A comparative analysis of the assessment and grades of IB DP and GCSE mathematics

Submitted to the International Baccalaureate (IB)

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Ecctis

Acronyms

AHL	Additional higher level
AO	Assessment objective
DP	Diploma Programme
GCSE	General Certificate of Secondary Education
GDC	Graphic display calculator
HEI	Higher Education Institution
HL	Higher level
IB	International Baccalaureate
MAA	Mathematics: analysis and approaches
MAI	Mathematics: applications and interpretation
SL	Standard level
UK	United Kingdom

Contents

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Executive summary

A demand-focused comparative analysis of mathematics in the International Baccalaureate Diploma Programme (DP) and GCSE concluded:

- The specifications and assessments for DP mathematics subjects at standard level (SL) are significantly more demanding than those for GCSE mathematics, exceeding both the Higher tier and, to an even greater extent, the Foundation tier.[1]
- As an extension of SL, the higher level (HL) specifications and assessments pose an even greater level of demand compared to those of GCSE mathematics.
- A DP mathematics grade 2 (for either SL or HL) demonstrates a level of mathematics achievement which is sufficient to meet the requirements of the GCSE grades examined in this study (6 to 4).

GCSE Grade	IB DP Mathematics Standard Level Grade	IB DP Mathematics Higher Level Grade
6	2	2
5		
4		

GCSE mathematics is graded 9 to 1 and DP mathematics is graded 7 to 1 (highest to lowest).

These conclusions apply to both mathematics subjects offered in the DP, namely 'Mathematics: analysis and approaches' and 'Mathematics: applications and interpretation'.

Context

The International Baccalaureate (IB) is a non-profit educational foundation offering four programmes across the world, namely the Primary Years Programme (PYP), Middle Years Programme (MYP), Diploma Programme (DP), and the Career-related Programme (CP).

The DP is an upper-secondary programme leading to the IB diploma qualification. Students in this programme complete the DP core alongside subjects from studies in language and literature, language acquisition, mathematics, science, individuals and societies, and the arts. The IB diploma is pursued by many students worldwide, with over 100,000 candidates in 2023.[2]

A significant number of these international students seek to gain entry to higher education institutions (HEIs) in the UK. In addition to Level 3 qualifications, such as A levels and the IB diploma, UK universities sometimes require a Level 2 qualification in mathematics, such as

[1] The GCSE Foundation tier does not aim to award the higher grades of 6-9, and as a result, its syllabus and assessments are overall less demanding than those of the GCSE Higher tier. However, this does not mean that achieving one of the overlapping GCSE grades (3, 4, and 5) on the Foundation tier is any less demanding than on the Higher tier. Indeed, measures are taken to ensure that these grades are equivalent across both tiers.
[2] IB. (2023). *The IB Diploma Programme and Career-Related Programme. Final Statistical Bulletin. May 2023 Assessment Section*. Available from: dp-cp-final-statistical-bulletin-may-2023.pdf (ibo.org)

the GCSE or MYP. Common entry requirements are GCSE mathematics grades 4, 5 and 6 (or equivalent).

However, many DP students do not hold a GCSE or MYP qualification and therefore need to meet the equivalent requirements institutions set. Therefore, it is important for institutions to understand how mathematics achievement in the DP compares to that of GCSE and which IB diploma grades meet their Level 2 mathematics requirements.

In this context, Ecctis was commissioned to conduct a demand-focused comparative analysis of the mathematics assessment in the DP and GCSE. To support the recognition of mathematics achievement in the DP, the analysis culminated in the development of grade comparisons. The analysis considered all subjects and levels offered in DP mathematics, namely:

- Mathematics: analysis and approaches at SL
- Mathematics: analysis and approaches at HL
- Mathematics: applications and interpretation at SL
- Mathematics: applications and interpretation at HL.

The analysis also considered both tiers of GCSE: Higher and Foundation. The Higher tier awards GCSE grades 9 to 3, while the Foundation tier awards the grades 5 to 1. Therefore grades 3, 4 and 5 are available in both tiers of entry.

Methodological approach

Ecctis applied a bespoke methodology to undertake a comparative analysis of the mathematics assessment and grades of the DP and GCSE. The methodology included a review of specifications and recent assessment samples. For assessment objectives and syllabus content, Ecctis used a mapping method to identify similarities and differences in demand. To analyse the demand of items, Ecctis used an expert panel approach, whereby each expert conducted a review and comparison of items from an assessment sample and subsequently took part in a panel to discuss and reach a consensus on the judgements.[3]

For grade comparisons, Ecctis drew upon grade descriptors and used an assessment sample to develop ‘grade profiles’. These grade profiles provided insight into the knowledge and skills required to achieve specific grades in the DP and GCSE assessment, enabling a comparison between them. After reviewing and comparing the grade profiles independently, a panel of experts met to discuss and finalise the grade comparison conclusions.

Comparative analysis summary

The demand-focused comparative analysis examined the methods and structure of assessment, assessment objectives, content, assessment components and items, as well as the marking approaches of DP and GCSE mathematics. The table below summarises the key findings of the comparative analysis, using a colour code to highlight the areas in which the DP demonstrated greater demand.

[3] Experts consisted of individuals with diverse mathematics teaching and mathematics curriculum review experience at appropriate levels and in international contexts.

Table: Summary of key findings from the comparative analysis.

Area	Key findings and conclusions
Assessment methods and structure	Both DP and GCSE mathematics are primarily assessed through external written exams, divided into 2-3 different papers. The duration of GCSE's external assessment is longer than SL but shorter than HL. The only key difference is that the DP also uses internal assessment, weighted at 20%. The assessment methods alone do not pose a difference in demand; this is determined by the following areas.
Assessment objectives	DP and GCSE mathematics assessment objectives share several similarities. Both assess students' ability to demonstrate knowledge and understanding, apply knowledge to various contexts, communicate mathematically, use reasoning, interpret information, and solve problems. However, the DP's objectives also emphasise technology and inquiry approaches, adding an extra layer of demand. The technology used in DP mathematics is more advanced than in GCSE and a higher proficiency is expected. Additionally, the DP's inquiry approaches objective particularly emphasises higher-order skills such as analysis and critical and creative thinking skills. Moreover, lower-order skills such as knowledge and application are weighted significantly higher in the GCSE compared to the DP, particularly in the Foundation tier. Overall, assessment objectives are an area of some difference in demand between DP and GCSE mathematics.
Syllabus content	The syllabus for both DP subjects, at each level, is significantly more demanding than the GCSE syllabus, surpassing the Higher tier content and, to a greater extent, the Foundation tier content. A considerable amount of content assessed in GCSE is assumed knowledge for the DP. While there is some shared content between DP and GCSE–more so with the Higher tier–this constitutes only a small proportion of the SL syllabus and an even smaller proportion of the HL syllabus. The remaining content in SL, and especially in HL, is significantly more demanding than that of GCSE, requiring substantially more prior knowledge.
Assessment components and items	Most DP assessment items are significantly more demanding than the items on the GCSE assessments. DP items assess content in considerably more depth and more frequently require sustained reasoning. Additionally, the content assessed by DP items is typically considerably more complex than that assessed by GCSE items, exceeding the complexity of those on the Higher tier and, to an even greater extent, the Foundation tier assessment. Moreover, the DP items are more rigorously defined and use more complex contexts, thus requiring stronger skills in interpretation and problem-solving. Lastly, the internally assessed mathematical exploration in the DP adds another element of demand, as it involves an extended, independent piece of work that emphasises mathematical communication, as well as the higher-order skills of reflection and creativity.
Marking approaches	The marking approaches used for external assessment are largely similar between DP and GCSE mathematics.

Key:

	An area of similarity which does not constitute a significant difference in demand between DP and GCSE mathematics.
	An area with some similarities, though DP mathematics poses greater demand.
	An area with considerable differences, with DP mathematics posing significantly more demand than GCSE. The degree of difference to GCSE increases from SL to HL.

Grade comparison summary

As demonstrated by the comparative analysis, GCSE and DP mathematics are pitched at different levels, with the DP mathematics specifications and assessments for SL, and especially for HL, exceeding the demands of GCSE. Consequently, GCSE and DP grades are not directly comparable or equivalent. **Therefore, the analysis determined the lowest DP grade that demonstrated a level of mathematics achievement sufficient to meet the requirements of GCSE grades 6 to 4**. **A panel of experts concluded that a grade 2 at**

either SL or HL satisfied these requirements. Consequently, any higher DP mathematics grade (3 to 7) also meets their requirements.

Several key considerations informed this conclusion. The panel determined that grade descriptors alone could not provide clear comparisons between DP and GCSE grades, given the differences in their specifications and assessments. Therefore, analysis of assessment samples and their grade boundaries were essential to understand the requirements of the grades and establishing comparisons. Discussions initially focused on comparing a grade 2 at SL and then expanded to other grades.

Compared to the GCSE grades, a lower proportion of assessment is required to attain a DP grade 2. However, the panel agreed that answering a small number of DP items, or even partial responses, could demonstrate skills and knowledge equivalent to, or beyond, those needed for GCSE grades 4 to 6. Indeed, the demand of the SL and HL assessments is significantly higher, and a single DP item or question can encompass the knowledge and skills tested by multiple GCSE items. Therefore, achieving enough marks to gain a grade 2 demonstrates mathematical knowledge and skills that would satisfy GCSE grades 4, 5 and 6. By similar reasoning, it followed that a grade 2 at HL, and higher grades, were also sufficient to meet the requirements of GCSE grades 4 to 6.

To maintain consistent grading standards, boundaries are set for each GCSE and DP exam series. Although one DP exam series had unusually low grade boundaries, making it unsuitable for comparisons, analysis of grade boundary trends confirmed this as an isolated case. Other exam series provided evidence supporting the conclusion that the mathematics achievement demonstrated by a DP grade 2 at SL is sufficient to meet the requirements of GCSE grades 4, 5 and 6.

Finally, the grades students receive from their assessment capture just one picture of their mathematical knowledge and skills. DP students will have studied a higher level of mathematics than GCSE over their two-year programme, regardless of the subject and level chosen. Institutions or professional bodies using grade comparison information should consider the different knowledge and skills demonstrated by DP and GCSE grades.

1. Introduction

1.1 Context and scope

The International Baccalaureate (IB) is a non-profit educational foundation offering four programmes across the world, including the Primary Years Programme (PYP), Middle Years Programme (MYP), Diploma Programme (DP), and the Career-related Programme (CP).

The DP is an upper-secondary programme leading to the IB diploma qualification. Students in this programme complete the DP core alongside subjects from studies in language and literature, language acquisition, mathematics, science, individuals and societies, and the arts. The IB diploma is pursued by many students worldwide, with over 100,000 candidates in 2023.[4]

A significant number of these international students seek to gain entry to higher education institutions (HEIs) in the UK. In addition to Level 3 qualifications, such as A-levels and the IB diploma, UK universities sometimes require a Level 2 qualification in mathematics, such as the GCSE or MYP. Common entry requirements are GCSE mathematics grades 4, 5 and 6 (or equivalent).

However, many DP students do not hold a GCSE or MYP qualification and therefore need to meet the equivalent DP mathematics requirement set by institutions. Hence, it is important for institutions to understand how mathematics achievement in the DP compares to that of GCSE and which IB diploma grades meet their Level 2 mathematics requirements.

In this context, Ecctis was commissioned to conduct a demand-focused comparative analysis of the mathematics assessment in the DP and GCSE. To support the recognition of mathematics achievement in the DP, the analysis culminates in the development of grade comparisons. As such, the report will seek to answer the following **research questions**:

1) How do the mathematics assessment frameworks (objectives, methods, weighting, etc.) compare between the two qualifications?

2) How do the demands placed on candidates by the specifications, mark schemes and specimen papers in DP mathematics compare against those in GCSE mathematics? If different, in what areas do the levels of demand differ between the two qualifications?

3) What is the grade comparison for the mathematics courses between the two qualifications (focusing on GCSE grades 4, 5 and 6 of the numerical scale 9-1)?

The report will consider all subjects and levels offered for DP mathematics, namely:

- Mathematics: analysis and approaches at standard level (MAA SL)
- Mathematics: analysis and approaches at higher level (MAA HL)
- Mathematics: applications and interpretation at standard level (MAI SL)
- Mathematics: applications and interpretation at higher level (MAI HL).

[4] IB. (2023). *The IB Diploma Programme and Career-Related Programme. Final Statistical Bulletin. May 2023 Assessment Section*. Available from: dp-cp-final-statistical-bulletin-may-2023.pdf (ibo.org)

1.2 Overview of DP and GCSE mathematics

1.2.1 DP mathematics

The International Baccalaureate Diploma Programme (DP) was established in 1968 as a two-year pre-university programme for 16-19-year-old students.[5] In the UK context, the DP is a Level 3 qualification and designed to be undertaken after GCSEs (Level 2) or an equivalent stage of education.[6]

For the DP, students must select one subject from: studies in language and literature, language acquisition, individuals and societies, science, mathematics, and the arts.[7] All subjects are studied concurrently over the two-year duration of the programme and most subjects can be taken at either standard level (SL) or higher level (HL). The recommended teaching time is 150 hours for individual subjects at SL and 240 hours for HL.[8] For their mathematics subject, DP students can choose between the below options:

Mathematics: analysis and approaches[9]
Mathematics: analysis and approaches (MAA) is offered at both SL and HL. This subject is suitable for students who are interested in both real and abstract applications of mathematical concepts and enjoy problem solving and generalisation.

Mathematics: applications and interpretation[10]
Mathematics: applications and interpretation (MAI) is also offered at both SL and HL. This subject is suitable for students who are interested in exploring more practical applications of mathematics and would enjoy using mathematical models and technology.

To achieve the IB Diploma, students must take at least three HL subjects.[11] The maximum number of subjects that can be taken at HL is four. HL subjects are intended to prepare learners for discipline specialisation in higher education, whilst the SL subjects balance this by broadening the range of subjects studied.[12]

In addition to the six subjects taken from the subject groups, students also need to complete three further curriculum components which comprise the DP 'core'. These are theory of knowledge (TOK), the extended essay, and creativity, activity, service (CAS).

All subjects are graded 7 to 1 (highest to lowest). To achieve the Diploma candidates must meet the following criteria:

- CAS requirements are met
- The candidate has achieved at least 24 total points
- A grade has been awarded in all subjects, TOK and the EE

[5] IB. (2015). *Diploma Programme. From principles into practice*. pg. 5.
[6] Department for Education. (n.d). *What qualification levels mean.* Available from: What qualification levels mean: England, Wales and Northern Ireland - GOV.UK
[7] IB. (2024). *DP Curriculum*. Available from: https://www.ibo.org/programmes/diploma-programme/curriculum/
[8] Ibid.
[9] IB. (2019). *Mathematics: analysis and approaches guide.*
[10] IB. (2019). *Mathematics: applications and interpretation guide.*
[11] IB. (2024). *DP Curriculum*.
[12] IB. (2015). *Diploma Programme. From principles into practice*. pg. 6.

- A grade of at least a 2 has been awarded in all subjects
- There are no more than two grade 2s awarded (SL or HL)
- There are no more than three grade 3s or below awarded (SL or HL)
- The candidate has at least 12 points on HL subjects. (For candidates who register for four HL subjects, the three highest grades count)
- Candidates have at least 9 points on SL subjects. (Candidates who register for two SL subjects must be awarded at least 5 points at SL).[13]

1.2.2 GCSE mathematics

As a Level 2 qualification in the UK, the GCSE is of a lower level than the IB Diploma.[14] The qualification is completed in secondary education, at the end of Key Stage 4 and before Key Stage 5. The ages of students sitting the exams are typically 14-16 years. Students often need a minimum of a GCSE grade 4 in mathematics to progress further into upper-secondary level education and later access higher education institutions. If students do not achieve a grade 4 or above by the end of Key Stage 4, they are required to re-sit the exam and study GCSE mathematics post-16.

The GCSE mathematics curriculum was revised by the Department for Education in 2015 for first assessment in 2017. This saw the GCSE grading change from letter grades to the numerical 9 to 1 scale (highest to lowest). GCSE mathematics has two tiers of entry for which students can be entered: Higher and Foundation. The Higher tier is graded 9 to 3 and the Foundation tier is graded 5 to 1. Any grade below these bounds is classified as 'Ungraded'. Grades 3, 4 and 5 are available in both tiers and measures are in place to ensure that it is no more or less difficult to achieve the same grade in different tiers.[15] Ofqual recommends that students who are expected to achieve a grade 4 or 5 should be entered for the Foundation tier.[16]

1.3 Structure of the report

The rest of the report is structured as follows:

2. Methodology: this section provides an overview of the methodology applied, including an outline of the approach used to compare the DP and GCSE assessments and grades.

3. Comparative analysis: this section presents the synthesis from the comparative analysis of DP and GCSE mathematics assessment. It includes a demand-focused analysis of their methods, objectives, content, components, items, and marking approaches.

4. Grade comparison: this section presents the grade comparisons between the DP and selected GCSE grades, as well as the key reasons for the conclusions.

5. Bibliography: this section references all the sources and documents used in the study.

[13] IB. (2018). *Assessment principles and practices – Quality assessments in a digital age.* pg. 220. Available from: https://www.ibo.org/contentassets/1cdf850e366447e99b5a862aab622883/assessment-principles-and-practices-2018-en.pdf
[14] Department for Education. (n.d). *What qualification levels mean.*
[15] Ofqual. (2017). *GCSE maths: choosing the 'right' tier*. Available from: GCSE maths: choosing the 'right' tier – The Ofqual blog
[16] Ofqual. (2020). *The Ofqual Blog. GCSE tier entry in 2020.* Available from: GCSE tier entry in 2020 – The Ofqual blog

2. Methodology

2.1 Documentation review and methodological development

The study first conducted a review of the following DP and GCSE documentation.

DP documentation

- Subject guides for MAA and MAI (for assessment from 2021)
- Grade descriptors
- Assessment papers and mark schemes (2022, 2023 and 2024)
- Grade boundaries (2022, 2023 and 2024)
- Grade award manual.

GCSE documentation

- Specification for Mathematics (9-1) (for assessment from 2017)
- Higher and Foundation tier assessment papers and mark schemes (2022 and 2023)
- Grade boundaries (2022 and 2023)
- Grade descriptors.

During the documentation review, key information regarding the features of both assessments was extracted. This information formed the basis for developing section 1.2 Overview of DP and GCSE mathematics and contributed to the methodological development, serving as a crucial preliminary step for the comparative analysis and grade comparison.

The study analysed the latest DP and GCSE specifications that were available and primarily used assessment samples from 2022 and 2023. The GCSE specification and assessment sample were selected from a single awarding organisation. All GCSE awarding organisations align their specifications with the learning outcomes, content, and assessment objectives set by the Department for Education and all are regulated by Ofqual to ensure consistent and high standards. Therefore, the specification and assessment from one awarding organisation can be considered representative of all. GCSE has two tiers: Higher and Foundation, both of which were considered in the comparison with DP mathematics.

2.2 Comparative analysis

The comparative analysis of DP and GCSE mathematics focused on assessment methods, structure, objectives, content, components, items, and marking approaches. Key similarities and differences were identified, and, where appropriate, the analysis compared the demand of the specifications and assessment features.

2.2.1 Assessment structure and methods

As part of the analysis, Ecctis compared the structure and methods of DP and GCSE mathematics assessment.[17]

[17] Based on a selected GCSE awarding organisation.

In particular, the analysis considered how they compared in terms of:

- Structure – how the assessment is broken down and the weighting given to each component
- Methods – the use and format of external and internal assessment and the weighting given to each
- Duration – for each component and overall.

The synthesis of the comparative analysis can be found in 3.1 Assessment structure and methods.

2.2.2 Assessment objectives

Ecctis compared the assessment objectives (AOs) of DP and GCSE mathematics. The AOs were extracted from each specification and compared by identifying common and different themes and skills. Assessment papers were also reviewed to account for specific skills present in the assessment design but not explicitly stated in the objectives.

The weightings of the AOs were compared to evaluate the emphasis placed on different skills in each assessment. One GCSE AO combines skills (communication and reasoning) that the DP divides into separate objectives. For comparison, the weightings of these DP objectives were combined. Bloom's Taxonomy was used to assess the demand posed by the assessment objectives and their weightings. The synthesis of the comparative analysis can be found in 3.2 Assessment objectives.

2.2.3 Syllabus content

The comparative analysis of content considered the breadth, depth, and topics of DP and GCSE mathematics. Their content was mapped to one another to determine the extent to which each topic and sub-topic was present in the other. The documentation review revealed that some GCSE content was listed as prior learning in the DP mathematics subject guides. Consequently, the GCSE content was first mapped to the list of prior learning, and then to the MAA and MAI syllabi. The analysis considered the proportion of GCSE content assumed as prior learning for the DP, the overlapping content between the specifications, and the content that was not shared. The complexity and amount of prerequisite knowledge needed were considered to determine the demand of the unshared content. The synthesis of the comparative content analysis can be found in 3.3 Syllabus content.

2.2.4 Assessment components and items

The demand of the DP and GCSE assessments was evaluated by reviewing and comparing their components and the items within them. For externally assessed components, the types of items were identified and their proportion in the assessment determined. The analysis also compared the demand of the items used in externally assessed DP and GCSE components.

To minimise potential subjectivity and bias in evaluating item demand, Ecctis used an expert demand panel approach. This panel, consisting of curricula, teaching, and assessment experts in secondary mathematics, reviewed assessment item samples for all DP courses and GCSE. Items were extracted from a full assessment set in a 2023 exam series and categorised based on the mathematical topic that they related to (e.g., Number and Algebra). The item

demand analysis compared each DP course's items with the GCSE items within the same topic area. The experts assessed the skills, content, style, and structure of the items to determine similarities and differences in demand. Each group of items were discussed in the panel and reasoning for conclusions was provided. These topic-level conclusions were then used to produce overarching item demand comparisons between GCSE and each DP course. The synthesis of the comparative assessment analysis can be found in 3.4 Assessment components and items.

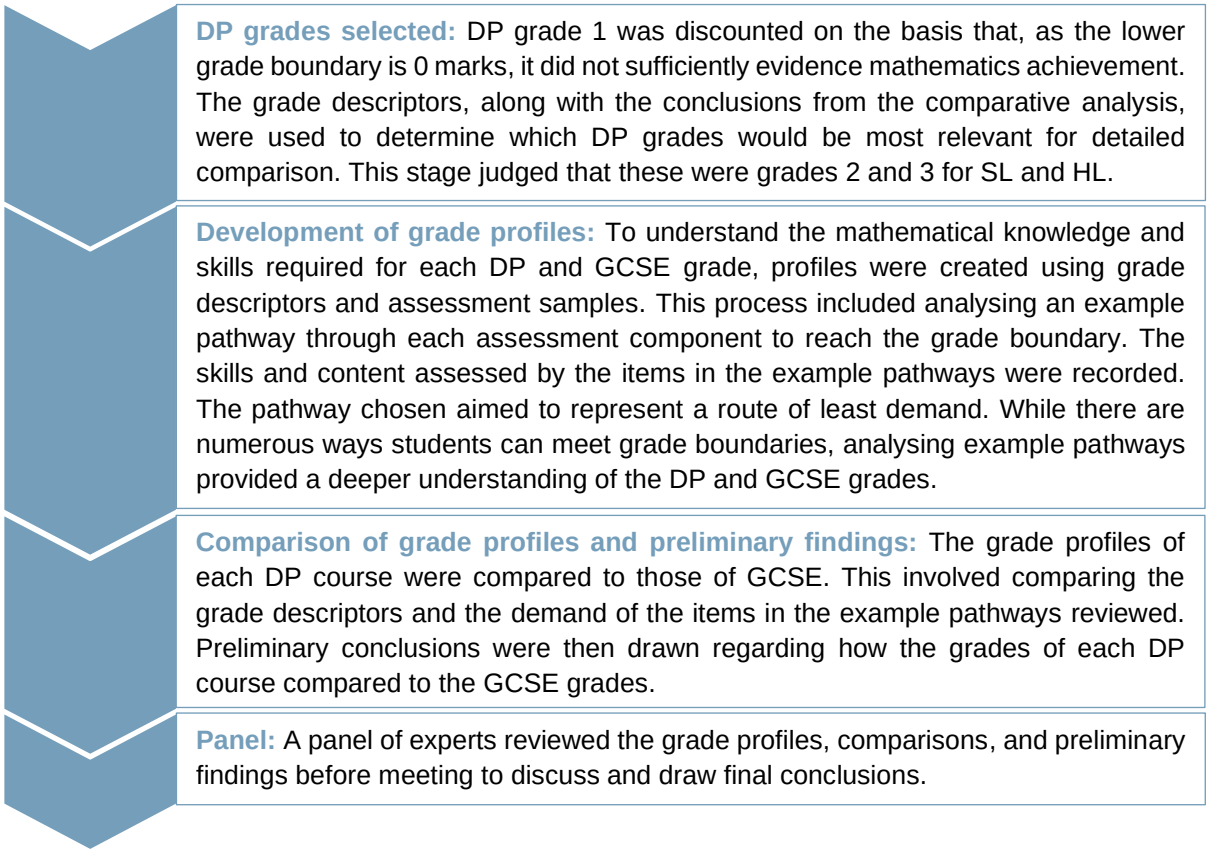
2.2.5 Marking approaches

DP and GCSE mathematics mark schemes were reviewed and compared. The analysis considered the marking codes and principles applied. The synthesis of the comparative analysis can be found in 3.5 Marking approaches.

2.3 Grade comparison

The grade comparison focused particularly on the correspondence between DP grades and GCSE grades 4, 5 and 6. For each DP course, the grade comparison aimed to identify the lowest grade that demonstrated a level of mathematics achievement sufficient to meet the requirements of the GCSE grade. To achieve this, Ecctis deployed a grade profile approach. The key steps of the methodology were as follows:

Figure 1: Methodological steps for grade comparison.



The grade comparison conclusions can be found in 4. Grade comparison.

3. Comparative analysis

This section compares the assessment features of DP and GCSE mathematics; it highlights key similarities and differences and evaluates how these impact demand. A summary of the analysis can be found in 3.6 Summary of key findings.

3.1 Assessment structure and methods

The table below presents a summary of the assessment structure and methods used by DP and GCSE mathematics.

Table 1: The assessment structure and methods of DP and GCSE mathematics.

	GCSE (Both tiers)	DP SL (MAA and MAI)	DP HL (MAA and MAI)
External assessment			
Total weighting	100%	80%	80%
Method	Written exams	Written exams	Written exams
Number of components	3	2	3
Component weighting	Paper 1 – $33\frac{1}{3}$% Paper 2 – $33\frac{1}{3}$% Paper 3 – $33\frac{1}{3}$%	Paper 1 – 40% Paper 2 – 40%	Paper 1 – 30% Paper 2 – 30% Paper 3 – 20%
Duration	4 hours 30 mins *(1 hour 30 mins x3)*	3 hours *(1 hour 30 mins x2)*	5 hours *(2 hours x2 + 1 hour)*
Component details	Paper 1: non-calculator Papers 2 & 3: calculator	*For MAA:* Paper 1: no technology* Paper 2: technology *For MAI:* All papers: technology	*For MAA:* Paper 1: no technology Papers 2 & 3: technology *For MAI:* All papers: technology
Internal assessment			
Total weighting	0%	20%	20%
Method	N/A	Mathematical exploration (a written piece)	Mathematical exploration (a written piece)
Number of components	N/A	1	1
Duration	N/A	10-15 hours (including teaching time)	10-15 hours (including teaching time)

*The first paper for MAA does not permit the use of any calculator. In other MAA papers, and all MAI papers, students should have access to graphic display calculators (GDCs).

Key similarities and differences:

- Both GCSE and DP mathematics primarily use externally assessed written exams.
- The duration of external assessment is longer for GCSE than DP SL, but shorter than DP HL.
- Both GCSE and DP MAA assessments include a paper that does not allow the use of calculators, whereas GDCs are permitted in all DP MAI assessments.
- DP assessment requires the use of GDCs, whereas only scientific calculators are required, and permitted, in GCSE assessments.
- Unlike GCSE, DP mathematics subjects also use internal assessment. This takes the form of a mathematical exploration, where students investigate an area of mathematics and produce an independently-written piece.

Overall, the assessment methods of DP and GCSE mathematics are largely similar, as both use external exams as the primary form of assessment. In isolation, the assessment methods and structure do not constitute an area where DP and GCSE methods differ significantly in demand.

3.2 Assessment objectives

GCSE mathematics has three assessment objectives (AOs), while DP mathematics has six AOs applicable to both subjects (MAA and MAI) and both levels (SL and HL). The table below displays the AOs of DP and GCSE mathematics side-by-side. The DP AOs have been presented such that they are next to the GCSE AOs that they align with most.

Table 2: Assessment objectives.

GCSE	DP
AO1 Use and apply standard techniques Students should be able to: • accurately recall facts, terminology and definitions • use and interpret notation correctly • accurately carry out routine procedures or set tasks requiring multi-step solutions	**AO1 Knowledge and understanding**: Recall, select and use their knowledge of mathematical facts, concepts and techniques in a variety of familiar and unfamiliar contexts
AO2 Reason, interpret and communicate mathematically Students should be able to: • make deductions, inferences and draw conclusions from mathematical information • construct chains of reasoning to achieve a given result • interpret and communicate information accurately • present arguments and proofs* • assess the validity of an argument and critically evaluate a given way of presenting information	**AO3 Communication and interpretation:** Transform common realistic contexts into mathematics; comment on the context; sketch or draw mathematical diagrams, graphs or constructions both on paper and using technology; record methods, solutions and conclusions using standardized notation; use appropriate notation and terminology.
	AO5 Reasoning: Construct mathematical arguments through use of precise statements, logical deduction and inference and by the manipulation of mathematical expressions*
AO3 Solve problems within mathematics and in other contexts Students should be able to: • translate problems in mathematical or non-mathematical contexts into a process or a series of mathematical processes • make and use connections between different parts of mathematics***** • interpret results in the context of the given problem • evaluate methods used and results obtained • evaluate solutions to identify how they may have been affected by assumptions made	**AO6 Inquiry approaches:** Investigate unfamiliar situations, both abstract and from the real world, involving organizing and analysing information, making conjectures, drawing conclusions, and testing their validity.
	AO2 Problem solving: Recall, select and use their knowledge of mathematical skills, results and models in both abstract and real-world contexts to solve problems.
	AO4 Technology: Use technology accurately, appropriately and efficiently both to explore new ideas and to solve problems

Key:
Knowledge and understanding
Reasoning, communication, and interpretation
Problem-solving
Inquiry approaches
A skill that is not explicitly shared between DP and GCSE mathematics AOs
*****A skill that is not explicit in the other's AOs but is present in its assessment.

Although organised differently, DP and GCSE assessment objectives share several skills.

Both sets of AOs include understanding and application of knowledge, problem-solving, reasoning, communication, and interpretation. The following describes their alignment:

- GCSE and DP AO1: Both focus on using and applying mathematics knowledge, such as facts, concepts, and techniques.
- GCSE AO2 and DP AO3/AO5: These include skills such as making inferences and deductions, creating mathematical arguments, and interpreting and communicating mathematical information. DP AO3 goes into more detail on what should be communicated using paper and technology – e.g. graphs and tables. GCSE also assesses these communication skills but do not emphasise the use of technology to conduct these. GCSE AO2 includes presentation of proofs, which is not explicit in the DP AOs. Proof is assessed in MAA but not MAI, which may explain its absence in the general AOs. Proof in GCSE is significantly more basic than in MAA.
- GCSE AO3 and DP AO2: Both focus on problem-solving skills, expecting students to solve problems in various contexts – both mathematical and non-mathematical. DP describes these contexts differently as abstract and real-world. GCSE AO3 includes making connections between different areas of mathematics, which, while not explicitly detailed in the DP AOs, is featured in the assessment.

Occasionally, skills from GCSE AOs appear in DP AOs with different focuses, and vice versa. For example, the use of notation is found in GCSE AO1 (Use and application of techniques) and DP AO3 (Communication and interpretation). Moreover, some skills in GCSE AO2 and AO3 align with those in DP AO6 (Inquiry approaches).

Higher-order thinking skills are present in both DP and GCSE AOs. However, DP AOs have additional demands due to their focus on technology and inquiry approaches.

While GCSE assessments expect the use of calculators, there is generally less emphasis on technology in the objectives. In contrast, DP AO4 specifies that students will be assessed on their ability to use technology efficiently and appropriately in exploration and problem-solving. Moreover, DP assessments involve more advanced technology tools, such as features of graphic display calculators. The DP specification encourages the use of a broader range of technology, including spreadsheets, graphing tools, and financial and statistical packages.

DP AO6 assesses inquiry approaches, which include higher-order thinking skills such as creative and critical thinking. Though some skills in GCSE AO2 and AO3 link to inquiry approaches, the overall emphasis is less. Indeed, DP assessment places more emphasis on assessing students' ability to investigate unfamiliar situations, make conjectures, and organise and analyse information.

Lastly, 'new ideas' and 'unfamiliar contexts' are more emphasised in DP AOs, indicating that the assessment will have a higher degree of novelty, which will add to its demand.

3.2.1 Assessment objectives weighting

The following tables present the weighting of AOs in DP and GCSE mathematics assessment. Unlike GCSE, the DP does not provide an overall weighting for each AO, therefore comparisons will be drawn between the ranges provided for the DP and GCSE components.

Table 3: GCSE assessment objectives weighting.

GCSE assessment objectives	Tier (Higher/ Foundation)	Paper 1 %	Paper 2 %	Paper 3 %	(Overall weighting %)
AO1 Use and apply standard techniques	H	30-50	30-50	30-50	40
	F	40-60	40-60	40-60	50
AO2 Reason, interpret and communicate mathematically	H	20-40	20-40	20-40	30
	F	15-35	15-35	15-35	25
AO3 Solve problems within mathematics and in other contexts	H	20-40	20-40	20-40	30
	F	15-35	15-35	15-35	25

Table 4: DP MAA assessment objectives weighting.

DP MAA assessment objectives	Paper 1 %	Paper 2 %	Paper 3 % HL only	Exploration
AO1 Knowledge and understanding	20-30	15-25	10-20	5-15
AO3 Communication and interpretation	20-30	15-25	15-25	15-25
AO5 Reasoning	5-15	5-10	10-20	5-25
AO3 and AO5 combined	**25-45**	**20-35**	**25-45**	**20-50**
AO2 Problem solving	20-30	15-25	20-30	5-20
AO4 Technology	0	25-35	10-30	10-20
AO6 Inquiry approaches	10-20	5-10	15-30	25-35

Table 5: DP MAI assessment objectives weighting.

DP MAI assessment objectives	Paper 1 %	Paper 2 %	Paper 3 % HL only	Exploration
AO1 Knowledge and understanding	20-30	20-30	10-20	5-15
AO3 Communication and interpretation	20-30	20-30	20-30	15-25
AO5 Reasoning	5-15	10-20	10-20	5-25
AO3 and AO5 combined	**25-45**	**30-50**	**30-50**	**20-50**
AO2 Problem solving	20-30	20-30	20-30	5-20
AO4 Technology	20-35	20-35	10-30	10-20
AO6 Inquiry approaches	5-15	5-20	15-30	25-35

Key similarities and differences:

- Understanding and application of knowledge are weighted lower in DP assessment, especially for Paper 3 (HL only) and the mathematical exploration.
- The weighting ranges for communication, interpretation, and reasoning (combined) overlap between DP and GCSE, but DP tends to have higher range boundaries, particularly in comparison to the GCSE Foundation tier.
- The minimum weighting for problem-solving in externally assessed components is similar, but GCSE components allow for a higher maximum weighting (by 10% for Higher and 5% for Foundation).
- Technology and inquiry approaches have weightings in DP assessment, while GCSE does not include similar AOs, resulting in no weighting.

These points indicate that DP assessment places greater emphasis on more demanding skills compared to GCSE.

The lower-order thinking skills of understanding and application are weighted more heavily in GCSE components, particularly in the Foundation tier assessment. DP assessment instead

allocates more weighting to other skills, some of which are higher-order.[18] Indeed, DP components have higher weighting ranges for communication, interpretation and reasoning skills combined and allocate weighting to technology and inquiry approaches. Inquiry approaches involve independent, creative, and critical thinking, thus have more demand than understanding and application. Additionally, the DP's use of more advanced technology such as GDCs adds further demand compared to GCSE. However, with fewer AOs, GCSE components can have a higher problem-solving weighting, though the difference is fairly small, especially compared to the Foundation tier.

DP and GCSE assessment objectives share several skills, including understanding, application, problem-solving, reasoning, communication, and interpretation. However, the DP's emphasis on technology and inquiry approaches, combined with its objective weightings, results in a higher level of demand compared to GCSE.

3.3 Syllabus content

GCSE content is divided into six main topics: Number; Algebra; Ratio, Proportion and Rates of Change; Geometry and Measures; Probability; and Statistics. Each of these topics is further divided into subtopics and sections. The national GCSE curriculum specifies content that:

- all students will develop confidence in
- all students will be assessed on,
- only high-attaining students will be assessed on.

Higher tier GCSE mathematics covers all the above content, whereas Foundation tier does not include the content that high-attaining students will be assessed on. Indeed, the Foundation tier does not target the higher GCSE grades of 6-9.

DP mathematics content (for all subjects and levels) is organised into five topics: Number and Algebra; Functions; Geometry and Trigonometry; Probability and Statistics; and Calculus. These topics are organised into sections of content:

- SL sections: Studied in SL and HL courses
- Additional Higher Level (AHL) sections: Studied only in the HL course.

MAA and MAI share some SL content sections at the beginning of each topic. The remaining sections differ, though similar content may appear in different sections.

The DP subject guides were reviewed to identify where and how much GCSE content is present, as shown in the following table.

[18] Armstrong, P. (2010). *Bloom's Taxonomy*. Vanderbilt University Center for Teaching. Available from: https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/

Table 6: Presence of GCSE content (encompassing both tiers) in DP mathematics.

GCSE topics	Subtopics	DP prior learning	DP MAA syllabus	DP MAI syllabus
Number	Structure and calculation			
	Fractions, decimals, percentages			
	Measures and accuracy			
Algebra	Notation, vocabulary, manipulation			
	Graphs			
	Solving equations and inequalities			
	Sequences			
Ratio, proportion and rates of change	Ratio, proportion and rates of change			
Geometry and measures	Properties and constructions			
	Mensuration and calculation			
	Vectors		HL only	HL only
Probability	Probability			
Statistics	Statistics			

Key:

	All/most GCSE content is present
	Some GCSE content is present
	A small amount of GCSE content is present
	No GCSE content is present

A considerable amount of GCSE content is prior learning for DP mathematics.

The IB outlines the prior learning students should have before studying DP mathematics, all of which is assumed knowledge in DP assessments. The DP topics requiring the most prior learning are Number and Algebra, Geometry and Trigonometry, and Statistics and Probability. Functions and Calculus have minimal prior learning requirements, as they are introduced in the course.

GCSE content is prevalent in the prior learning topics for DP mathematics. GCSE content from Number and the subtopics ‘Notation, vocabulary, manipulation’ and ‘Solving equations and inequalities’ is particularly present. A good amount of content is also present from most Geometry and Measures subtopics, as well as the Probability and Statistics topics. However, not all GCSE content, such as Graphs and Sequences, is listed as prior learning for DP mathematics.

The analysis also reviewed the GCSE specification for DP MAA and MAI content, the findings of which are displayed in the following tables.

Table 7: Presence of DP mathematics content in GCSE Higher tier.

MAA	MAI	MAA	MAI	MAA	MAI	MAA	MAI	MAA	MAI
Number and algebra		Functions		Geometry and trigonometry		Statistics and probability		Calculus	
SL		SL		SL		SL		SL	
1.1		2.1		3.1		4.1		5.1	
1.2		2.2		3.2		4.2		5.2	
1.3		2.3		3.3		4.3		5.3	
1.4		2.4		3.4	3.4	4.4		5.4	
1.5		2.5	2.5	3.5	3.5	4.5		5.5	
1.6	1.6	2.6	2.6	3.6	3.6	4.6		5.6	5.6
1.7	1.7	2.7		3.7		4.7		5.7	5.7
1.8	1.8	2.8		3.8		4.8		5.8	5.8
1.9		2.9		AHL		4.9		5.9	
AHL		2.10		3.9	3.7	4.10	4.10	5.10	
1.10	1.9	2.11		3.10	3.8	4.11	4.11	5.11	
1.11	1.10	AHL		3.11	3.9	4.12		AHL	
1.12	1.11	2.13	2.7	3.12	3.10	AHL		5.12	5.9
1.13	1.12	2.14	2.8	3.13	3.11	4.13	4.12	5.13	5.10
1.14	1.13	2.15	2.9	3.14	3.12	4.14	4.13	5.14	5.11
1.15	1.14	2.16	2.10	3.14	3.13		4.14	5.15	5.12
1.16	1.15			3.16	3.14		4.15	5.16	5.13
				3.17	3.15		4.16	5.17	5.14
				3.18	3.16		4.17	5.18	5.15
							4.18	5.19	5.16
							4.19		5.17
									5.18

Table 8: Presence of DP mathematics content in GCSE Foundation tier.

MAA	MAI	MAA	MAI	MAA	MAI	MAA	MAI	MAA	MAI
Number and algebra		Functions		Geometry and trigonometry		Statistics and probability		Calculus	
SL		SL		SL		SL		SL	
1.1		2.1		3.1		4.1		5.1	
1.2		2.2		3.2		4.2		5.2	
1.3		2.3		3.3		4.3		5.3	
1.4		2.4		3.4	3.4	4.4		5.4	
1.5		2.5	2.5	3.5	3.5	4.5		5.5	
1.6	1.6	2.6	2.6	3.6	3.6	4.6		5.6	5.6
1.7	1.7	2.7		3.7		4.7		5.7	5.7
1.8	1.8	2.8		3.8		4.8		5.8	5.8
1.9		2.9		AHL		4.9		5.9	
AHL		2.10		3.9	3.7	4.10	4.10	5.10	
1.10	1.9	2.11		3.10	3.8	4.11	4.11	5.11	
1.11	1.10	AHL		3.11	3.9	4.12		AHL	
1.12	1.11	2.13	2.7	3.12	3.10	AHL		5.12	5.9
1.13	1.12	2.14	2.8	3.13	3.11	4.13	4.12	5.13	5.10
1.14	1.13	2.15	2.9	3.14	3.12	4.14	4.13	5.14	5.11
1.15	1.14	2.16	2.10	3.14	3.13		4.14	5.15	5.12
1.16	1.15			3.16	3.14		4.15	5.16	5.13
				3.17	3.15		4.16	5.17	5.14
				3.18	3.16		4.17	5.18	5.15
							4.18	5.19	5.16
							4.19		5.17
									5.18

Key:

	All/most content from this section is covered in GCSE
	Some/limited content from this section is covered in GCSE
	No content from this section is present in GCSE

GCSE and DP mathematics share common content across several topics. Since the GCSE Foundation tier covers less content than Higher tier and excludes the more demanding concepts, it shares less content with DP mathematics.

As shown in Table 7, a few sections of DP mathematics content are particularly present in the GCSE Higher tier syllabus. These include content on standard form, straight line graphs, basic geometry and trigonometry, presenting data, and basic probability. Other sections of content, such as those involving arithmetic sequences and correlation, have a more limited presence in the GCSE Higher tier syllabus. As the Foundation tier covers less content than the Higher tier, the presence of DP content in its syllabus is more limited, as illustrated in Table 8.

Where GCSE content overlaps with the DP, this is mostly with the SL sections, particularly those shared between MAA and MAI at the beginning of topics. However, there are instances where GCSE includes content from subtopics introduced in HL, such as counting principles (MAA only) and vectors. However, it's important to note that the presence of these sections' content is very limited in GCSE and HL covers these areas in considerably more depth.

Occasionally, GCSE Higher tier content is more present in one DP subject than the other. For example, bounds and errors is more present in MAI (SL 1.6) than MAA. Similarly, the GCSE content regarding simple proof is covered in MAA (SL 1.6) but not MAI. However, where present, the GCSE content can usually be found in both DP subjects.

Most GCSE content is either prior learning to DP mathematics or covered in its syllabi.

This is particularly the case for GCSE content from Number, Algebra, Probability, and Statistics, as well as the subtopics 'Vectors' and 'Mensuration and calculation'. However, some GCSE content, such as from 'Properties and construction', is neither prior learning nor covered in the DP syllabi. Indeed, content regarding similarity, congruence, and constructions with a compass are not a focus for DP mathematics.

DP mathematics at SL covers a significantly greater breadth and depth of content than GCSE Higher tier, and even more so than the Foundation tier. The additional content in DP mathematics at SL is considerably more demanding than GCSE content.

The SL content in both DP mathematics subjects goes beyond what is covered in GCSE to include more complex mathematical concepts that require a greater amount of prior knowledge. For example, within Statistics and Probability, SL content covers discrete random variables (4.7), the binomial distribution (4.8) and the normal distribution (4.9). Calculus, which requires extensive prior knowledge of algebra and functions, is a main topic in DP mathematics but is not covered in GCSE. The following table provides further examples of SL subtopics which have greater demand.

Table 9: Examples of more demanding content in DP subjects at SL.

Number and algebra	Functions	Geometry and trigonometry	Statisitcs and probability	Calculus
Arithmetic and Geometric series	Definition of functions, inc. domain and range	Trigonometric equations (MAA)	Linear regression	Finding derivatives
Laws of logarithms (MAA)	Analytical solutions (MAA)	Trigonometric identifies (MAA)	Discrete random variables and binomial distribution	Finding tangents and normals
Amortization and annuity (MAI)	Modelling of functions e.g. sinusoidal (MAI)	Voronoi diagrams (MAI)	Hypothesis testing (MAI)	Definite integrals

Likewise, and to an even greater extent, DP mathematics at HL covers a significantly greater breadth and depth of content than GCSE and covers many subtopics which are considerably more demanding than all GCSE content.

DP mathematics at HL includes all SL content, as well as AHL content. AHL content often builds on SL content and is therefore even more demanding than GCSE content. Indeed, AHL content is often complex, with concepts requiring significant prior knowledge of multiple areas of mathematics. See the following table with examples of AHL content that is notably more demanding than GCSE.

Table 10: Examples of more demanding content in DP subjects at HL.

Number and algebra	Functions	Geometry and trigonometry	Statistics and probability	Calculus
Complex numbers	Polynomial and rational functions (MAA)	Vector equations of a line	Continuous random variables (MAA)	Volumes of revolution
Proof by contradiction and induction (MAA)	More complex analytical and graphical solutions (MAA)	Reciprocal trigonometric ratios and identifies (MAA)	Non-linear regression (MAI)	Evaluation of limits and L'Hôpital's rule (MAA)
Eigenvalues and eigenvectors (MAI)	Modelling of functions e.g. piecewise (MAI)	Adjacency matrices (MAI)	Hypothesis testing (building on SL) (MAI)	Phase portraits (MAI)

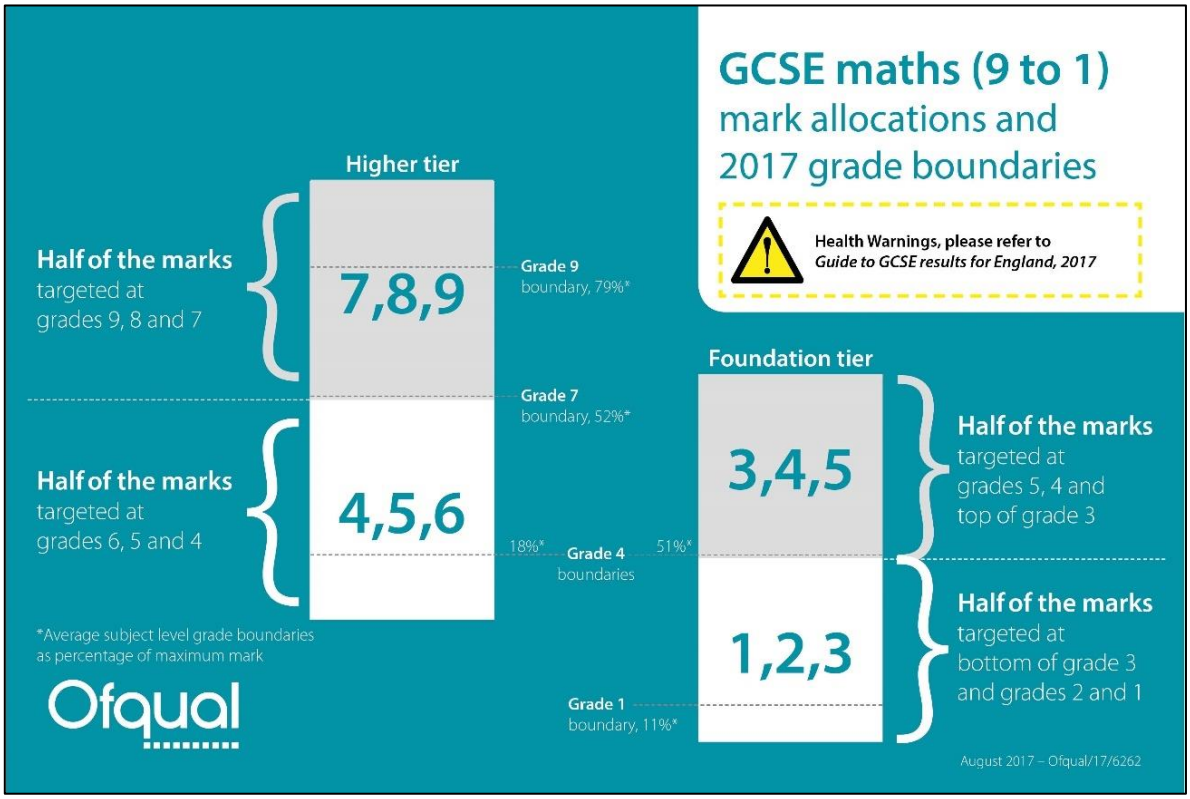
The content in DP mathematics is considerably more extensive and demanding than that of GCSE, exceeding both the Higher tier and, to an even greater extent, the Foundation tier. The difference in demand becomes more pronounced from SL to HL. A significant proportion of GCSE content is assumed knowledge for DP mathematics. Whilst there is some overlapping content between DP and GCSE mathematics, this shared content constitutes only a fraction of what is covered in DP mathematics at SL, and an even smaller fraction of content covered at HL. The additional content in SL, and particularly HL, is more significantly more challenging than GCSE.

3.4 Assessment components and items

This section compares the demand of the assessment components and items of GCSE and DP mathematics. The analysis considers both GCSE tiers. The GCSE Higher tier assessment

targets grades 9 to 4, with a safety net of a grade 3, while the Foundation tier assessment targets grades 5 to 1. As shown in the infographic below, the Higher tier assessment is designed to differentiate performance at the top end and is consequently more demanding than the Foundation tier assessment. Therefore, where the analysis concludes that the DP assessment has greater demand than the GCSE Higher tier assessment, this conclusion applies even more strongly to the Foundation tier assessment.

Figure 2: Assessment design for GCSE Higher tier and Foundation tier.



Source: The Ofqual blog. [19]

This is not to say that achieving one of the overlapping GCSE grades (3, 4, and 5) on the Foundation tier is any less demanding than on the Higher tier. Indeed, measures are taken to ensure that these grades are equivalent across both tiers. For example, as seen in the infographic, the grade boundary for a grade 4 is set higher for the Foundation tier than for the Higher tier.

The following table provides a comparison of the types of items and tasks used in each component of the DP and GCSE assessments.

[19] Ofqual. (2017). *GCSE maths grade boundaries*. Available from: GCSE maths grade boundaries – The Ofqual blog

Table 11: Overview of the items and tasks in GCSE and DP mathematics assessment components.

Component	Item/task types		
	GCSE (both tiers)	DP MAA	DP MAI
Paper 1	A mix, ranging from short, single-mark questions to multistep problems	Section A: short-response Section B: extended-response	Short-response
Paper 2		Section A: short-response Section B: extended-response	Extended-response
Paper 3		**(HL only)** Two extended response problem-solving questions	**(HL only)** Two extended response problem-solving questions
Internal assessment	N/A	An exploration of approximately 12-20 pages long	An exploration of approximately 12-20 pages long

The DP subject guides state that short-response items require a small number of steps to solve each question. Extended-response items involve sustained reasoning and development of a single theme – sometimes requiring knowledge of more than one topic. Finally, extended response problem-solving items have the properties of extended-response, but with a particular emphasis on problem-solving which leads to a generalisation or interpretation of a context.

Based on an assessment sample set, the following tables present the distribution of mark allocations for each individual question and then item on GCSE and DP exams. Individual questions are parts of items or the whole item itself (if not broken into parts).

Table 12: Number of individual questions which carry each mark allocation (based on a sample assessment set).

Number of marks	Number of individual questions					
	GCSE (Foundation)	GCSE (Higher)	DP AA SL	DP AI SL	DP AA HL	DP AI HL
1 mark	38	29	3	8	10	10
2 marks	43	27	23	39	23	44
3 marks	21	25	11	12	14	20
4 marks	12	18	7	7	12	13
5 marks	1	2	6	2	6	7
6 marks	0	0	1	0	7	5
7 marks	0	0	2	0	7	0
8 marks	0	0	0	0	1	0
Total marks	240	240	160	160	275	275

Table 13: Number of items which carry each mark allocation (based on a sample assessment set).

Number of marks	Number of items					
	GCSE (Foundation)	GCSE (Higher)	DP AA SL	DP AI SL	DP AA HL	DP AI HL
1 mark	2	8	0	0	0	0
2 marks	18	14	0	0	0	0
3 marks	22	26	0	0	0	0
4 marks	22	20	0	0	0	0
5 marks	6	4	4	4	4	5
6 marks	3	3	5	4	7	6
7-9 marks	0	1	3	5	7	6
13-20 marks	0	0	3	5	4	7
21-30 marks	0	0	0	0	4	2
Total marks	240	240	160	160	275	275

Key similarities and differences:

The analysis of the 2023 assessment sample found:

- Both DP and GCSE assessments used free response items of varying length. The GCSE assessment also included a few selected-response items.
- The GCSE assessments had a significantly greater proportion of 1-mark questions.
- Except for MAI SL, the DP assessments had more high-mark questions.
- The DP assessments had more multi-part items compared to GCSE assessments. These require students to demonstrate sustained reasoning.
- Most GCSE items were 4 or fewer marks and thus carried less marks than all DP items. A large proportion of the DP SL and HL assessment consisted of high-mark items. The extended-response items in particular carried more marks than GCSE items, being between 13 and 20 marks. Some HL items were worth 20-30 marks, which was 3-4 times more than the maximum item mark on GCSE.

A panel of curriculum and assessment experts compared the demand of items from a sample of DP and GCSE assessments. The key conclusions are presented below:

Some low-demand DP items had similar demand to high-demand items on the GCSE Higher tier assessment. These were rarer on the HL assessment than the SL.

Due to the small amount of overlapping content between DP and GCSE mathematics, there were a few items on the DP assessment which had similar demand to items appearing on GCSE Higher tier assessment. As the overlapping content represents a smaller proportion of the HL content than SL content, there were fewer instances of this on the HL assessment. In the assessment sample reviewed, MAI SL had slightly more items which had similar demand to GCSE items than MAA SL.

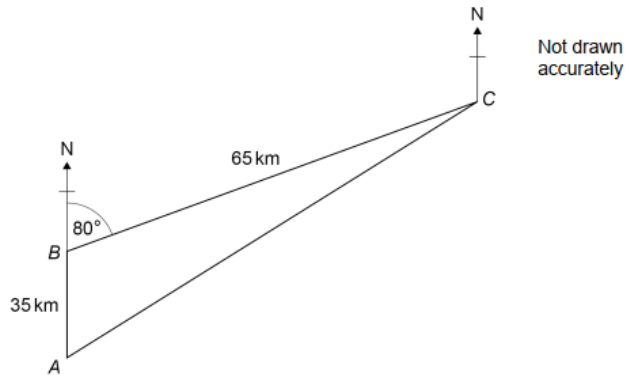
Items with similar demand were often those that were of low-demand in the DP context and high-demand in the GCSE Higher tier context. Indeed, the low-demand DP items assessed content, such as the sine and cosines rule, that appears in high-demand items on GCSE Higher tier. The style of the DP items also contributed to the conclusion that, if appearing on a GCSE Higher tier paper, they would represent very high demand, akin to an ‘end of a paper’ GCSE Higher tier item. That said, some of the low-demand DP items had slightly less demand than the final questions on the GCSE papers, as they had less of a problem-solving element (see example below).

Occasionally, a low-demand DP item was concluded to be more similar in demand to a medium-high demand item on GCSE. Nonetheless, the DP item still had greater demand than a considerable number of other GCSE items.

Figure 3: Examples of GCSE and DP items.

High-demand GCSE item (Item 23 on Paper 3)

23



A boat sails 35 km North from *A* to *B*.
From *B* the boat sails to *C* and then back to *A*.

23 (a) Show that the distance the boat sails from *C* to *A* is 79 km to the nearest km
You **must** show your working.

[2 marks]

23 (b) Work out the bearing of *A* from *C*.

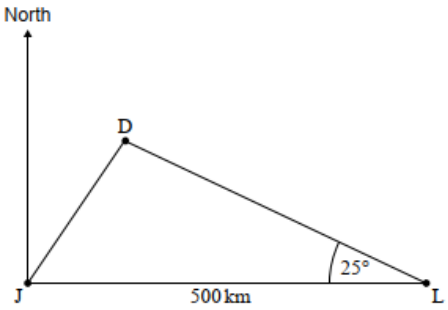
[4 marks]

Low-demand DP SL item (Item 1 on MAA SL Paper 2)

1. [Maximum mark: 5]

The cities Lucknow (L), Jaipur (J) and Delhi (D) are represented in the following diagram.
Lucknow lies 500 km directly east of Jaipur, and $J\hat{L}D = 25°$.

diagram not to scale



The bearing of D from J is 034°.

(a) Find $J\hat{D}L$. [2]

(b) Find the distance between Lucknow and Delhi. [3]

The low-demand DP SL item and high-demand GCSE item both assess knowledge of basic angle properties, bearings, and the application of the sine or cosine rule. Both items require students to correctly identify a bearing from the item's description, work out a missing angle from the information given, recognise that the sine or cosine rule must be applied, and successfully carry out the correct techniques. The GCSE item is slightly more demanding as it has a more complex context and requires more steps in the second part. However, the DP item is the first item on the paper, whereas the GCSE item is the last, thus the items represent the low-end of demand in the DP assessment and the top-end of GCSE. Consequently, the DP item is more demanding than many other GCSE items.

Individual questions in some DP items were not necessarily more demanding than GCSE items.

Occasionally, while an overall item on DP SL and HL assessment had greater demand than GCSE items, some of the individual parts were not necessarily more demanding – see example below.

Figure 4: Example DP item.

DP SL item (MAI SL, Paper 2, item 4)

4. [Maximum mark: 17]

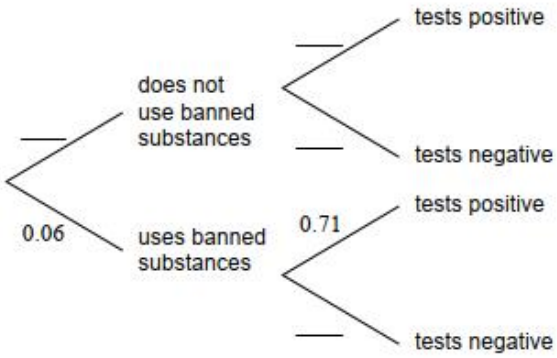
A large international sports tournament tests their athletes for banned substances.
They interpret a positive test result as meaning that the athlete uses banned substances.
A negative result means that they do not.

The probability that an athlete uses banned substances is estimated to be 0.06.

If an athlete **uses** banned substances, the probability that they will test positive is 0.71.

If an athlete does **not use** banned substances, the probability that they will test negative is 0.98.

(a) Using the information given, **copy** (into your answer booklet) and complete the following tree diagram. [2]



(b) (i) Determine the probability that a randomly selected athlete does not use banned substances and tests negative.

(ii) If two athletes are selected at random, calculate the probability that both athletes do not use banned substances and both test negative. [4]

(c) (i) Calculate the probability that a randomly selected athlete will receive an **incorrect** test result.

(ii) A random sample of 1300 athletes at the tournament are selected for testing. Calculate the expected number of athletes in the sample that will receive an incorrect test result. [5]

Team X are competing in the tournament. There are 20 athletes in this team. It is known that none of the athletes in Team X use banned substances.

(d) Calculate the probability that none of the athletes in Team X will test positive. [4]

(e) Determine the probability that more than 2 athletes in Team X will test positive. [2]

While this DP item was concluded to be overall more demanding than the probability items in GCSE, individual parts such as (a) and (b) were not, as similar items can appear on GCSE. However, it was noted that while GCSE might assess one or perhaps two of these parts, they would typically assess all of them together as done in the DP item.

Overall, many of the DP SL items, and especially the HL items, were significantly more demanding than the GCSE Higher tier items, and even more so the Foundation tier items.
The panel noted the following key reasons for this conclusion:

- As concluded in section 3.3, the content covered by DP subjects at SL and especially HL is considerably more demanding than GCSE. This results in most DP items having higher demand than the GCSE items (see examples below). Indeed, many of the GCSE items assess content that is assumed knowledge in the DP assessment, making them less demanding. Since HL content often requires knowledge of SL content, HL items tend to have an even greater degree of demand than GCSE items.

- The DP items combine complex content with reasoning, interpretation, and problem-solving, further increasing their demand in comparison to GCSE items. Moreover, the DP's extended-response items require students to show sustained reasoning, which is required considerably less in GCSE items. The DP items in HL paper 3 particularly involve complex problem-solving and use of inquiry-based approaches, making them significantly more demanding than any GCSE items.

- The rigour and contexts used in DP items contribute to their higher level of demand compared to GCSE items. In contrast to GCSE items, DP items are more rigorously defined and frequently use advanced mathematical notation. Furthermore, while GCSE items are often simple and direct, DP items present complex contexts that require greater problem-solving and interpretation skills, as well as more perseverance and attention. Even where the assessed content occasionally overlaps with GCSE content; the rigour and context of the DP items adds an additional element of demand.

- The structure of the DP items also adds to their demand compared to GCSE. Most DP items contain more parts and carry higher marks than GCSE items – especially the extended-response and HL items. As such, DP items assess mathematical areas in greater depth than GCSE items, which span a breadth of content. Moreover, since GCSE items are more often stand-alone, students can move on to different items which assess a different area. In contrast, if a DP student struggles with the initial parts of an item, they may not be able to attempt the rest, which has a greater impact on the marks they can gain.

The following examples illustrate some of the conclusions above.

Figure 5: Examples of DP and GCSE items.

GCSE Foundation tier items (range of demand)

1 (a) Solve $5x = 15$

[1 mark]

1 (b) Solve $y + 7 = 50$

[1 mark]

1 (c) Solve $\frac{c}{4} = 8$

[1 mark]

GCSE Foundation tier items (range of demand)

15 Write down all the integers that satisfy the inequality

$$-3 \leqslant x < 2$$

[2 marks]

22 Expand and simplify fully $5(3x + 4) - 2(x - 1)$

[2 marks]

24 Sunita is x years old.

Beth is one year younger than Sunita.

Joel is double Sunita's age.

The mean of their ages is 5

How old is **Joel**?

[5 marks]

GCSE Higher tier items (range of demand)

13 Charlie is driving 293 miles home.

He

- leaves at 9.00 am
- travels the first 176 miles at an average speed of 48 mph
- drives the rest of the way at an average speed of 65 mph

Will he be home by 2.30 pm?

You **must** show your working.

[4 marks]

15 Expand $(x^2 - 9xy)(2x + 5y)$

[2 marks]

18 $f(x) = x^2 + 6x$

$g(x) = 2x + 4$

18 (a) Show that $fg(x) = 4x^2 + 28x + 40$

[3 marks]

18 (b) Solve $fg(x) = -5$

[3 marks]

27 A journey has two stages.

	Distance (km)	Average speed (km/h)	Time (h)
Stage 1	30	a	$\frac{30}{a}$
Stage 2	30	b	$\frac{30}{b}$

Show that the average speed for the **whole** journey, in km/h, is $\frac{2ab}{a+b}$

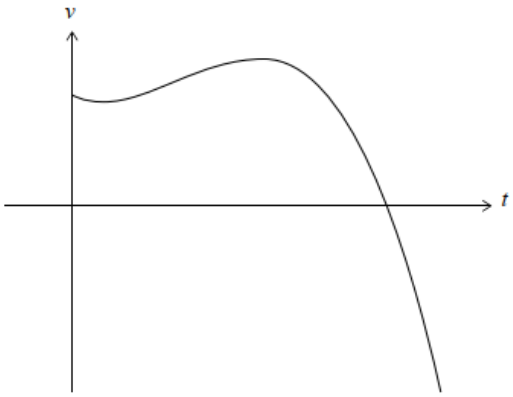
[3 marks]

DP SL item (MAA, Paper 1)

9. [Maximum mark: 17]

An object moves along a straight line. Its velocity, $v\,\text{m s}^{-1}$, at time t seconds is given by $v(t) = -t^3 + \frac{7}{2}t^2 - 2t + 6$, for $0 \le t \le 4$. The object first comes to rest at $t = k$.

The graph of v is shown in the following diagram.



At $t = 0$, the object is at the origin.

(a) Find the displacement of the object from the origin at $t = 1$. [5]

(b) Find an expression for the acceleration of the object. [2]

(c) Hence, find the greatest speed reached by the object before it comes to rest. [5]

(d) Find the greatest speed reached by the object for $0 \le t \le 4$. [2]

(e) Write down an expression that represents the distance travelled by the object while its speed is increasing. Do not evaluate the expression. [3]

Example DP HL item (MAI, Paper 2)

6. [Maximum mark: 15]

A model speedboat has its position, at time t seconds $t \ge 0$, defined by

$$\frac{dx}{dt} = 5y - 0.05x,\ \frac{dy}{dt} = -5x - 0.05y,$$

where x metres is the distance east and y metres is the distance north of a fixed point O.

(a) Find the eigenvalues of $A = \begin{pmatrix} -0.05 & 5 \\ -5 & -0.05 \end{pmatrix}$, giving your answers in the form $a + bi$, where $a \ne 0$, $b \ne 0$. [4]

(b) (i) State what $a \ne 0$ indicates about the path of the speedboat.

(ii) State what the sign of a indicates about the path of the speedboat. [2]

At time $t = 0$, the speedboat has position $(20, 0)$.

(c) At time $t = 0$, find the value of

(i) $\frac{dy}{dt}$.

(ii) $\frac{dy}{dx}$. [5]

(d) Use your answers to parts (b) and (c) to sketch the path of the model speedboat. [4]

The DP SL example is a typical extended-response item. The DP SL item has more parts than any of the GCSE items and overall carries significantly more marks (17). The DP item goes into considerably more depth than the GCSE items and requires a greater degree of sustained reasoning. Moreover, the assessed content in the DP item is significantly more demanding than any assessed by the GCSE Higher tier items and, to a greater extent, the Foundation tier items. Indeed, the assessed content (integration of a function) and applied context (kinematics) assumes that students would already have the knowledge assessed by the GCSE items (basic algebraic manipulation and equation solving and, from the Higher tier items, speed/distance/time and function notation).

The HL extended-response item has similar features to the SL example, whilst also bringing together a range of more complex content (eigenvalues and differential equations), which require prior knowledge that is also significantly beyond GCSE (complex numbers, matrices, differentiation, and integration). The item requires students to interpret this information in the context, as well as use reasoning and problem-solving skills.

The mathematical exploration also adds demand to the DP mathematics assessment.

The mathematical exploration requires students to produce a written piece investigating a mathematical area. There is no similar task in GCSE, which is assessed entirely by external written exams, so direct comparisons cannot be made. However, this requirement supports the conclusion that the DP assessment is more demanding than that of GCSE. Indeed, the mathematical exploration has similarities to independent work required in higher education. It involves students planning their work, submitting drafts, and using referencing where necessary. Moreover, the criterion for the mathematical exploration assesses students on presentation, communication, personal engagement, reflection, and the use of mathematics. The mathematical exploration emphasises communication more than singular assessment items and the personal engagement and reflection criteria include higher-order skills such as creative and critical thinking. The mathematics used in the exploration must be commensurate with the respective course (SL or HL). Since both the SL and HL syllabi are more demanding than GCSE, the exploration may be on a mathematical area that is more challenging than GCSE content. However, the overlap with GCSE content may mean this is not necessarily the case for SL students' mathematical explorations.

DP mathematics assessments are significantly more challenging than those of GCSE, exceeding the demand of the Higher tier and even more so that of the Foundation tier. With HL assessment including items that are more demanding than those in SL assessments, the difference in demand compared to GCSE items becomes even greater. Furthermore, the mathematical exploration creates an additional layer of demand to the DP assessment.

3.5 Marking approaches

The DP and GCSE have largely similar approaches and principles to marking external exam papers, including:

- The use of method and answer/accuracy marks
- The awarding of follow-through marks where a mistake has been made in an earlier step
- Once a correct answer is seen, other working can be ignored unless otherwise instructed

- Students are penalised for clearly incorrect methods.

There are a few differences in the marking approaches which can be noted:

- Unless the GCSE item specifies that students must show their working, a correct answer alone can be awarded full marks. In contrast, working is expected in all DP items and will be checked
- However, the DP has a code for implied method and answer marks
- GCSE has a code for awarding marks independent of method
- The DP also uses 'reasoning' marks, though not frequently
- The DP specifies that students should always simplify their final answer where it leads to an integer and should simplify algebraic expressions.

The marking approaches of the DP and GCSE assessment are largely similar, with a few small differences. Overall, the marking approaches do not constitute an area by which the DP and GCSE significantly differ in demand.

3.6 Summary of key findings

The table below summarises the key findings and conclusions from sections 3.1-3.5 of the comparative analysis, highlighting the areas where the DP and GCSE differ in demand.

Table 14: Summary of key findings from the comparative analysis.

Area	Key findings and conclusions
Assessment structure and methods	Both DP and GCSE mathematics are primarily assessed through external written exams, divided into 2-3 different papers. The duration of GCSE's external assessment is longer than SL but shorter than HL. The only key difference is that DP mathematics also uses internal assessment, weighted at 20%. The assessment methods alone do not pose a difference in demand; this is determined by the following areas.
Assessment objectives	DP and GCSE mathematics assessment objectives share several similarities. Both assess students' ability to demonstrate knowledge and understanding, apply knowledge to various contexts, communicate mathematically, use reasoning, interpret information, and solve problems. However, the DP's objectives also emphasise technology and inquiry approaches, adding an extra layer of demand. The technology used in DP mathematics is more advanced than in GCSE and a higher proficiency is expected. Additionally, the DP's inquiry approaches objective particularly emphasises higher-order skills such as analysis and critical and creative thinking skills. Moreover, lower-order skills such as knowledge and application are weighted significantly higher in the GCSE compared to the DP, particularly in the Foundation tier. Overall, assessment objectives are an area of some difference in demand between DP and GCSE mathematics.
Syllabus content	The syllabus for both DP subjects, at each level, is significantly more extensive and demanding than the GCSE syllabus, surpassing the Higher tier content and, to a greater extent, the Foundation tier content. A considerable amount of content assessed in GCSE is assumed knowledge for the DP. While there is some shared content between DP and GCSE–more so in the Higher tier–this constitutes only a small proportion of the SL syllabus and an even smaller proportion of the HL syllabus. The remaining content in SL, and especially in HL, is significantly more demanding than that of GCSE, requiring substantially more prior knowledge.
Assessment components and items	Most DP assessment items are significantly more demanding than the items on the GCSE assessments. DP items assess content in considerably more depth and more frequently require sustained reasoning. Additionally, the content assessed by DP items is typically more complex than that assessed by GCSE items, exceeding the complexity of those on the Higher tier assessment and, to an even greater extent, the Foundation tier assessment. Moreover, the DP items are more rigorously defined and use more complex contexts, thus requiring stronger skills in interpretation and problem-solving. Lastly, the internally assessed mathematical exploration in the DP adds another element of demand, as it involves an extended, independent piece of work that emphasises mathematical communication, as well as the higher-order skills of reflection and creativity.
Marking approaches	The marking approaches used for external assessment are largely similar between DP and GCSE mathematics.

Key:

	An area of similarity which does not constitute a significant difference in demand between DP and GCSE mathematics
	An area with some similarities, though DP mathematics poses greater demand
	An area with considerable differences, with DP mathematics posing significantly more demand than GCSE. The degree of difference to GCSE increases from SL to HL.

Overall conclusions	The specifications and assessments for DP mathematics at SL are significantly more demanding than those for GCSE mathematics, surpassing both the Higher tier and, to an even greater extent, the Foundation tier. As an extension of SL, the HL specifications and assessments pose an even greater level of demand compared to those for GCSE.
These conclusions apply to both DP subjects – mathematics: analysis and approaches (MAA) and mathematics: applications and interpretation (MAI).	

4. Grade comparison

The following table presents the grade comparisons between GCSE and DP mathematics at SL and HL. As demonstrated by the comparative analysis, GCSE and DP mathematics are pitched at different levels, with the DP mathematics specifications and assessments for SL, and especially for HL, exceeding the demands of GCSE. Consequently, GCSE and DP grades are not directly comparable or equivalent. **Therefore, the analysis determined the lowest DP grade that demonstrated a level of mathematics achievement sufficient to meet the requirements of GCSE grades 6 to 4**. 'Mathematics achievement' refers to the level of mathematical knowledge and skills.

For all GCSE grades reviewed, a grade 2 for either SL or HL was concluded to demonstrate a level of mathematics achievement sufficient to meet their requirements. Consequently, higher DP grades (3 to 7) also demonstrate mathematics achievement that meets their requirements.

Table 15: Grade comparisons.

GCSE Mathematics Grade	IB DP Mathematics Standard Level Grade (MAA and MAI)	IB DP Mathematics Higher Level Grade (MAA and MAI)
6	2	2
5		
4		

GCSE mathematics is graded 9 to 1 and DP mathematics is graded 7 to 1 (highest to lowest).

The below summarises the reasoning for the grade comparison conclusions and includes key points of discussion in the panel.

DP grade 1

A grade 1 for DP mathematics was discounted as an option for the grade comparisons to GCSE. The lower boundary for a grade 1 is 0 marks, thus the grade does not provide evidence of mathematics achievement and cannot be compared to GCSE grades 4, 5 or 6. Moreover, to receive the IB diploma, DP students need a grade 2 or higher in every subject taken.

Grade descriptors

To understand the mathematics achievement in the GCSE and DP grades, the grade descriptors in Table 15 were reviewed and compared. Since there are no grade descriptors for GCSE grades 4 and 6, only grade 5 was reviewed. The DP grade descriptors are the same for SL and HL, though refer to their respective syllabi.

The DP grade 4 descriptor states students have a 'satisfactory knowledge of the syllabus'[20] and can perform a range of mathematical skills in routine contexts. Since the syllabi of SL and, particularly, HL exceeds that of GCSE, it was deemed that the descriptor clearly represented a higher level of mathematics achievement compared to GCSE. Therefore the analysis focused more on the lower DP grades, specifically 2 and 3.

[20] IB. (n.d.). *Group 5 (mathematics) grade descriptors.*

Table 16: Grade descriptors.

<table>
<tr><th>GCSE Grade 5 descriptor</th><th>DP Grade 2 descriptor</th></tr>
<tr><td rowspan="8">To achieve grade 5, candidates will be able to:
perform routine single- and multi-step procedures effectively by recalling, applying and interpreting notation, terminology, facts, definitions and formulae
interpret and communicate information effectively
make deductions, inferences and draw conclusions
construct chains of reasoning, including arguments
generate strategies to solve mathematical and non-mathematical problems by translating them into mathematical processes, realising connections between different parts of mathematics
interpret results in the context of the given problem
evaluate methods and results</td><td>Demonstrates limited knowledge of the syllabus; attempts to carry out mathematical processes at a basic level; communicates some mathematics, but often uses inappropriate techniques, notation or terminology; unable to use calculator correctly when required—questions exclusively requiring the use of the GDC are generally not attempted.</td></tr>
<tr><th>DP Grade 3 descriptor</th></tr>
<tr><td>Demonstrates partial knowledge of the syllabus and limited understanding of mathematical arguments in performing some routine tasks; attempts to carry out mathematical processes in straightforward contexts; makes an attempt to use problem solving techniques in routine situations; communicates some mathematics, using some appropriate techniques, notation or terminology; occasionally uses calculator's functionality, but often inefficiently—does not always use it when required and may use an inefficient analytic approach.</td></tr>
<tr><th>DP Grade 4 descriptor</th></tr>
<tr><td>Demonstrates a satisfactory knowledge of the syllabus; applies mathematical arguments in performing some routine tasks; uses problem solving techniques in routine situations; successfully carries out mathematical processes in straightforward contexts; shows some ability to recognize patterns and structures; has limited understanding of the significance of results and attempts to draw some conclusions; communicates mathematics adequately, using some appropriate techniques, notation and terminology; makes some use of calculator's functionality, but perhaps not always when required (this use may occasionally be inefficient).</td></tr>
</table>

Regarding the DP grade 2 descriptor, the panel observed that it lists fewer skills than the GCSE grade 5 descriptor, notably excluding problem solving, reasoning, and interpreting results. Additionally, the language used in the grade 2 descriptor suggests a lower level of ability compared to the more confident level indicated by the GCSE grade 5 descriptor. However, these differences were not deemed sufficient to prevent a comparison between a DP grade 2 and GCSE grades. The panellists emphasised the importance of considering the vastly different syllabi and assessment to which the grade descriptors refer.

Regarding the DP grade 3 descriptor, the panel noted that it includes more of the skills that appear in the GCSE grade 5 descriptor. Both descriptors mention carrying out processes, using notation and technology, problem-solving, and employing mathematical arguments. However, some skills, such as reasoning, are still less emphasised in the DP grade 3 descriptor. Again, the language of DP grade 3 indicates relatively limited knowledge and proficiency in using these skills. However, as noted above, this is within the context of the DP SL and HL syllabus and assessment, which differ significantly to those of GCSE.

Overall, the panel concluded that the differences in the specification and assessment of DP and GCSE mean that the grade descriptors alone cannot provide clear comparisons. Therefore, consideration of the grade boundaries and assessment samples is essential to determine comparisons.

Grade boundaries and assessment sample

In reviewing grade boundaries and assessment samples, the panel primarily discussed DP SL grade 2, which represents the lowest level of mathematics achievement in the DP (after

grade 1). The conclusions drawn for SL grade 2 also applied, to a greater degree, to the other grades. The following points were made in the discussions.

The panel noted that the GCSE grades, particularly 5 and 6, required students to complete more items and correctly answer a higher proportion of the exams compared to DP grades 2 and 3. However, GCSE exams included a high proportion of single-skill and stand-alone items, with many marks awarded for 1-mark questions. In contrast, the lowest mark for the DP items was 5, and very few individual parts carried 1 mark. The DP papers also featured multi-mark items (up to 20 marks on SL and 30 marks on HL) that assessed complex, multi-step tasks requiring both breadth and depth of understanding.

Additionally, the GCSE grades could be achieved by answering many items that assessed content that is assumed knowledge for the DP assessment. To achieve a grade 2, DP students would likely answer questions that implicitly demonstrate understanding of the content explicitly assessed by many of the GCSE items – for example, one DP item on bearings demonstrated knowledge of angle properties, bearings, and the sine rule (which involves manipulating and solving equations, fractions, and right-angled trigonometry). However, as fewer questions are required to be answered, it can be noted that a DP SL grade 2 does not require as much breadth of knowledge to be demonstrated compared to GCSE grades 5 and 6.

While GCSE grades, particularly grade 6, required more items specifically targeting problem-solving and reasoning skills to be answered, the content was of a significantly lower level than that of the DP syllabus (e.g., money and ratio were topics that were assessed in GCSE problem-solving items). While problem-solving items with higher demand are present on the GCSE papers, students do not need to answer these to achieve grades 4 to 6. Moreover, the style and contexts used in even the low-demand DP items require skills of interpretation and problem-solving that are not demanded by the style and contexts of GCSE items. To be able to access the DP SL and HL exams, with their style and demand, it was deemed that students would need additional skills and knowledge to those needed for GCSE grades 4 to 6.

Overall, it was concluded that a DP SL grade 2 demonstrated mathematics achievement that met the requirements of all the GCSE grades reviewed (4 to 6). Although only a relatively small number of marks were needed to attain a grade 2, the panel agreed that answering a small number of questions, or even a partial response, could demonstrate skills and knowledge equivalent to, or beyond, those needed for GCSE grades 4 to 6. Indeed, a single DP item or question could encompass the knowledge and skills tested by multiple GCSE items. By similar reasoning, it followed that a grade 2 at HL, and higher grades, also demonstrated mathematics achievement meeting the requirements of GCSE grades 4 to 6.

Low grade boundaries

Like GCSE, DP grade boundaries are determined for each exam series to ensure consistent grading standards. DP grade boundaries were observed to vary more so than GCSE, though only a small sample were reviewed.

Tables 17 and 18: Component and grade boundary ranges for the summer exam series, spanning both time zones over the years 2022-24

SL	Paper 1	Paper 2	Mathematical exploration	Overall (Scaled)
MAA Grade 2	3-9	3-9	3	5-11
MAI Grade 2	4-12	5-11	3	6-13

HL	Paper 1	Paper 2	Paper 3	Mathematical exploration	Overall (Scaled)
MAA Grade 2	5-15	5-16	5-9	3	7-14
MAI Grade 2	9-16	9-16	4-8	3	8-13

For both DP mathematics subjects, one of the exam series reviewed had notably low grade boundaries, likely due to heightened assessment demand. The panel observed only a few marks were needed to achieve a SL grade 2, which made this exam series unsuitable for drawing meaningful comparisons to the GCSE grades.

However, an analysis of grade boundary trends over three years across both time zones revealed that this was an isolated case. Consequently, it was concluded that observations from other exam series provided sufficient evidence that a DP grade 2 at SL demonstrates skills and knowledge required for the GCSE grades 4 to 6. The IB establishes grade boundaries for exam series to ensure consistent grading standards. Hence, while assessment demand may vary slightly between series, the standard of a grade 2 remains consistent.

The same exam series also exhibited lower-than-usual grade boundaries for a HL grade 2. Nonetheless, it was determined that this did not impact the grade comparison conclusions, for similar reasons. Furthermore, the level of HL assessment demand ensures that even a few marks demonstrate mathematics achievement sufficient to meet GCSE requirements. Moreover, to be enrolled in the HL course students must be deemed capable of handling its demanding scope, which extends well beyond GCSE.

Final comments

The grades students receive from their assessment capture just one picture of their mathematical knowledge and skills. DP students will have studied a higher level of mathematics than GCSE over the two-year programme, regardless of the subject and level chosen. Moreover, the grade comparisons presented here may not be ‘one-size fits all’. Institutions or professional bodies using grade comparison information should be aware of the differences in the mathematical knowledge and skills demonstrated by DP and GCSE grades. For example, while DP students cover advanced topics such as calculus, GCSE students focus more on a breadth of foundational concepts. Therefore, a direct comparison of grades might not fully reflect the breadth and depth of knowledge that each student possesses.

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