1. CURRICULUM INTENT OVERVIEW PLAN
Key Stage 4

Subject: Mathematics

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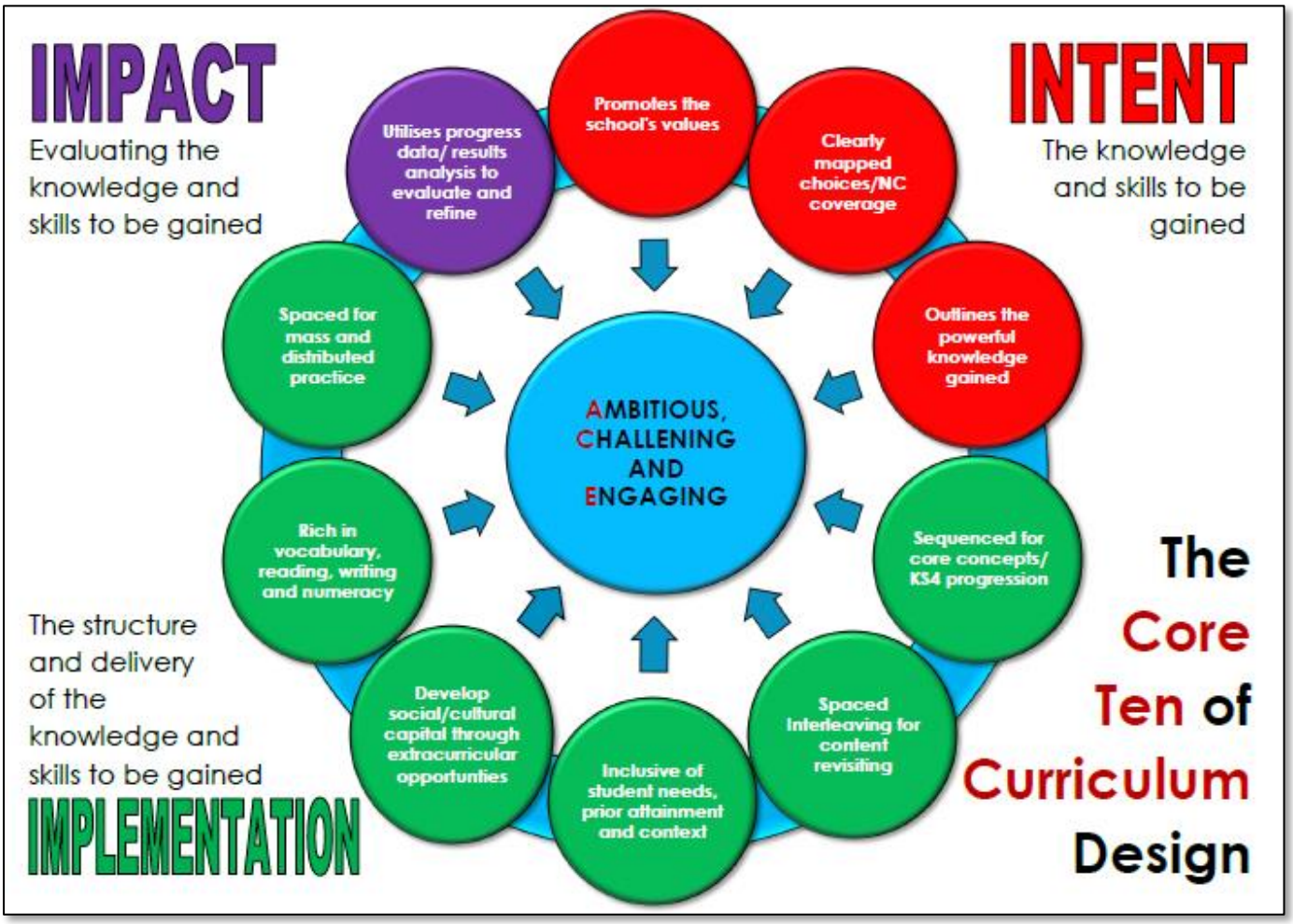

THINKING PROCESS - CURRICULUM INTENT OVERVIEW PLAN (KS4)

Intent Statement – at Landau Forte Amington, we believe learning powerful knowledge helps students achieve and creates a fairer society.
How are you trying to accomplish this, with this Programme of Study (PoS)?

DEFINITION: Powerful Knowledge is described as knowledge which enriches students' lives and creates a fairer society by providing students with intellectual power. It is knowledge which support students in engaging with the world and communicating with people regardless of background or social standing.

The maths curriculum is designed to provide students with a range of skills and knowledge that enable them to succeed, not only in their maths education and examinations, but to also provide a solid foundation for their futures. Students are taught a range of skills and knowledge based on the National Curriculum through an interleaved and spaced scheme of learning that also incorporates real life links and aims to develop critical and curious approaches to a range of problems. It is the aim that by the time students leave in Year 11, they will have a repertoire of knowledge and skills that enable them to succeed in their chosen career (or future education) and in their daily lives, achieved by exploring key mathematic skills such as time management, financial understanding, and links to other fields, among others. The scheme of learning is designed as a 5-year progression such that students who achieve Expected Standard or higher in Y6 SATs would get full coverage up to the Higher tier GCSE content by the end of Year 11.

Aims – what do you want pupils to be able to know and do by the time they finish this Programme of Study (PoS)?

By the time students leave in Year 11, they should:

- Have a deep and broad understanding of the application of maths to a range of problems, as per the National Curriculum for KS3 and KS4.
- Possess a well-rounded knowledge of number properties, calculation skills and algebraic manipulation, an appreciation of shape, space and measure, an appreciation of ratio and proportion (and its role in life) and a broad understanding of statistics and probability
- Be fluent in a range of skills across the 5 key areas of mathematics (number, algebra, ratio & proportion, shape, space & measure, and statistics & probability) achieved through clear expert instruction and refined through purposeful practice, interleaving and spaced practice.
- Be able to apply logic and reason to understand, unpick and solve a range of problems, including the skills of planning, conjecturing, making generalisations, developing a mathematical argument, justification, and proof
- Have an appreciation of mathematics in real life contexts, and have some understanding of where the skills they have developed are used in society and other areas of specialism
- Have an appreciation of the language of mathematics and be able to articulate their thoughts, ideas, and conjectures in a mathematically accurate way

Academy Values – at Landau Forte Amington, we want students to be ambitious, brave and kind. How are these values promoted in this PoS?

Ambitious – Stretch and challenge material should be available to all students in all lessons. Students are given feedback on their work and provided with personalised feedback to allow students to make the progress that is most suitable for them, encouraging them to extend their thinking further to more complex contexts where appropriate.

Brave – Students are encouraged to take control of their own learning and can choose to access challenge work in lessons, as well as being a vehicle for their own progress by utilising the marking and feedback provided by their class teacher to move forward, regardless of ability, setting or prior attainment. Staff are asked to mark and provide feedback in a way that allows students time to reflect on the marking and provide them with a clear next step to promote progress regardless of the student's prior attainment, SES, ethnicity or SEND status

Kind – Mathematics classrooms should build a culture of support and collaboration, where thoughts are shared freely and critiqued in a way that does not undermine or devalue the contributions students have made (both staff and students). Students are encouraged to provide positive feedback about others work during peer marking, including the use of phases such as "strengths" and "targets" for areas of improvement.

KS4 Specification Choices – what topics are taught and does it ensure breadth and depth, as well as meet the requirements of the exam specification?
(Please note - the sequencing of topics will be explored in the implementation overview, the main purpose at this stage is to know what is taught)

YEAR	Term 1	Term 2	Term 3	Term 4	Term 5	Term 6

10

Unit/Topic

Specification/ Assessment Objective

Unit	Topics Covered	NC Reference
1	Similarity **Pythagoras' Theorem** Standard Trigonometry	G11, G10, R1
2	Calculating powers Index laws / Surds Bounds	N2, N3, N4, N8
3	Linear simultaneous equations Iteration	A14, A15
4	Transformations 2D and 3D Similarity	G2, G9, G14
5	Algebraic fractions Factorisation Surds Expanding brackets	A1, A2
6	Ratio **Compound measures** Direct & inverse proportion	R2,R3, R4
7	Linear sequences Quadratic sequences	A18, A19
8	Solving inequalities Multiple representations of inequalities	A17
9	Surface area Volume 3D similarity	G8, G9
10	Circle theorems	G3, G4
11	Exploring non-linear graphs including reciprocal, quadratic and exponential	A7, A10, A11, R6
12	Recurring decimals and fractions **Compound interest**	A6, R7
13	Solving quadratic equations	A13
14	Venn diagrams Probability	P3, P4
15	**Sampling** Averages **Analysis of data**	S1, S4
16	Straight line graphs Equations of circles	A6, A12
17	Vectors	G15

11	**Unit/Topic** **Specification/ Assessment Objective**	

Unit	Topics Covered	NC Reference
1	Pythagoras' Theorem Trigonometry (extended)	G10, G11, G12, G13
2	Manipulating Surds	A1, N4
3	Quadratic Formula Solving Quadratics Iteration Formulae	A7, A13, A15
4	Enlargement (negative & fractional scale factors)	G1
5	Function notation Inverse functions Composite functions	A5
6	Algebraic proportion	R4
7	Geometric sequences	A18
8	Quadratic inequalities Graphical inequalities Quadratic simultaneous equations	A14, A17
9	Plotting and interpreting exponential graphs Trigonometric graphs Transforming graphs and functions	A8, A9
10	Histograms	S3
11	Gradients of curves Rates of change	A6
12	Vectors (extended)	G15

Further Maths (11A only) **bold content is content that is exclusive to the FM qualification**

Unit	Topics Covered	Reference in Specification
1	Algebraic manipulation	1.1, 1.2, 1.3, 2.6, 2.7, 2.14
2	Quadratic equations, Algebraic fractions	2.1, 2.8, 2.9, 2.10, 2.12, 2.14
3	Functions Graphs	2.2, 2.3, 2.4, 2.5, 2.12, 2.13,
4	Simultaneous equations, **Factor theorem** Inequalities, **Sequences (advanced)**	2.11, 2.15, 2.16, 2.17, 2.18, 2.19, 2.20, 2.21, 2.22
5	Coordinate geometry including: **Equations of circles**	3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9
6	Pythagoras' theorem **Trigonometry (advanced)**	6.1, 6.2, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 6.10
7	Trigonometry (advanced) **3D problem solving**	6.1, 6.2, 6.3, 6.4, 6.5,
8	**Calculus**	4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9
9	**Matrices**	5.1, 5.2, 5.3, 5.4

11F	**Unit/Topic**	**Specification/ Assessment Objective**

Unit	Topics Covered	NC Reference
1	Similarity **Pythagoras' Theorem** Standard Trigonometry	G6, R1, G9
2	Calculating powers & roots **Using a calculator**	N3
3	Linear simultaneous equations	A14, A16
4	**Enlargement** Similarity & congruence	G1, G9
5	Algebraic manipulation Factorising	A1, A2
6	**Proportionality** Algebraic proportion	R3, R4, R5
7	**Geometric progressions**	A18
8	**Area** **Volume** **Surface Area** **Pythagoras' Theorem**	G7, G8, G10
9	**Compound interest**	R7
10	Quadratic graphs	A7
11	Solving quadratic equations	A13
12	**Sampling**	A1, A4
13	Vectors	G15

Exam specification content missing from this PoS and why?	Content taught in addition to the exam specification and why?
Some of the exam specification content is covered in the KS3 PoS as it is a 5-year progressive curriculum.	**Students are encouraged to explore the following areas that link the exam specification to real world problems:** - Financial maths (exploring budgeting, income and taxes, value for money, bank accounts, interest rates) to build financial know-how and financial understanding to better prepare students for managing their own money - Practical maths (DIY projects, designing projects) to help build an appreciation for the costs and time involved in completing projects, look at transferrable skills and develop planning, designing, and budgeting skills - Problem solving and deduction in a range of contexts (Escape Rooms Trip for Year 10 in Summer term) to better develop problem solving skills in preparation for future careers and in exam context - **Top sets will have the opportunity to also study the Further Maths qualification which will better prepare them for studying mathematics at A Level and beyond**

Powerful Knowledge Choices – what powerful knowledge is included in this PoS? Consider what knowledge is it important for our students to know, so that when they leave school they can engage in and lead discussions, with people from the most advantaged backgrounds? *(Please note - the sequencing of topics will be explored in the implementation overview, the main purpose at this stage is to know what powerful knowledge is gained)*

YEAR		Term 1	Term 2	Term 3	Term 4	Term 5	Term 6
10	Powerful Knowledge	1. **Pythagoras' Theorem** 2. **Compound measures** 3. **Compound Interest** 4. **Sampling** 5. **Analysis of Data**					
	Why it is important to know	1. Pythagoras' theorem is used in a range of contexts such as architecture, safety of ladder use which makes it a transferrable skill that has a range of applications. 2. Compound measures include speed, pressure and density, and will overlap with science, but also have real-life applications such as the average speed of a vehicle, the time taken to travel a certain distance (assumptions will also be explored), whether being stood on by an elephants foot will exert more or less pressure than the heel of a stiletto, why some materials will sink in water but others will float. 3. Compound interest is the main way interest is calculated on mortgages and loans, as well as on savings accounts. Students will be taught the mathematical understanding and then encouraged to explore it further by looking at available saving option and mortgage deals, and they will be guided to learn about how to spot a good deal, a bad deal, and the long term effects of different interest rates. 4. Sampling is useful in other subjects like sociology, science, psychology etc. It is beneficial for students to be aware of how sampling is scaled up to make generalisations and the danger of doing so. This will be explored in the context of advertising and how some adverts use statistics to make things seem more desirable than the numbers truly represent. 5. Analysing data will be applicable to a range of careers and further study, including sociology, science, psychology, business etc. As such, students will be encouraged to compare data sets, draw conclusions, and explore the benefits and pitfalls of different averages.					
11	Powerful Knowledge	1. **Pythagoras' Theorem** 2. **Geometric sequences** 3. **Exponential Graphs**					
	Why it is important to know	1. Pythagoras' theorem is used in a range of contexts such as architecture, safety of ladder use which makes it a transferrable skill that has a range of applications. 2. Geometric sequences utilise compound interest-type relationships and therefore can be used to model a range of situations, including (but not limited to) savings accounts, length of time taken to run a marathon, and changes to populations. As such it can be applied to a range of areas such as finances, business modelling, sports modelling, population, and scientific modelling. 3. Exponential graphs are useful in modelling of situations such as pandemic outbreaks, population growth/decay so exposure to these can build an understanding of this type of data representation and builds critical thinking skills about presenting data in this way					

11F	**Powerful Knowledge**	1. **Pythagoras' Theorem** 2. **Using a calculator** 3. **Enlargement** 4. **Proportionality** 5. **Geometric progressions** 6. **Area, volume & surface area** 7. **Compound Interest** 8. **Sampling**
	Why it is important to know	1. Pythagoras' theorem is used in a range of contexts such as architecture, safety of ladder use which makes it a transferrable skill that has a range of applications. 2. Calculators are more prevalent now than ever before, and many students will leave school and go on to jobs that may require use of a calculator (or a programme that has similar functions) so having an appreciation for the varying functions and efficient use of one is key. Additionally, it can provide support in adulthood for calculations that people may find too difficult or time consuming to complete manually (i.e. working out the return on an investment for a given interest rate) 3. Enlargement is useful in design and art-based subjects as it is important to keep designs and images in proportion when scaling to make larger / smaller for different products. It will also be beneficial in careers that require technical drawings such as fashion, engineering and architecture for scale drawings, accurate measurements and calculating the amount of materials needed to produce a given product. 4. Proportionality will give students an appreciation of the need to keep related amounts in given values or ratios in a range of contexts, such as ingredients for cooking, baking, value for money and cost per unit (businesses). This is a skill that will likely be used in daily life such as shopping, maintaining healthy diets through home cooking as well as potentially in a future career. 5. Geometric progression utilises compound interest-type relationships and therefore can be used to model a range of situations, including (but not limited to) savings accounts, length of time taken to run a marathon, and changes to populations. As such it can be applied to a range of areas such as finances, business modelling, sports modelling, population, and scientific modelling. 6. Learning about area, volume and surface area will provide students with the knowledge and understanding they will need to complete a range of tasks (even without directly calculating) such as decorating (volume of paint required), packaging and box designs and packing items into boxes/delivery vehicles. This is just a few areas where these skills could be applied, but there will be careers that require more mathematical applications, for example interior design, architecture, landscaping, product design, and manufacturing and distribution. 7. Compound interest is the main way interest is calculated on mortgages and loans, as well as on savings accounts. Students will be taught the mathematical understanding and then encouraged to explore it further by looking at available saving option and mortgage deals, and they will be guided to learn about how to spot a good deal, a bad deal, and the long term effects of different interest rates. 8. Sampling is useful in other subjects like sociology, science, psychology etc. It is beneficial for students to be aware of how sampling is scaled up to make generalisations and the danger of doing so. This will be explored in the context of advertising and how some adverts use statistics to make things seem more desirable than the numbers truly represent.

How does the Curriculum Intent meet the ACE curriculum design?	
Ambitious	The scheme of work is designed so that by the time students finish the Year 11 scheme of work, they will have covered all content included on the Higher Tier specification, allowing students to access higher grades where applicable. Students in 11A classes will be given the opportunity to sit the AQA Further Maths qualification which will prepare them for A Level mathematics and further study in mathematics. The content for this course will be linked to the main scheme and be taught in tandem where applicable / practical.
Challenging	Students will be encouraged to explore topics in depth and breadth in all cases and will be signposted to activities that enforce and deepen links and concepts rather than being accelerated through content.
Engaging	Contextual and real life problems are linked to the SOW when possible and students are encouraged to engage with how maths will support them in their future pursuits.

What are the current strengths of the Curriculum Intent?

The curriculum is ambitious in its design by aiming for higher GCSE entries for the majority (although these will be considered on a case by case basis in Year 11, and suitability of the curriculum for each teaching group will be reviewed at least twice yearly).
It has taken into account research around developing a curriculum to support memory by utilising interleaving and spaced learning.

What specific actions have to be taken in response to the above? Please consider:

- KS4 Curriculum content changes;
- Powerful knowledge changes;
- Modifications to ensure an ACE curriculum design;
- CPD for teachers in your subject area;
- Additional research you have to consider as part of this review.

- CPD – as much department time as possible will be dedicated to developing subject knowledge and pedagogy to allow staff to facilitate students as learners in the best way possible. This will include work on lesson planning, metacognition, task design, spaced learning and recall techniques, questioning strategies, links to literacy, model for expert teaching. This is a long term project that I expect to take 2-3 years to see full it through to fruition, but the benefits of this should be evident from the first half term.
- Exam board change – from 2020/21 students will sit the Edexcel 9-1 GCSE paper instead of the AQA 9-1 GCSE owing to the wealth of knowledge, experience and resources of the CL. Staff will be supported in this change and CPD will be incorporated to smoothen the transition of exam boards. Class teachers will be encouraged to apply to be Examiners for Pearson Edexcel as it provides fantastic CPD opportunities, a wealth of knowledge around the marking process as well as developing pedagogical and subject content knowledge around misconceptions and exam technique
- Data Analysis – once QLA data is available for previous cohorts, topic analysis will take place to enable balancing of the PoS to reflect the typical needs of students by identifying areas where they typically succeed and areas where they typically underachieve.
- Tiering – It is assumed that students in 11A and 11B sets will sit the higher tier paper. It will be clear from the end of Year 10 mocks whether this is suitable and whether there will be any classes that have split tiering. Where this is the case, students will be moved groups if appropriate and numbers allow, as well as using RAC (HLTA) to split the class into the higher and foundation tiers – creating 11Ba and 11Bb for example.

- QA of teaching – regular learning walks will take place where CL will spend a short time in classrooms to assess classroom atmosphere and quality of teaching. More formal "drop ins" will be completed at least termly, and most likely half-termly in the first instance, with the CL and SLT link for maths and will take specific focuses based on the teacher's known strengths and areas of developments. Feedback will be provided promptly after the drop in and will be used to further develop quality of teaching. These will be pre-warned and scheduled events, with the intention not to catch staff out. Regular work scrutiny will take place at departmental level and with staff outside of the department to monitor quality and quantity of work being completed by students in lessons. Student voice will be carried out at least 1 per year for each year group (ideally at least twice)

National Curriculum Statements Mathematics KS4(2014)

Text in {**brackets**} denotes higher tier only content / non-compulsory

Number

N1. Apply systematic listing strategies {**including use of the product rule for counting**}
N2. {**Estimate powers and roots of any given positive number**}
N3. Calculate with roots, and with integer {and fractional} indices
N4. Calculate exactly with fractions, (surds) and multiples of π; {**simplify surd expressions involving squares [for example $\sqrt{12} = \sqrt{4 \times 3} = \sqrt{4} \times \sqrt{3} = 2\sqrt{3}$] and rationalise denominators**}
N5. Calculate with numbers in standard form $A \times 10^n$, where $1 \leq A < 10$ and n is an integer
N6. {**Change recurring decimals into their corresponding fractions and vice versa**}
N7. Identify and work with fractions in ratio problems
N8. Apply and interpret limits of accuracy when rounding or truncating, {**including upper and lower bounds**}

Algebra

A1. Simplify and manipulate algebraic expressions (including those involving surds {**and algebraic fractions**}) by:
   a. Factorising quadratic expressions of the form $x^2 + bx + c$, including the difference of two squares; {**factorising quadratic expressions of the form $ax^2 + bx + c$**}
   b. Simplifying expressions involving sums, products and powers, including the laws of indices
A2. Know the difference between an equation and an identity, argue mathematically to show algebraic expressions are equivalent, and use algebra to support and construct arguments {**and proofs**}
A3. Where appropriate, interpret simple expressions as functions with inputs and outputs; {**interpret the reverse process as the 'inverse function'; interpret the succession of two functions as a 'composite function'**}
A4. Use the form $y = mx + c$ to identify parallel {**and perpendicular**} lines; find the equation of the line through two given points, or through one point with a given gradient
A5. Identify and interpret roots, intercepts and turning points of quadratic functions graphically; deduce roots algebraically {**and turning points by completing the square**}
A6. Recognise, sketch and interpret graphs of linear functions, quadratic functions, simple cubic functions, the reciprocal function $y = \frac{1}{x}$ for $x \neq 0$, {**the exponential function $y = k^x$ for positive values of k, and the trigonometric functions (with arguments in degrees), $y = \sin x$, $y = \cos x$, and $y = \tan x$ for angles of any size**}
A7. {**sketch translations and reflections of the graph of a given function**}
A8. Plot and interpret graphs (including reciprocal graphs {**and exponential graphs**}) and graphs of non-standard functions in real contexts, to find approximate solutions to problems such as simple kinematic problems involving distance, speed and acceleration
A9. {**calculate or estimate gradients of graphs and areas under graphs (including quadratic and other non-linear graphs), and interpret results in cases such as distance-time graphs, velocity-time graphs and graphs in financial contexts**}
A10. {**recognise and use the equation of a circle with centre at the origin; find the equation of a tangent to a circle at a given point**}
A11. Solve quadratic equations {**including those that require rearrangement**} algebraically by factorising, {**by completing the square and by using the quadratic formula**}; find approximate solutions using a graph

A12. Solve two simultaneous equations in two variables (linear/linear {**or linear/quadratic**}) algebraically; find approximate solutions using a graph

A13. {**find approximate solutions to equations numerically using iteration**}

A14. Translate simple situations or procedures into algebraic expressions or formulae; derive an equation (or two simultaneous equations), solve the equation(s) and interpret the solution

A15. Solve linear inequalities in one {**or two**} variable{**s**}, {**and quadratic inequalities in one variable**}; represent the solution set on a number line, {**using set notation and on a graph**}

A16. Recognise and use sequences of triangular, square and cube numbers, simple arithmetic progressions, Fibonacci type sequences, quadratic sequences, and simple geometric progressions (r n where n is an integer, and r is a positive rational number {**or a surd**}) {**and other sequences**}

A17. Deduce expressions to calculate the nth term of linear {**and quadratic**} sequences

Ratio, Proportion & Rates of Change

R1. compare lengths, areas and volumes using ratio notation and/or scale factors; make links to similarity (including trigonometric ratios)

R2. convert between related compound units (speed, rates of pay, prices, density, pressure) in numerical and algebraic contexts

R3. understand that X is inversely proportional to Y is equivalent to X is proportional to $\frac{1}{Y}$; {**construct and**} interpret equations that describe direct and inverse proportion

R4. interpret the gradient of a straight-line graph as a rate of change; recognise and interpret graphs that illustrate direct and inverse proportion

R5. {**interpret the gradient at a point on a curve as the instantaneous rate of change; apply the concepts of instantaneous and average rate of change (gradients of tangents and chords) in numerical, algebraic, and graphical contexts**}

R6. set up, solve, and interpret the answers in growth and decay problems, including compound interest {**and work with general iterative processes**}.

Geometry & Measures

G1. interpret and use fractional {**and negative**} scale factors for enlargements

G2. {**describe the changes and invariance achieved by combinations of rotations, reflections, and translations**}

G3. identify and apply circle definitions and properties, including centre, radius, chord, diameter, circumference, tangent, arc, sector, and segment

G4. {**apply and prove the standard circle theorems concerning angles, radii, tangents, and chords, and use them to prove related results**}

G5. construct and interpret plans and elevations of 3D shapes

G6. interpret and use bearings

G7. calculate arc lengths, angles, and areas of sectors of circles

G8. calculate surface areas and volumes of spheres, pyramids, cones, and composite solids

G9. apply the concepts of congruence and similarity, including the relationships between lengths, {**areas and volumes**} in similar figures

G10. apply Pythagoras' Theorem and trigonometric ratios to find angles and lengths in right-angled triangles {**and, where possible, general triangles**} in two {**and three**} dimensional figures

G11. know the exact values of $\sin\theta$ and $\cos\theta$ for $\theta = 0°,\ 30°,\ 45°,\ 60°$ and $90°$;know the exact value of $\tan\theta = 0°,\ 30°,\ 45°,$ and $60°$

G12. {**know and apply the sine rule, $\frac{a}{\sin\theta} = \frac{b}{\sin\theta} = \frac{c}{\sin\theta}$, and cosine rule, $a^2 = b^2 + c^2 - 2bc\cos A$, to find unknown lengths and angles**}

G13. {**know and apply $\text{Area} = \frac{1}{2}ab\sin C$ to calculate the area, sides, or angles of any triangle**}

G14. describe translations as 2D vectors

G15. apply addition and subtraction of vectors, multiplication of vectors by a scalar, and diagrammatic and column representations of vectors; {**use vectors to construct geometric arguments and proofs**}.

Probability

P1. apply the property that the probabilities of an exhaustive set of mutually exclusive events sum to one

P2. 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

P3. calculate the probability of independent and dependent combined events, including using tree diagrams and other representations, and know the underlying assumptions

P4. {**calculate and interpret conditional probabilities through representation using expected frequencies with two-way tables, tree diagrams and Venn diagrams**}.

Statistics

S1. infer properties of populations or distributions from a sample, whilst knowing the limitations of sampling

S2. interpret and construct tables and line graphs for time series data

S3. {**construct and interpret diagrams for grouped discrete data and continuous data, i.e. histograms with equal and unequal class intervals and cumulative frequency graphs, and know their appropriate use**}

S4. interpret, analyse and compare the distributions of data sets from univariate empirical distributions through:

   a. appropriate graphical representation involving discrete, continuous, and grouped data, {**including box plots**}
   b. appropriate measures of central tendency (including modal class) and spread {**including quartiles and inter-quartile range**}

S5. apply statistics to describe a population

S6. use and interpret scatter graphs of bivariate data; recognise correlation and know that it does not indicate causation; draw estimated lines of best fit; make predictions; interpolate and extrapolate apparent trends whilst knowing the dangers of so doing.

Further Maths Qualification Specification Statements

1. Number

Ref	Content	Notes
1.1		Knowledge and use of numbers and the number system including fractions, decimals, percentages, ratio, proportion and order of operations are expected
1.2	The product rule for counting	Work out how many 5-digit odd numbers can be formed using the digits 1 3 4 6 8 with no repetition of any digit
1.3	Manipulation of surds, including rationalising the denominator	The use of surds in exact calculations Write $\sqrt{200} - \sqrt{72} + \sqrt{162}$ in the form of $a\sqrt{2}$ Rationalise and simplify $\frac{3\sqrt{2}+4}{5\sqrt{2}-7}$ Write the expression $\frac{3\sqrt{3}+7}{\sqrt{3}-5}$ in the form $a+b\sqrt{3}$, where a and b are integers

2. Algebra

Ref	Content	Notes
2.1	The basic processes of algebra	Knowledge and use of basic skills in manipulative algebra including use of the associative, commutative and distributive laws, are expected
2.2	Definition of a function	Notation f (x) will be used, e.g. $f(x) = x^2 - 9$
2.3	Domain and range of a function	Domain may be expressed as, for example, $x > 2$, or 'for all x, except $x = 0$' and range may be expressed as $f(x) > -1$
2.4	Composite functions	The result of two or more functions, say f and g, acting in succession. $fg(x)$ is g followed by f
2.5	Inverse functions	The inverse function of f is written f^{-1} Domains will be chosen for f to make f one-one
2.6	Expanding brackets and collecting like terms	Expand and simplify $(y^2 - 2y + 3)(2y - 1) - 2(y^3 - 3y + 4y - 2)$

Ref	Content	Notes
2.7	Expand $(a + b)^n$ for positive integer n	Expand and simplify $(5x + 2)^3$ Use Pascal's triangle to work out the coefficient of x^3 in the expansion of $(3 + 2x)^5$
2.8	Factorising	Factorise fully $(2x + 3)^2 - (2x - 5)^2$ Factorise $15x^2 - 34xy - 16y^2$ Factorise fully $x^4 - 25x^2$
2.9	Manipulation of rational expressions: Use of + – × ÷ for algebraic fractions with denominators being numeric, linear or quadratic	Simplify $\frac{5}{x+2} - \frac{3}{2}$ Simplify $\frac{1x - x^3 + 2x^2 + x}{x^2 + x}$ Simplify $\frac{5x^2 - 14x - 3}{4x - 25} \div \frac{x - 3}{4x^2 + 10x}$
2.10	Use and manipulation of formulae and expressions	Rearrange $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ to make v the subject
2.11	Use of the factor theorem for rational values of the variable for polynomials	Factorise $x^3 - 2x^2 - 5x + 6$ Show that $2x - 3$ is a factor of $2x^3 - x^2 - 7x + 6$ Solve $x^3 + x^2 - 10x + 8 = 0$ Show that $x - 7$ is a factor of $x^5 - 7x^4 - x + 7$
2.12	Completing the square	Work out the values of a, b and c such that $2x^2 + 6x + 7 \equiv a(x + b)^2 + c$

Ref	Content	Notes
2.13	Drawing and sketching of functions Interpretation of graphs	Graphs could be linear, quadratic, exponential and restricted to no more than 3 domains Exponential graphs will be of the form $y = ab^x$ and $y = ab^{-x}$, where a and b are rational numbers Sketch the graph of $y = x^2 - 5x + 6$ Label clearly any points of the intersection with the axes A function f (x) is defined as f (x) = x^2 $0 \leqslant x < 1$ = 1 $1 \leqslant x < 2$ = $3 - x$ $2 \leqslant x < 3$ Draw the graph of f(x) on the grid below for values of x from 0 to 3 Given a sketch of $y = ab^{-x}$, and two points, work out the values of a and b
2.14	Solution of linear and quadratic equations	Solutions of quadratics to include solution by factorisation, by graph, by completing the square or by formula Problems will be set in a variety of contexts, which result in the solution of linear or quadratic equations
2.15	Algebraic and graphical solution of simultaneous equations in two unknowns, where the equations could both be linear or one linear and one second order	Solve $4x - 3y = 0$ and $6x + 15y = 13$ Solve $y = x + 2$ and $y^2 = 4x + 5$ Solve $y = x^2$ and $y - 5x = 6$ Solve $xy = 8$ and $x + y = 6$
2.16	Algebraic solution of linear equations in three unknowns	Solve $2x - 5y + 4z = 22$ $x + y + 2z = 4$ $x -$ $y - 6z = -4$
2.17	Solution of linear and quadratic inequalities	Solve $5(x - 7) > 2(x + 1)$ Solve $x^2 < 9$ Solve $2x^2 + 5x \leqslant 3$

Ref	Content	Notes
2.18	Index laws, including fractional and negative indices and the solution of equations	Express as a single power of x $\sqrt{x^{\frac{1}{2}} \times x^{\frac{7}{2}}}$ Express as a single power of x $\sqrt{\frac{x^{\frac{3}{2}} \times x^{\frac{7}{2}}}{x^2}}$ Solve $x^{-\frac{1}{2}}=3$ Solve $\sqrt{x} + \frac{10}{\sqrt{x}} = 3 \quad x > 0$
2.19	Algebraic proof	Prove $(n + 5)^2 - (n + 3)^2$ is divisible by 4 for any integer value of n
2.20	Using nth terms of sequences Limiting value of a sequence as $n \to \infty$	Work out the difference between the 16th and 6th terms of the sequence with nth term $\frac{2n}{n+4}$ Write down the limiting value of $\frac{2n}{n+4}$ as $n \to \infty$
2.21	nth terms of linear sequences	A linear sequence starts 180 176 172 … By using the nth term, work out which term has value –1000 Work out the nth term of the linear sequence $r + s \quad r + 3s \quad r + 5s \ldots$
2.22	nth terms of quadratic sequences	Work out the nth term of the quadratic sequence 10 16 18 16 … Which term has the value 0?

3. Coordinate Geometry (2 dimensions only)

Ref	Content	Notes
The straight line		
3.1	Know and use the definition of a gradient	
3.2	Know the relationship between the gradients of parallel and perpendicular lines	Show that A (0, 2), B (4, 6) and C (10, 0) form a right-angled triangle
3.3	Use Pythagoras' theorem to calculate the distance between two points	
3.4	Use ratio to find the coordinates of a point on a line given the coordinates of two other points.	Including midpoint
3.5	The equation of a straight line $y = mx + c$ and $y - y_1 = m(x - x_1)$ and other forms	Including interpretation of the gradient and $y$intercept from the equation
3.6	Draw a straight line from given information	
The coordinate geometry of circles		
3.7	Understand that $x^2 + y^2 = r^2$ is the equation of a circle with centre (0, 0) and radius r	Including writing down the equation of a circle given centre (0, 0) and radius The application of circle geometry facts where appropriate: the angle in a semi-circle is 90°; the perpendicular from the centre to a chord bisects the chord; the angle between tangent and radius is 90°; tangents from an external point are equal in length.
3.8	Understand that $(x - a)^2 + (y - b)^2 = r^2$ is the equation of a circle with centre (a, b) and radius r	Including writing down the equation of any circle given centre and radius
3.9	The equation of a tangent at a point on a circle	

4. Calculus

Ref	Content	Notes
Differentiation		
4.1	Know that the gradient function $\frac{dy}{dx}$ gives the gradient of the curve and measures the rate of change of y with respect to x	
4.2	Know that the gradient of a function is the gradient of the tangent at that point.	
4.3	Differentiation of kx^n where n is an integer, and the sum of such functions	Including expressions which need to be simplified first Given $y = (3x + 2)(x - 3)$ work out $\frac{dy}{dx}$ Given $y = \frac{5}{x^3}$ work out $\frac{dy}{dx}$
4.4	The equation of a tangent and normal at any point on a curve	
4.5	Increasing and decreasing functions	When the gradient is positive/negative a function is described as an increasing/decreasing function
4.6	Understand and use the notation $\frac{d^2y}{dx^2}$	Know that $\frac{d^2y}{dx^2}$ measures the rate of change of the gradient function
4.7	Use of differentiation to find maxima and minima points on a curve	Determine the nature either by using increasing and decreasing functions or $\frac{d^2y}{dx^2}$
4.8	Using calculus to find maxima and minima in simple problems	$V = 49x + \frac{81}{x}$ $x > 0$ x Use calculus to show that V has a minimum value and work out the minimum value of V
4.9	Sketch/ interpret a curve with known maximum and minimum points	

5. Matrix transformations

Ref	Content	Notes
		All calculations will be restricted to 2 × 2 or 2 × 1 matrices
5.1	Multiplication of matrices	Multiplying a 2 × 2 matrix by a 2 × 2 matrix or by a 2 × 1 matrix Multiplication by a scalar
5.2	The identity matrix **I**	2 × 2 only
5.3	Transformations of the unit square in the $x - y$ plane	Representation by a 2 × 2 matrix Transformations restricted to rotations of 90°, 180° or 270° about the origin, reflections in the lines $x = 0$, $y = 0$, $y = x$, $y = -x$ and enlargements centred on the origin
5.4	Combination of transformations	Using matrix multiplications Use of **i** and **j** notation is not required

6. Geometry

Ref	Content	Notes
6.1		Knowledge of perimeter and area of rectangles and circles; and of the area of triangles, parallelograms and trapezia; and of the surface area and volume of prisms, cylinders, spheres, cones and pyramids Knowledge of angle properties of parallel and intersecting lines, triangles, all special types of quadrilaterals and polygons Understand and use circle theorems: Angle at the centre is twice the angle at the circumference; angles in the same segment are equal; opposite angles in cyclic quadrilateral add up to 180°; alternate segment theorem; the theorems listed in the notes of section 3.7

Geometric proof		
6.2	Understand and construct geometrical proofs using formal arguments	The use of theorems listed in the notes of 3.7 and 6.1
Trigonometry in triangles		
6.3	Sine and cosine rules in scalene triangles; area of a triangle $= \frac{1}{2}ab\sin C$	Knowledge and use of trigonometry to solve right-angled triangles is expected
Pythagoras' theorem		
6.4	Use of Pythagoras' theorem in 2D and 3D	Recognise Pythagorean triples; 3, 4, 5; 5,12,13; 8,15,17; 7, 24, 25 and simple multiples of these
6.5	Be able to apply trigonometry and Pythagoras' theorem to 2 and 3 dimensional problems	Including the angle between a line and a plane and the angle between two planes; including triangles that do not have right angles
Ratios of angles and their graphs		
6.6	Sketch and use graphs of $y = \sin x$, $y = \cos x$ and $y = \tan x$ for angles of any size	
6.7	Be able to use the definitions sin θ, cos θ and tan θ, for any positive angle up to 360°(measured in degrees only)	Angles measured anticlockwise will be taken as positive
6.8	Knowledge and use of 30°, 60°, 90° triangles and 45°, 45°, 90° triangles	The use of the ratios 1 : 3 : 2 and 1 : 1 : $\sqrt{2}$
6.9	Know and use $\tan\theta = \frac{\sin\theta}{\cos\theta}$ and $\sin^2\theta + \cos^2\theta = 1$	Including expressions to be simplified, proofs of identities and equations solved
6.10	Solution of simple trigonometric equations in given intervals	Equations will be restricted to single angles: $\sin x = 0.5$; $\sqrt{2}\sin x = \cos x$ for $0^\circ \leqslant x \leqslant 360^\circ$; $\sin x = \frac{1}{4}$ for $0^\circ \leqslant x \leqslant 360^\circ$