the standard form of linear equations |  |  |  |  |
| Apply and convert between numerical, analytical, and graphical methods for solving equations |  |  |  |  |
| Find approximate solutions graphically, including simultaneous equations |  |  |  |  |
| Generate and describe terms of a sequence |  |  |  |  |
| Recognise arithmetic sequence and find the nth term rule |  |  |  |  |
| Recognise geometric sequences and others that arise i.e. Fibonacci |  |  |  |  |
| **Geometry and Measures** | Identify properties of 2D and 3D shapes using appropriate language |  |  |  |  |
| Know and describe similarity and congruence, including the use of scale |  |  |  |  |
| Accurately plot points, shapes, and lines in all four quadrants of the 2D Cartesian plane |  |  |  |  |
| Identify, describe, and accurately draw reflections, rotations, translations and enlargements |  |  |  |  |
| Accurately draw constructions, loci and bearings by hand and using technology |  |  |  |  |
| Measure, identify and calculate angles of regular and irregular polygons and between parallel lines |  |  |  |  |
| Know and apply Pythagoras’ theorem |  |  |  |  |
| Use the trigonometric ratios sine, cosine, and tangent to calculate properties of triangles |  |  |  |  |
| Solve simple problems in 3D |  |  |  |  |
| Calculate and solve problems with perimeters, areas, surface areas and volumes of simple and compound shapes and solids |  |  |  |  |
| **Statistics and Probability** | Record, describe and analyse the outcomes from data collection and simple experiments  |  |  |  |  |
| Know and apply the stages of the handling data cycle |  |  |  |  |
| Identify and display outcomes using ordered lists, sample space diagrams, and tree diagrams  |  |  |  |  |
| Define outcomes in relation to randomness and fairness |  |  |  |  |
| Calculate and interpret experimental and theoretical probabilities of single and combined events |  |  |  |  |
| Describe, interpret, and compare discrete, continuous, and grouped data sets |  |  |  |  |
| Calculate measures of central tendency and spread including consideration of outliers |  |  |  |  |
| Construct, interpret and compare appropriate tables, charts and diagrams including frequency tables, pictograms, bar chats, vertical line graphs, frequency polygons, and pie charts |  |  |  |  |
| Identify relationship between bivariate data sets using scatter diagrams, lines of best fit and the principles of correlation |  |  |  |  |
| Systematically order and analyse sets using Venn Diagrams and related notation |  |  |  |  |
| **Key Stage 4** | **Personal knowledge and Skills** | **Experience of developing Pupil knowledge and skills** |
| **1-4** | **Justification** | **1-4** | **Justification** |
| **Number, Ratio and Proportion, and Algebra** | Understand appropriate applications of exact calculations using π, surds, standard form and limits of accuracy |  |  |  |  |
| Extend proportional reasoning to include proportional change and exponential growth |  |  |  |  |
| Identify upper and lower bounds of values and calculations |  |  |  |  |
| Extension of algebraic skills to quadratic functions, simultaneous equations (elimination and substitution methods), and contexts including inequalities, surds, and algebraic fractions  |  |  |  |  |
| Recognise, plot and sketch graphs of exponential, reciprocal, and trigonometric functions |  |  |  |  |
| Transform functions, including reflections, stretches, and shifts, relating algebraic components to graphical representations |  |  |  |  |
| Convert between related compound units (speed, rates of pay, prices, density, pressure) in numerical and algebraic contexts |  |  |  |  |
| Construct and interpret equations that describe direct and inverse proportion  |  |  |  |  |
| Recognise and interpret graphs that illustrate direct and inverse proportion |  |  |  |  |
| Interpret the gradient of a straight-line graph as a rate of change |  |  |  |  |

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| **Geometry and Measures** | Draw and use 3D coordinate systems |  |  |  |  |
| Convert between measures and compound measures |  |  |  |  |
| Compare lengths, areas and volumes using ratio notation and scale factors |  |  |  |  |
| Identify and accurately define similarity and congruence of triangles and other compound shapes |  |  |  |  |
| Recognise trigonometrical relationships and use to solve problems |  |  |  |  |
| Draw, describe and identify combinations of transformations |  |  |  |  |
| Know and apply the circle theorems |  |  |  |  |
| Draw, define and solve problems with vectors in two dimensions |  |  |  |  |
| **Statistics and Probability** | Presentation, analysis and interpretation of large sets of grouped and ungrouped data, including scatter diagrams, box plots, stem and leaf diagrams, cumulative frequency curves, and histograms |  |  |  |  |
| Identify mutually exclusive, dependent, and independent events |  |  |  |  |
| Calculate the probability of independent and dependent combined events, including using tree diagrams and other representations, and know the underlying assumptions |  |  |  |  |
| Use a probability model to predict the outcomes of future experiments; understand that empirical unbiased samples tend towards theoretical probability distributions, with increasing sample size |  |  |  |  |
| Calculate and interpret conditional probabilities through representation using expected frequencies with two-way tables, tree diagrams and Venn diagrams |  |  |  |  |

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| **Key Stage 5** | **Personal knowledge and Skills** | **Experience of developing Pupil knowledge and skills** |
| **1-4** | **Justification** | **1-4** | **Justification** |
| **Number, Algebra, and Proof** | Know and apply laws of indices for all rational exponents |  |  |  |  |
| Use and manipulate surds |  |  |  |  |
| Manipulate rational expressions including simplifying |  |  |  |  |
| Complete algebraic division (by linear functions only) |  |  |  |  |
| Know and apply the Factor and Remainder Theorems |  |  |  |  |
| Identify and interpret the discriminant of a quadratic function |  |  |  |  |
| Find solutions to quadratic functions using factorisation, the formula, completing the square, and graphical methods |  |  |  |  |
| Algebraic manipulation of polynomials, including expanding brackets, collecting like terms, and factorisation |  |  |  |  |
| Define relations and functions including their domain, range, composition, and inverse |  |  |  |  |
| Recognise modulus functions and use modulus notation |  |  |  |  |
| Recognise, plot and sketch graphs of functions and their inverses including rational functions |  |  |  |  |
| Identify vertical and horizontal asymptotes of functions |  |  |  |  |
| Solve linear and quadratic equations and inequalities analytically and graphically including identifying points of intersection and solution regions as appropriate |  |  |  |  |
| Extend knowledge of transformations on the graph of y = f(x) as represented by y = af(x), y = f(x) + a, y = f(x + a), y = f(ax) and combinations of these |  |  |  |  |
| Decompose rational functions into partial fractions  |  |  |  |  |
| Construct proofs using methods including deduction, exhaustion, counter example, and contradiction  |  |  |  |  |
| **Co-ordinate geometry** | Know and use the equation of a straight line in the form y – y1 = m(x – x1) and ax + by + c = 0 |  |  |  |  |
| Understand and use the equation of a circle in the form (x - a)2 + (y - b)2 = r2 |  |  |  |  |
| Understand and use the parametric equations of curves and convert between Cartesian and parametric forms |  |  |  |  |
| **Sequences and series** | Generate, identify, and define sequences, including those given by a formula for the nth term, and those generated by simple recurrence relations of the form xn+1 = f(xn) |  |  |  |  |
| Define a sequence with relation to its increasing, decreasing, periodic, convergent or divergent nature  |  |  |  |  |
| Understand and use Sigma notation |  |  |  |  |
| Identify and define arithmetic series, including the formula for the nth term and the sum to n terms |  |  |  |  |
| Identify and define geometric series, including the formula for the nth term, the sum of a finite geometric series and the sum to infinity of a convergent geometric series |  |  |  |  |
| Know and apply factorial and nCr notation |  |  |  |  |
| Complete binomial expansions of (1 + x)n for positive integer values of n and identify specified terms  |  |  |  |  |
| Extend binomial expansions to any rational n, including its use for approximations |  |  |  |  |
| **Trigonometry** | Solution of trigonometric equations over a given interval |  |  |  |  |
| Know and use exact values of sine, cosine and tangents and corresponding multiples |  |  |  |  |
| Recognise and interpret the graphs of sine, cosine and tangent functions including amplitude, symmetries, and periodicity |  |  |  |  |
| Know and apply the sine rule, cosine rule and the area of a triangle in the form ½absinC  |  |  |  |  |
| Understand and apply radian measure including calculating arc length and sector area |  |  |  |  |
| Understand and apply the standard small (radian) angle approximations of sine, cosine, and tangent |  |  |  |  |
|  Understand and use the definitions of secant, cosecant, cotangent, arcsin, arccos, and arctan including understanding of their graphs, ranges, and domains |  |  |  |  |
| Knowledge and use of the trigonometric identities  |  |  |  |  |
| Knowledge and use of double angle formulae |  |  |  |  |
| Understand and construct geometrical proofs involving trigonometric functions and identities |  |  |  |  |
| Apply knowledge of trigonometric functions to solve problems involving vectors, kinematics, and forces |  |  |  |  |
| **Exponentials and logarithms** | Recognise and interpret the functions of the form ax and ex and their graphs |  |  |  |  |
| Recognise and interpret exponential growth and decay |  |  |  |  |
| Know and use the definitions of logax and lnx as the inverses of ax and ex respectively and their corresponding graphs |  |  |  |  |
| Understand and use the laws of logarithms |  |  |  |  |
| Solve equations through the application of logs |  |  |  |  |
| Use logarithmic graphs to estimate parameters in relationships of the form y = axn and y = kbx, given data for x and y |  |  |  |  |
| **Differentiation** | Understand and calculate the derivative of f(x) as the gradient of the tangent to the graph of y = f(x) at a point |  |  |  |  |
| Interpret the derivative as a rate of change |  |  |  |  |
| Understand the gradient of the tangent as a limit |  |  |  |  |
| Differentiate from first principles for small positive integer powers of x |  |  |  |  |
| Sketch gradient functions for a given curve |  |  |  |  |
| Calculate second and higher order derivatives |  |  |  |  |
| Use second order derivatives to identify concavity and inflexion points |  |  |  |  |
| Differentiate a variety of functions including xn, ekx, ln kx, sinkx, coskx, tankx and their multiples, sums, differences, products, and quotients |  |  |  |  |
| Use differentiation to identify gradients at a point, equations of tangents and normals, maxima, minima, stationary and inflexion points, and increasing and decreasing functions |  |  |  |  |
| Differentiate functions using the chain, product, and quotient rules including connected rates of change and inverse functions |  |  |  |  |
| Evaluate the first derivative of simple functions defined implicitly or parametrically |  |  |  |  |
| Construct simple differential equations in contexts including kinematics and population growth |  |  |  |  |
| **Integration** | Know and use the Fundamental Theorem of Calculus |  |  |  |  |
| Understand indefinite integration as the reverse of differentiation |  |  |  |  |
| Understand and use integration as the limit of a sum |  |  |  |  |
| Integrate a variety of functions including xn, ekx, 1/x, sinkx, coskx and their multiples, sums, and differences |  |  |  |  |
| Evaluate definite integrals and interpret as the area under a curve |  |  |  |  |
| Calculate the area between two curves |  |  |  |  |
| Calculate volumes of revolution |  |  |  |  |
| Evaluate simple cases of integration by substitution and integration by parts |  |  |  |  |
| Integrate using partial fractions that have linear denominators |  |  |  |  |
| Evaluate the analytical solution of simple first order differential equations with separable variables |  |  |  |  |
| Interpret the solution of a differential equation in the context of solving a problem |  |  |  |  |

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| **Numerical Methods** | Locate roots of f(x) = 0 by considering changes of sign of f(x) in an interval of x in which f(x) is continuous |  |  |  |  |
| Solve equations approximately using simple iterative methods; be able to draw associated cobweb and staircase diagrams |  |  |  |  |
| Solve equations using the Newton-Raphson method and other recurrence relations of the form xn+1 = g(xn) |  |  |  |  |
| Understand and use numerical integration of functions including the use of the trapezium rule |  |  |  |  |
| **Vectors** | Use and interpret vectors in 2D and 3D including position vectors and calculating the distance between two points |  |  |  |  |
| Calculate the magnitude and direction of a vector |  |  |  |  |
| Understand algebraic operations of vector addition and scalar multiplication, and their geometric interpretations |  |  |  |  |
| Identify and interpret vector equations of lines |  |  |  |  |
| **Statistical sampling** | Understand and use the terms population and sample |  |  |  |  |
| Use samples to make inferences about the population |  |  |  |  |
| Understand and use sampling techniques, including simple random sampling and opportunity sampling |  |  |  |  |
| Select and evaluate sampling techniques in problem-solving contexts |  |  |  |  |
| **Data presentation and interpretation** | Interpret and compare diagrams for single-variable and bivariate data including histograms and scatter diagrams |  |  |  |  |
| Interpret regression lines and correlation |  |  |  |  |
| Calculate and interpret standard deviation  |  |  |  |  |
| Select and evaluate data presentation techniques in context |  |  |  |  |
| Clean data, including dealing with missing data, errors, and outliers |  |  |  |  |
| **Probability** | Understand and identify discrete and continuous distributions |  |  |  |  |
| Understand and use the conditional probability formula |  |  |  |  |
| Construct probability models and critique validity |  |  |  |  |
| **Statistical distributions** | Understand and use simple discrete probability distributions, including the binomial distribution |  |  |  |  |
| Understand and use the Normal distribution model |  |  |  |  |
| Calculate probabilities from a given distribution |  |  |  |  |
| Model contextual problems with an appropriate distribution |  |  |  |  |
| **Statistical hypothesis testing** | Understand and apply the language of statistical hypothesis testing |  |  |  |  |
| Interpret a given correlation coefficient using a given p-value or critical value |  |  |  |  |
| Conduct a hypothesis test for the proportion in the binomial distribution and interpret the results in context |  |  |  |  |
| Understand that the significance level is the probability of incorrectly rejecting the null hypothesis |  |  |  |  |
| Conduct a hypothesis test for the mean of a Normal distribution with known, given, or assumed variance and interpret the results in context |  |  |  |  |
| **Kinematics** | Understand and use fundamental and derived quantities and units |  |  |  |  |
| Understand and accurately use the language of kinematics |  |  |  |  |
| Understand, use and interpret graphs in kinematics for motion in a straight line, displacement against time, velocity against time and interpret the gradient and area under the graph |  |  |  |  |
| Understand, use and derive the formulae for constant acceleration for motion in a straight line, including extending to 2D vectors |  |  |  |  |
| Use calculus in kinematics |  |  |  |  |
| Model motion, including projectiles, under gravity in a vertical plane using vectors |  |  |  |  |
| **Forces and Newton’s laws** | Understand and use Newton’s first, second, and third laws in 2D  |  |  |  |  |
| Understand and use weight and motion in a straight line under gravity, including gravitational acceleration, g |  |  |  |  |
| Understand and use the addition of forces, resultant forces, and dynamics for motion in a plane |  |  |  |  |
| Understand and use the $F \leq μR$ model for friction |  |  |  |  |
| Understand limiting friction and statics |  |  |  |  |
| Understand and use moment in simple static contexts |  |  |  |  |

This final section considers characteristics of mathematics learners and mathematicians that are central to all key stages. These are personal characteristics relating to your approach to learning and engaging with mathematics curricula, therefore, please self-assess against these alternative criteria. You do not need to provide justifications for these self-assessments, however, do allow these to inform self-reflection and continue to review over time.

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| **Mathematical characteristic** | **Demonstrate rarely** | **Demonstrate occasionally** | **Demonstrate frequently** | **Demonstrate consistently** |
| Reflect on solutions considering assumptions made in models used |  |  |  |  |
| Apply inductive and deductive reasoning |  |  |  |  |
| Model situations mathematically and express the results using a range of formal mathematical representations  |  |  |  |  |
| Select appropriate concepts, methods and techniques to apply to unfamiliar and non-routine problems.  |  |  |  |  |
| Identify and mathematically specify patterns |  |  |  |  |
| Be fluent in recalling and applying mathematical principles in varied contexts |  |  |  |  |
| Reason mathematically by following a line of inquiry, make conjectures, use systematic testing methods and counter examples, make generalisations, and develop arguments, justifications or proofs |  |  |  |  |
| Use mathematical language and notation precisely |  |  |  |  |
| Use technology appropriately to support the understanding and investigation of mathematical problems |  |  |  |  |
| Fluently move between numerical, algebraic, graphical, and diagrammatic representations |  |  |  |  |
| Persevere in seeking solutions and demonstrate resilience when facing challenges |  |  |  |  |
| Evaluate the validity and accuracy of multiple alternative solutions or arguments |  |  |  |  |
| Evaluate the validity of inferences made from statistical and probabilistic contexts |  |  |  |  |
| Identify and define the distinction between correlative and casual relationships |  |  |  |  |