MATHS at Parkside

Curriculum Overview - Maths

Principles and Purpose of the Maths Curriculum

The purpose of the Maths curriculum is to provide a secure understanding of mathematical concepts, from basic principles of mathematics to complex topics that combine several areas of study into a single question. The curriculum promotes retention of knowledge and a depth of learning rather than an accelerated curriculum, resulting in pupils who are confident in taking their studies further into sixth form, university and beyond.

In all year groups, there is an intentional focus on numeracy which will support pupils not only in their study of maths but will also enable them to access mathematical questions in other subjects.

The following principles have informed the planning of the United Learning curriculum across all subjects:

- **Entitlement:** All pupils have the right to learn what is in the United Learning curriculum, and schools have a duty to ensure that all pupils are taught the whole of it.
- **Coherence:** Taking the National Curriculum as its starting point, our curriculum is carefully sequenced so that powerful knowledge builds term by term and year by year. We make meaningful connections within subjects and between subjects.
- **Mastery:** We ensure that foundational knowledge, skills and concepts are secure before moving on. Pupils revisit prior learning and apply their understanding in new contexts.
- **Adaptability:** The core content – the 'what' – of the curriculum is stable, but schools will bring it to life in their local context, and teachers will adapt lessons – the 'how' – to meet the needs of their own classes.
- **Representation:** All pupils see themselves in our curriculum, and our curriculum takes all pupils beyond their immediate experience.
- **Education with character:** Our curriculum - which includes the taught subject timetable as well as spiritual, moral, social and cultural development, our co-curricular provision and the ethos and 'hidden curriculum' of the school – is intended to spark curiosity and to nourish both the head and the heart.

Here we explore these principles in the context of the maths curriculum:

- **Entitlement:** All pupils in maths are exposed to extensive number, algebra, geometry, proportion, and statistics content and are not taught on separate pathways until Key Stage 4. This ensures that all pupils can access all areas of maths and have time to develop their skills before limiting their entitlement to Higher maths.
- **Coherence:** Our curriculum has been carefully sequenced to ensure that knowledge is revisited without having a spiral curriculum, and to ensure that classic misconceptions between topic areas are avoided.
- **Mastery:** Mathematical concepts are taught in-depth and continually revisited through careful interleaving of content into future teaching topics. The focus on retention of knowledge is at the core of the maths curriculum; the mastery approach supports this.

- **Adaptability:** Teachers are provided with a fully resourced curriculum that will meet the expectations of the maths curriculum in Key Stage 3 and Key Stage 4. Teachers are expected to adapt these resources and have autonomy in the way they are delivered in the classroom.
- **Representation:** Maths is universal, providing all pupils with an elegant and logical way of viewing the world. Where our resources include names and places, these have been selected to be inclusive. We believe that a secure understanding of maths is an essential starting point for all young people.
- **Education with character:** Mathematics is a common language in which all pupils can solve, analyse, and problem solve. Our curriculum supports pupils to build logical reasoning, critical thinking and is mentally rigorous.

Content of the Maths Curriculum

The majority of the content covered in Maths at Parkside is intended to prepare students for the Mathematics GCSE (which in turn enables them to progress to further study of post-16 mathematics). This part of the curriculum is heavily based on the curriculum structure provided by United Learning, but with some adjustments made to account for the typical needs of Parkside students. For example, topics may be brought earlier or given greater emphasis because they play a significant role in supporting progression to the Maths courses which form part of the IB Diploma, because understanding these concepts supports students' learning in other subjects such as Science, or because our experience with teaching in our local context suggests that students will gain a better understanding from encountering ideas in a slightly different order.

Additionally, at Parkside the Computing element of the KS3 curriculum is delivered through Maths, English and Humanities lessons rather than as a separate subject. This means that a number of technical Computing topics are included in the Maths curriculum. These topics are shown in yellow on the roadmap below. The sequencing of these topics is designed to allow teachers to make links to related concepts within the curriculum (for example, in Year 7 the use of variables within computer programs is taught following algebraic substitution) or to allow reinforcement and interleaving of these concepts (in Year 8, students reinforce their learning about co-ordinates by writing programs which produce computer-generated images)

At Key Stage 5, IB Diploma Programme students study one of two courses (Mathematics: analysis and approaches or Mathematics: applications and interpretation) at either Standard Level or Higher Level. Analysis and approaches is more closely related to a typical post-16 Maths course and focuses heavily on algebra, geometry and calculus. Applications and interpretation focuses to a greater extent on practical applications of mathematics and involves greater reliance on technological methods (such as the Graphic Display Calculator) for solving equations, graphing functions and carrying out statistical procedures. Students on each course are taught the content common to SL and HL in three lessons per week, and students taking the course at HL study the additional content in two further lessons per week. Typically the additional HL content which builds on a given topic from the common content is introduced shortly after it has been completed in SL lessons so that students can further develop their understanding of the topic. For example, after SL and HL students learn together about quadratic and exponential models in the second term of Year 12 applications and interpretation, HL students will go on to study logarithmic, logistic and power models, as well as the use of log-log and semi-log graphs to identify the appropriate model for a given set of data.

Roadmap of the Maths Curriculum in Key Stage 3

The roadmap diagram on the following page sets out the route that we expect pupils to take through our Key Stage 3 curriculum. The roadmap shows the sequence of units covered in Year 7 to Year 9, broken down into a half-term structure to support planning and assessment points. All units are compulsory components of Key Stage 3 teaching and results in a core base of knowledge to begin Key Stage 4. The curriculum has been carefully designed to continuously interleave content, enabling pupils to revisit prior knowledge without having a spiral curriculum. The curriculum focuses on teaching in a sequence that provides building blocks for pupils to access future topics.

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Year	HT	Topic
7	1a	Numerical skills
		Order of operations
		Basics of algebra
		Factors and multiples
7	1b	Expanding and factorising
		Addition and subtraction
		Perimeter
		Programming with Scratch
7	2a	Multiplication and division
		Area of triangles and quadrilaterals
		Mean
7	2b	Fraction manipulation
		Comparing and ordering fractions
		Adding and subtracting fractions
		Fractions of amounts
		Basic probability
7	3a	Polygons and symmetry
		Angles
		Coordinates
		Using variables in programming
7	3b	Substitution
		Generalising with algebra
		Calculating with time
		Data representation in a computer

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Year	HT	Topic
8	1a	Indices
		Prime factorisation
		Rounding
		Fractions
		Drawing with Python
8	1b	Forming and solving equations
		Creating algebraic models
		Basic linear graphs and $y = mx + c$
8	2a	Angles on parallel lines
		Interior and exterior angles
		Circumference
		Modular programming
8	2b	Proportional reasoning
		Fractions, decimals and percentages
		Ratio
8	3a	Area of circles and composite shapes
		Presenting and interpreting data
		Averages and spread
8	3b	Spreadsheets
		3-D visualisation
		Volume
		Computer systems

Year	HT	Topic
9	1a	Index laws
		Standard form
		Estimation and limits of accuracy
		Decimal manipulation and related calculations
		Fraction calculations
9	1b	Algebraic manipulation
		Expanding and factorising double brackets
		Probability
		Python programming
9	2a	Proportion
		Percentages and percentage change
		Modelling with spreadsheets
9	2b	Sequences
		Linear equations
		Linear inequalities
		Pythagoras
9	3a	Interior and exterior angles
		Parallel lines
		Basic vectors
		Transformations
9	3b	Plans and elevations
		Circles
		Surface area
		Python programming with sequences

'Why This, Why Now?'

In our planning, we have asked ourselves 'why this, why now?' Here we provide some examples of the curriculum choices we have made, and why the units have been placed in the order we have chosen:

- Perimeter and angles are taught following addition and subtraction so that pupils have the skill set needed to access the numeracy demands of these topics.
- Area is taught following multiplication and division so that pupils have the skill set needed to access the numeracy demands of this topic.
- Algebraic manipulation is taught in-depth early in Year 7 to support solving equations in Year 8. Introducing algebraic notation early in the year also provides opportunities throughout the year for challenging students by asking them to work with algebraic expressions as well as number as part of other topics.
- Fraction and decimal manipulation are taught in Year 7 and are then continually interleaved into future topics such as means, linear equations and circumference.
- Solving linear equations is taught in-depth in Year 8 and then it is continually interleaved into future topics such as angles in parallel lines.
- The mean is taught in-depth in Year 7 before the introduction of the median, mode and range in Year 8. This is to avoid misconceptions in the analysis of averages.
- Perimeter and area are taught separately with a suitable time gap to avoid misconceptions with these two mathematical areas.
- Standard form and methods for working with proportional relationships are introduced at the start of Year 9 so that students can develop an understanding of these ideas before encountering their use in Science lessons.

The Maths Curriculum and the IB Diploma Programme

As with all IB Diploma Programme teaching, lessons in Key Stage 5 Maths are planned to incorporate specific elements of the IB learner profile and other elements of an IB education. An example from the first term of each of the IBDP Group 5 courses is shown below.

	Knowledge, concepts and skills	**Learner Profile**	**TOK links**	**Connections to other learning**	**Connections beyond the classroom**
Error and accuracy (Maths: application and interpretation)	Absolute and relative error; the range of values a result may really take; appropriate degrees of accuracy; accuracy of measurement	Inquirers Knowledgeable Thinkers Communicators Reflective	If measurements cannot be precise, how can we use mathematical models to represent the real world? How accurate do we expect information given to us to be?	Exact versus approximate models in later work on modelling Estimation of results Limitations of measurement accuracy in Science	Interpreting figures in the news and in academic publications
Exponents and logarithms	Laws of exponents; rational functions and their graphs; laws of logarithms,	Inquirers Knowledgeable Thinkers	Why does using logarithms to replace multiplication with	Manipulation of exponents in later work on polynomials and	Understanding exponential growth and the implications for

(Maths: analysis and approaches)	including change of base	Communicators Open-minded Reflective	addition seem simpler to us? Are number bases part of the number system or only an aspect of its representation?	solution of equations. Use of logarithms in the experimental sciences.	natural resources; logarithmic perception of sound and brightness

Teaching the Maths Curriculum

The maths curriculum promotes a consistent approach to lesson delivery by linking lesson structure to the Rosenshine Principles of Instruction, in line with United Learning's centralised teaching and learning approach. We use these principles because cognitive research (e.g. Kirschner, Sweller and Clark, 2006) suggests that students need a large amount of subject knowledge in their long-term memory to become competent in any subject. In maths, pupils will be far better equipped to apply mathematical thinking to a problem if their working memory is not overloaded with basic calculations. Therefore, our curriculum always emphasises secure content knowledge before moving onto problem-solving tasks. This is a step away from discovery-based learning and acknowledges the gap between teachers as experts and pupils as novices, with the key point being that we cannot expect pupils to show mathematical expertise until they have acquired fluency with numbers.

The development of long-term memory is supported by a curriculum that focuses on interleaving content, regular low stakes quizzing, daily starter grids that review prior learning, and formative assessments that feed into teacher planning to close gaps in knowledge. Consistent review of key content is integral to the structure and order of the curriculum itself. Teachers use the Sparx homework platform to review this content as homework.

Our curriculum is designed to provide a challenge for all learners. Teachers are expected to adapt resources for the needs of their students. We use carefully constructed resources that exemplify accessible methods for students and teachers. We provide an opportunity for challenge by depth rather than accelerating through the curriculum. In Key Stage 4, exam questions focusing on the specification objectives AO1/2/3 are used, when appropriate, to assess understanding of core fluency and application of it in context. In Key Stage 5, a similar distinction exists with Paper 1 questions (Applications and interpretation) or Section A questions (Analysis and approaches) filling the role of AO1 and Paper 2/Section B filling the role of AO2/3.

So, when we walk into a maths lesson, what should we expect to see?

Although teachers may use different or modified resources and tasks, all lessons will follow a similar pattern. This pattern links directly to the Rosenshine Principles.

Rosenshine Principles

R1 - Begin with a short review of prior learning
R2 - Present new material in small amounts or steps
R3 - Ask many questions and check the responses of all students R4
- Provide models
R5 - Guide student practice
R6 - Check for student understanding
R7 - Obtain a high success rate
R8 - Provide scaffolds for difficult tasks
R9 - Require and monitor independent practice

R10 - Engage students in weekly and monthly review

'Do now' activity: R1

- Mixed fluency skills based on pre-requisite knowledge presented in a structured starter grid
- Students self-assess their responses against pre-prepared answers and record the correct solution method for any questions they did not complete successfully
- Questions vary minimally over the course of each week, allowing students to improve and then consolidate their understanding of how to respond to specific types of question
- Starter questions for all classes are based on a common set of resources but teachers may adapt them where necessary to further consolidate specific skills or repeat question types which were answered poorly

Introduction of new skills: R2 – R5, R8

- Carefully chosen examples that are modelled in detail without whole class questioning in order to allow all students to focus on the method and the teacher's explanation
- Students complete a similar example to the modelled example for the teacher to check
- The teacher may ask targeted questions to check and further develop understanding

Check for understanding – AFL – R6, R3

- Check the understanding of examples – this could be in books, on MWB, with questioning and/or purposeful circulation
- Re-model questions that were not understood

Independent practice – R7

- Independent practice that relates directly to the modelled examples
- The teacher's assessment will inform the form, difficulty and quantity of independent practice within each lesson
- Enough time is given for students to complete questions with minimal copying out
- Students will generally self-mark their answers as they complete each question or exercise, with the teacher circulating and monitoring students' independent practice (shown by ticking exercise books in pink pen)
- All students are expected to complete significant independent practice on each topic to aid their retention. Students who progress quickly through independent practice tasks may be challenged with similar questions of escalating difficulty, problem-solving questions or deliberate practice problems based around a specific broader question ("Mathematical etudes"). Additional challenges will always exercise the same fundamental skills as the main content of the lesson so that students' sequence of content acquisition is not affected by their attainment on a particular topic

Review of independent practice – R9

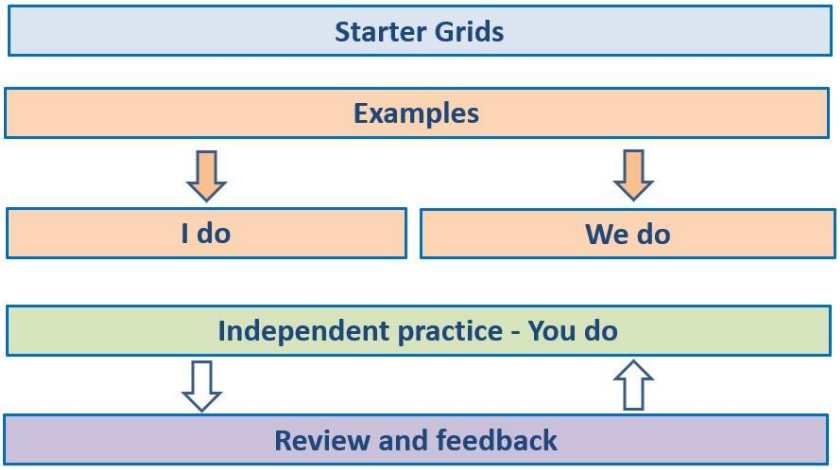
- Answers given to independent practice (prepare answers and minimise pupil input to increase the pace and maximise the clarity of answers)
- Students self-assess their work (green pen)

Regular review – R10

- Use starters and regular quizzing to review knowledge taught
- At the end of each KPI (topic), students complete a Learning Check which is marked by their teacher
- The teacher will prepare a feedback document for the whole class based on their work on the Learning Check which students then use to correct or improve their answers

The focus of our lesson design is the **I/we/you model:** Explanation/modelling >> guided practice >> independent practice.

The flow chart below summarises a typical structure that we should expect to see in maths lessons



Exam questions feature in most Year 11 and 13 lessons and many lessons in Year 12. Where exam questions are used there should be a clear reference to the number of marks available, how they are attained, and where it is likely to feature on an exam.

Homework

Key Stage 3 and 4 students complete homework online using Sparx, which supports the Key Stage 3 and Key Stage 4 curriculum. Our resources signpost students to the relevant maths clips on these websites. For example, Learning Checks include references to topics on Sparx so that where a student has struggled with a question they can undertake further independent revision. Following summative assessments, students receive a question level analysis sheet ("feedback sheet") which also links each question to a Sparx topic.

Students' homework is linked to the topics they have been studying recently. The maths curriculum is programmed into the Sparx system at the start of the year and amended by teachers if necessary on a week-by-week basis, directly linking our curriculum to the homework platform. Sparx automatically adds consolidation activities to each homework to aid with spaced practice.

Key Stage 5 students are expected to complete regular independent work based on the exercises from the Haese & Harris series of IB textbooks, marking it themselves and seeking feedback from their teacher if they need further support. Teachers use the formative assessment methods outlined below to identify students whose independent work may not be supporting them in developing a sufficiently secure understanding of each topic so that they can be offered more structured oversight of their work.

Assessing the Maths Curriculum

Formative Assessment in Maths

Formative assessment can identify what pupils can and cannot do and is a way to review prior knowledge. The following resources support formative assessment in maths:

- **"Do Now" grids** – daily quiz at the beginning of every lesson covering prior knowledge.
- **Learning checks** – to identify class gaps in a recently taught unit. Teachers' marking identifies themes in pupils' responses which can inform reteaching and starter grid content as well as being used to provide whole-class feedback. Teachers also monitor outcomes of Learning Checks over time in order remain aware (and make parents aware) of any difficulties each student may be having. Learning Checks are used in all Key Stages, although they take place in class time in KS3 and KS4 but are completed independently in KS5.

- **Fluency tests** – used in Year 11 as a further method of identifying possible gaps in knowledge while reviewing the course

Summative Assessment in Maths

In Years 7-10, two summative assessments are carried out per year, known as the mid-year assessment and end-of-year assessment. Summative assessments are followed by an in-class review of key gaps in learning. Each student is provided with colour coded, personalised, question-level analysis sheets directing them to independent learning tasks on Sparx. Year 12 also has two summative assessments, the outcomes of which are used to support students in identifying their appropriate "next steps" in a guided reflection session led by the teacher. In Years 11 and 13, the summative assessments take the form of mock exams using full past papers, with feedback provided to students in the same way as in Year 10 or 12 respectively.

Recovery and Catch-up in Maths

Formative and summative assessment will both help to identify pupils who have fallen behind and need to catch up. QLAs post-assessment provides pupils with targeted support directing them to independent learning tasks on Sparx. Formative monitoring is also used to keep parents informed about their child's progress through each topic.

Gaps identified through summative and formative assessments can be addressed in starter grids and designated catch-up lessons.

Progression in the Maths Curriculum

Primary to Secondary:

The Year 7 curriculum builds on and develops the Key Stage 2 curriculum. The curriculum ensures that topics are revisited in depth to support the transition from Year 6. For example, numeracy and geometry are revisited in the first term, covering basic and extended content. This ensures that pupils have an opportunity to quickly catch up if there are any gaps in their Key Stage 2 knowledge. A baseline assessment at the start of Year 7 helps to identify what students can and cannot do. The Year 7 curriculum is also mapped to prior learning in Key Stage 2 so that teachers know which material pupils have been exposed to.

Key Stage 3 to Key Stage 4:

The Key Stage 3 curriculum covers key mathematical building blocks in depth that will support a successful start to the Key Stage 4 GCSE curriculum. In the Key Stage 4 curriculum, there are many opportunities to revisit prior knowledge through formative assessment resources such as starter grids and fluency tests.

Key Stage 4 to Key Stage 5:

Post-16 study of Maths both at Parkside and elsewhere assumes a secure knowledge of the GCSE course. Students who intend to progress to study Mathematics: Analysis and approaches, to study Mathematics: Applications and interpretation at Higher level or to take A Level Maths at another Sixth form will need to be particularly confident with the more challenging elements of the Higher tier Maths GCSE, and transition resources are provided to assist them with this.

Key Stage 5 to University:

- All IB Diploma students at Parkside study one of four possible Maths routes, comprising a choice of two courses taken at either Higher Level or Standard Level.
- Maths: Analysis and Approaches provides a route similar to “traditional” academic post-16 Maths courses such as A-level Maths and Further Maths, usually a prerequisite for students who intend to take Maths or Physics at university level.
- Maths: Applications and Interpretation provides students with exposure to practical use of mathematics, including the use of technology and statistical methodology which supports a wide variety of career paths, particularly social sciences and Medicine. When taken at Higher Level, Applications and Interpretation may also be suitable for students who intend to progress to degree-level study of Engineering, Computer Science or Economics.
- The opportunities available to degree level Maths graduates are vast.
- The UCAS subject page HERE is a helpful way of viewing the different degrees related to Maths.