



**Mathematics Advanced,
Mathematics Extension 1
and Mathematics Extension 2**

July 2008

General Comments

Over the course of consultation period, MANSW obtained responses from members in a number of ways such as open forums for members, written submissions from individuals and schools and individual meetings with members of the MANSW Executive.

In general, the MANSW membership recognises the enormity of the task in rewriting these calculus-based courses and would like to begin by commending the writers on their efforts to produce these draft syllabuses. The team working on the calculus courses has done an excellent job within the very short time frame given to them. Whilst there are a number of quite significant issues that require attention before these syllabuses could be implemented by any teacher, these draft syllabuses essentially contain the ‘bones’ of three excellent Stage 6 Mathematics courses.

Our members were very pleased to see the essential ‘calculus’ nature of these courses had been retained. Whilst there are differing opinions on the order and organisation of course components, and some differing points of view on the topics that have been ‘removed’ and the topics that have been ‘added’, it is certainly the case that students in NSW will continue to leave school with a good understanding of the fundamentals of calculus. Our members were very pleased to see the clear attempts that have been made in all three calculus-based courses to maintain the level of challenge and rigour of our current courses. Many of our members were also very pleased to see the suggestion of ‘Mathematics Advanced’ as a course name to avoid the current confusion between a course name and the name of the mathematical discipline.

The following submission describes firstly our concerns that relate to all the calculus-based courses and secondly information on some particular concerns as related to individual courses.

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Please do not hesitate to contact the MANSW office directly if you require clarification or further information on any of the issues raised in this document at any stage in the revision process.

Concerns in the calculus-based courses

1. A lack of clarity, precision and direction in the descriptions of the knowledge, skills and understanding students need to develop

In many subtopics of the draft syllabuses, insufficient detail is provided for teachers (and students) to be clear about the content of the syllabus. In some sections, the current draft is far too ambiguous for teachers to be clear about the content and intent of the subtopic. MANSW believes that the scope and depth of the course content needs to be absolutely clear from the description of the knowledge, skills and understanding that students will acquire in the course. This is particularly important in Stage 6 as it is this content that will be assessed and examined as part of the internal and external assessment process.

To illustrate this with just one specific example:

Mathematics Advanced, p44, PMA3.4 : Region and Inequality

- * describing a set of points geometrically and algebraically
- * sketching regions on the number plane whose points satisfy given inequalities
- * sketching regions on the number plane resulting from the intersection of two or more inequalities
- * describing regions using language such as interior, exterior, bounded by, boundary, sector, common to, etc.

In considering programming this subtopic, teachers would ask many questions including: What sort of functions and relations do my students need to be able to sketch? What terminology do my students need to understand? Which algebraic techniques might be needed? Is this topic restricted to lines, circles and parabolas (the only examples stated on p45) or might it include the intersection of other polynomials, conics, hyperbolas, etc? The description of the subtopic states that “students will explore further the connection between algebra and geometry” and yet there is no explicit algebra used to describe the content of this subtopic. The use of ‘etc’ at the end of the last dot point implies that the list of terminology is well understood by all teachers and students and this is not the case. An experienced mathematics teacher should be able to open ANY page of the syllabus and have an immediate idea of what that mathematics might look like in their classroom. A new syllabus cannot rely on knowledge of a previous syllabus to describe the exact nature of the new course. A new syllabus can not rely on a collective body of ‘typical’ questions that have been assessed in HSC examinations in the past to articulate the scope and depth of the content. The syllabus must specify the mandatory content clearly for every topic and sub-topic in every course. This is not the case in this, and many other instances, in these draft syllabuses and must be rectified before these syllabuses could be implemented.

2. Errors – mathematical and typographical

Throughout all calculus-based courses there are a significant number of mathematical errors and/or typographical errors. Some course specific examples are provided later on in this submission and MANSW is confident that other submissions in this review process, including those provided by the expertise of academic mathematicians, will provide more exhaustive information on this matter.

MANSW members well understand the difficulty in type setting and proof reading mathematical documents, but final syllabus documents are too important to contain any such errors. To provide just two simple examples:

- In the Mathematics Advanced course (p73) a statement indicates that the value of the correlation coefficient, r , is found in the range $-1 < r < 1$ which seems to exclude the notion of ‘perfect’ correlation or values $r = \pm 1$.

- In the Mathematics Extension 1 course (p59) the second order difference equation is stated as $ax_n - bx_{n-1} + cx_{n-2} = 0$ when the information following it suggests that it is actually referring to $ax_n + bx_{n-1} + cx_{n-2} = 0$.

Both of these errors occur in material that will be less familiar to teachers in NSW because it is new. MANSW insists that the Board of Studies ensures that the final versions of the syllabuses and the support documents that accompany them, are proof read by a number of independent expert mathematicians and mathematical proof readers to ensure that no such errors appear in the final versions of all of these syllabuses. This task will take time, but the students and teachers of NSW deserve no less than the best quality mathematical syllabuses we can produce. All teachers and students will be relying on these documents and the quality control procedures need to be in place to ensure that these sorts of errors are removed. The precision and accuracy of the final syllabuses must be significantly improved before these syllabuses could be implemented.

3. Assessment Issues

During our consultation, MANSW members expressed concern on three specific assessment issues.

Firstly, the lack of specificity over the amount of Preliminary course content that could appear in an assessment program and in the HSC examination was cause for concern. A number of topics in these courses do not flow necessarily into related HSC topics. The current directions appear to leave open the possibility for an Advanced Mathematics HSC examination that could have half the questions on Preliminary content (such as some aspects of Counting Techniques, Probability, Data Analysis and Series and Sequences for example). Given that the mathematics courses are one of the few Stage 6 courses that explicitly assess Preliminary course material in the HSC Examination, there was significant concern amongst our members that students would perceive this situation as the mathematics courses requiring far more from them than other subject areas. Given the declining numbers in the existing Mathematics (2 Unit) course, this situation would be unacceptable. Whilst all mathematics teachers agree that the precise counting of Preliminary and HSC content is also not desirable, we would suggest a prescription such as “no more than 25% of the HSC examination would contain Preliminary material” may be a reasonable compromise.

Secondly, the mandatory assessment components and weightings for the HSC course components are also of great concern. In solving mathematical problems, it seems contrary to the aims of our courses to suggest that the use of mathematical concepts and techniques is somehow separated from the application of mathematical reasoning and communication. Many members asked the question: What might a question look like that assessed a student’s mathematical reasoning without simultaneously assessing a mathematical concept and/or technique? To specify these assessment components in the HSC course forces teachers to spend a significant amount of time answering such questions and indeed counting marks to ensure that these weightings are met exactly in the school-based assessment program. It also forces the examination committees to do the same with the HSC Examination. To be effective, such mandatory assessment specifications require a clear, common understanding of the nature of the different components being assessed for teachers and students. We would strongly suggest that these components be replaced.

Lastly, many members expressed concern over the use of objective response questions in mathematics examinations. Our course objectives in the calculus-based courses describe our common desire for students to develop the ability to do things such as construct proofs and mathematical arguments, solve problems and communicate mathematically. We do not think that objective response questions are suited to the assessment of these ideas. Questions such as Question 4 provided in the Mathematics Advanced sample questions seem to direct students

to a particular way of writing and solving the area problem presented, rather than allowing them to use and apply their skills in more flexible and diverse ways. We are also concerned that objective response questions reduce the focus on the problem solving process and focus much more on the answer(s) obtained. Many mathematics teachers (and possibly HSC markers too) can describe situations where students have obtained a correct answer for completely the wrong reasons. Objective-response questions do not allow teachers to see this situation. Some types of objective response questions also allow students just to 'guess' an answer with no mathematical reasoning or thought involved. Whilst we acknowledge that there are many simpler questions throughout our current HSC calculus examinations which at first glance could easily be re-written as objective response questions, these often occur as 'lead in' parts of longer questions. To remove these 'lead in' questions altogether, would result in the rest of the paper seeming significantly harder for the students by disrupting the easy → hard, easy → hard flow of the papers. Many MANSW members believe strongly that free response questions are a much more appropriate way of assessing calculus-based mathematics courses.

4. Use of technology in the HSC examination

As MANSW has argued in several earlier submissions and discussions, systems and individual schools will need significant time to budget for new calculators. Whilst we understand that this pressure will ease over time, our current Year 9 students (the first to study these new courses) are already well into their mathematical studies using their current calculators. If this cohort is required to use a different calculator, then these will need to be produced by the calculator companies, funded by schools and systems, ordered and then delivered into the hands of every single student and teacher during the course of the 2009 year. Depending upon the nature of the technology, teachers may also require professional development to use this technology most effectively. Some teachers also raised the question of whether these calculators that will eventually be approved for mathematics examinations will also be approved for all other HSC examinations in other subjects that require calculator usage, or whether students may be required to use two different calculators depending upon their subject choices.

The Broad Directions for the revision and development of the Stage 6 Mathematics courses state that "That the use of technology in HSC examinations for the calculus-based courses be further investigated and clarified in the Writing Brief phase". At the moment, the exact specifications for the HSC examinations are unclear and schools have been given no indication of the likely budgetary implications of these mandatory technology requirements for the external examinations. Many MANSW members, being unable to answer these questions, feel as though this Broad Direction has not been met. We would again urge the Board of Studies to provide this information to schools as soon as possible as we are yet to be able to determine "that, in the consideration of the use of technology in Stage 6 Mathematics courses, due regard must be given to the related access and equity issues." Part of this equity issue is that every student needs to have access to this technology from the start of their Stage 6 course – not some in January 2010 and others in December 2010. For this to occur, schools and teachers must be given sufficient time and resources to plan and implement these technology requirements before they are able to teach these syllabuses fairly and equitably.

5. Broad Directions for the revision and development of Stage 6 Mathematics

Many MANSW members felt that the Broad Directions for the development of our syllabuses provided an excellent set of overarching principles for this process. Significant progress has been made in addressing some of these Broad Directions. Others (such as those described above) appear not to have been addressed. There are others which we are unable to assess as yet because insufficient information has been provided at this stage. In particular, these are:

- That the appropriateness of the current processes for the examination of Stage 6 Mathematics courses be reviewed, with particular emphasis on the examination of Mathematics ('2 Unit')-only candidates.
- That the syllabus documents within the Stage 6 Mathematics syllabus package incorporate applications, implications and considerations for the teaching of the syllabus content, including in relation to depth of coverage.

We look forward to further information from the Board of Studies on the strategies used to address these aspects of the Broad Directions. NSW teachers will require information on these two areas before they are able to implement these new courses.

6. Other comments

MANSW represents a broad range of teachers across NSW. Our members expressed many differing points of view about the removal of some topics and the addition of others. Some are strongly in favour of the inclusion of Data Analysis in these courses, whilst others are strongly opposed. Similar comments could be made in relation other topics such as Conics in Extension 2, Parameters in Extension 1 or Geometry in Advanced Mathematics. Whilst our members have differing views on these topics, they are all of the view that the final syllabus MUST reflect the amount that can be taught, and learnt by the typical student, in the indicative time. In assessing all the comments made in response to the draft syllabuses we encourage the Board of Studies to keep this principle first and foremost in their development of the final syllabuses.

During discussions with our members, the similarity between the 'codes' used for subtopics and the 'codes' used for the course outcomes was raised as a possible cause for concern. For example, in the Mathematics Advanced course, the code PMA2 is used for the Preliminary topic on Probability whereas PA2 represents the outcome "uses algebraic and graphical concepts in the solution of problems involving functions and coordinate geometry". Despite these similar codes, the two are not related in any particular way. Many teachers felt that the coding systems used for outcomes and topics should be completely different. This would assist students in understanding the structure of the new courses and would also reduce the chance that a simple typographical error could in fact refer to a completely different section of a syllabus. This is particularly true of the outcome codes for the Extension courses where the accidental addition of a 'X' or omission of an 'X' not only changes the outcome, but changes the course it refers to.

A number of MANSW members commented on their significant difficulties in assessing the appropriateness, difficulty and length of the current draft syllabuses because of the lack of clarity in the syllabus, the lack of information about the technology that students would have access to in the HSC examination and the lack of information about what level of information might be contained on a formula sheet. During our consultation with members, we had many comments of the form "If this statements means then that would be great, but if it means then that is far too hard/long for my students". This made it extraordinarily difficult to complete the survey provided with the draft syllabuses.

Teachers also commented on the necessity of seeing sample HSC specimen papers as soon as possible. Lastly, many members commented that the addition of a glossary to the syllabus package would be exceptionally helpful for both teachers and students.

Course specific issues: Mathematics Advanced

Many MANSW members recognise the difficulty in writing this particular course, with some expressing the view that in some ways this is the hardest course to write. Students undertaking this course are destined for many different post-school pathways requiring a great diversity of mathematical knowledge, skills and understanding. It is also the course often articulated as ‘assumed knowledge’ or ‘recommended knowledge’ for many university courses. And it is the mathematics course which seems to be experiencing the most significant downward trend in candidature.

One of the Broad Directions for the revision and development of Stage 6 Mathematics states our desire to ensure that “the amount of content prescribed for Stage 6 Mathematics courses reflect the amount that can be taught, and learnt by the typical student, in the indicative time.” The greatest concern of our members with relation to the Mathematics Advanced course is that the Preliminary course is far too long. A straw poll taken at one MANSW forum on the calculus courses indicated that most teachers thought they would require approximately 6 weeks longer than the indicated 120 hours to teach this part of the course. This difficulty has largely arisen from the assumption that many of the 5.3 outcomes have been taught in Year 10. This is simply not the reality for the overwhelming number of students undertaking this course. They will have mastered some of these outcomes, but certainly not all of them. These are the very students many MANSW members are trying to encourage to challenge themselves by staying with this more challenging mathematics course in Year 11. This will be impossible if the current assumptions stated on p8 are maintained, with no time allowed for these to be reviewed during Year 11. Even the most capable students still require time in Year 11 to achieve the required mathematical fluency with many of these assumed skills and techniques, particularly in algebra. Time must be allocated for this to be achieved in the Preliminary course and the total size of the Preliminary course must be reduced in the final syllabus.

There were mixed feelings amongst MANSW members about the reduction of this HSC examination from 120 marks back to 100 marks. Some have argued that this will make each of those marks more difficult to obtain. Others have said that it depends on which 20 marks are removed from our current style 2 Unit papers – the hardest 20 marks in the course? The easiest 20 marks? A range from across the paper? Whatever the original intention of this decision, it is our view that diligent students of average ability in this course should be able to leave the HSC examination feeling positive about the course and that they have been able to show what they know and can do. This should NOT be related to the students who undertake the more difficult Extension course.

A number of members also commented on the difficulty in finding the placement and status of specific content in the syllabus. For example, where will students first find the equation of tangents to a curve using calculus? They certainly appear explicitly on both p60 and on p102, leaving teachers wondering whether this type of questions can be taught in either section or should be taught in both? Is it preliminary content or HSC content? Another example - are the sine rule and cosine rule still in the course somewhere or is it assumed to be Stage 5 content for all students, independent of the pathway each student actually studied in Year 9 and 10? This lack of clarity needs to be addressed.

Other specific comments from MANSW members on the Mathematics Advanced course are contained in Appendix A (page 10)

Course specific issues: Mathematics Extension 1

The most significant issue with the draft syllabus of the Mathematics Extension 1 course was the status of the Advanced only material in relation to assessment in the Extension 1 course. Many members were not clear whether it would be possible to see an Extension 1 HSC examination that contained for example 30 of the 70 marks made up from topics such as Data Analysis, basic Probability and Series and Sequences which all currently only appear in the Advanced course? The current specifications seem to indicate that this may occur as long as the examination is based 'mainly' on the Extension 1 course. The lack of specificity and clarity in the examination specifications for Extension 1 need to be rectified.

Many MANSW members were also somewhat surprised by the placement of some of the Extension 1 outcomes. For example, surely PX6 (p19) should actually be an HSC outcome since it refers to Projectile Motion and other HSC topics? Similarly, HX2 (p14) refers to proof by induction, a Preliminary topic, and perhaps should be a Preliminary outcome? The outcomes HX5 (p15) seems to refer to trigonometry in three dimensions despite this not appearing in any of the knowledge, skills and understanding that students are required to acquire. We would suggest that further work and consideration is required on many of these outcomes and their placement in the final version of the syllabus.

A significant number of our members also expressed serious concern over Mathematical Induction in this course. As stated on p51, the strongest form of induction (requiring an assumption about all values $S(1), S(2), \dots, S(k)$) now appears to be required rather than the simpler assumption involving just $S(k)$. However, it also appears that none of the examples provided in this topic of the syllabus actually require this stronger assumption. Many MANSW members felt that the inclusion of so called 'strong induction' was an unnecessary complication for a Preliminary topic in Year 11 and should be amended.

As indicated earlier on, there was also concern expressed by some members over the removal of Simple Harmonic Motion and Parameters as a separate topic. There was also a very strong feeling at the MANSW forum that the Logistic Growth Equation and the notion of chaotic behaviour was far too difficult for a Preliminary Extension 1 topic and should be removed altogether. As a number of members commented that the Preliminary course was again too long, this may not need to be replaced.

Other specific comments from MANSW members on the Mathematics Extension 1 course are contained in Appendix B (page 11)

Course specific issues: Mathematics Extension 2

Many MANSW members expressed a concern that the Mathematics Extension 2 syllabus requires significantly more detail in many sections. Currently, many teachers have a thorough understanding of the course which has been shaped through many years of HSC Examinations. This will not be the case in the future and it is essential that this syllabus clearly articulates the exact nature of depth and scope of the content in this course. This is an extraordinarily difficult task with this level of mathematics when constrained to a form of short 'dot points' in the syllabus.

Whilst we understand that the order in which the topics are presented in the syllabus does not necessarily imply the order in which they should be taught, many members thought that the topics should be organised in one of the possible logical orders that would be possible. A significant number of our members raised the issue that the placement of further inequalities as the first topic in the syllabus was not desirable as it was far too hard to begin the course with.

An overall majority of our members who attended our forums indicated that second order differential equations should be removed from this course altogether. Instead, it would be preferable to have time to study first order equations a little more systematically, including perhaps the study of standard techniques for solving such problems eg using an integrating factor or by the separation of variables. Being a course for our most capable students, many members felt it was more appropriate to provide more depth in this area than a broad look at both first and second order equations, without any real solution techniques.

Again, there were many differing points of view on particular topics. Many suggested that Conics was such an elegant topic and that it was a pity that it had been omitted, whilst others argued that perhaps the pool of the most well-designed questions had already been asked and that perhaps it was good to have a change. Many members indicated that Direction fields should be removed altogether and that circular motion had much to offer students and that it should be retained. A number of members also expressed a concern that they were uncertain whether $\frac{d}{dx}\left(\frac{1}{2}v^2\right)$ was now placed within the Extension 1 course or the Extension 2 course. Such issues of clarity must be rectified before these syllabuses can be successfully implemented.

Other specific comments from MANSW members on the Mathematics Extension 2 course are contained in Appendix C (page 13)

Concluding Remarks

As indicated at the beginning of this submission, these drafts essentially contain the ‘bones’ of three excellent Stage 6 Mathematics courses. However, they are not yet in a form which could even begin to be implemented by teachers in NSW.

It is our belief that teachers will require all of the following before they are in a position to begin programming these new courses:

- A comprehensive description of the depth and scope of the content of each course and a clear, precise, error-free description of the knowledge, skills and understanding students need to acquire
- Suggested applications, considerations and teaching applications consistent with the content described in the syllabus
- A clear indication of the technological features that students will have access to in the external examinations
- Other essential support material including the formula sheet for each course, a glossary of terms and a specimen examination paper for each course.

Whilst other support may also be provided, it is our view that these courses can not be implemented in the absence of these resources specified above. We strongly urge the Board of Studies to ensure that this is available to teachers before the beginning of the 2009 school year, to allow teachers the essential time to adjust their Year 10 Scope and Sequences and to program the three Year 11 Preliminary courses for the following year. Any later delivery of these resources would seem to indicate that a delay in the implementation of at least some of these courses would be more appropriate.

Please do not hesitate to contact the MANSW office directly if you require clarification or further information on any of the issues raised in this document at any stage in the revision process.

Appendix A: Other specific comments from members (Mathematics Advanced)

p 32 Probability. The terms ‘event’ and ‘outcome’ seem to have been used interchangeably throughout this section without particular thought. Some members have argued that outcomes include any subset of a sample space whereas events are collections of outcomes.

p 39 Dot point 2. More correctly, the absolute value can be better defined as the non-negative square root of x rather than the positive square root.

p 41 Dot point 7. “A property of a graph of a function is that no two points will have the same ordinate”. This is clearly incorrect and excludes many common functions for example $y = \sin x$, $y = x^2$ and many other polynomials!

p 46 Dot point 2. What does it mean to ‘construct’ a real function? This seems to be unclear to many members and requires further clarification.

p 65 The opening statement indicates that “the extent to which formal proofs are introduced will be decided by teachers” however the applications and considerations for this subtopic appear to indicate that teachers will also give simple examples “before preceding with a proof”. Many members believe the proof of results such as the function of a function rule is typically not appropriate for our current 2 Unit candidates. Whilst this is certainly a desirable exercise for those students studying Extension 1, this is not the case for the majority of 2 Unit students. We would suggest that the syllabus advises teachers more strongly: “Teachers are not encouraged to involve Mathematics Advanced candidates with formal proofs of these difficult theorems. Practical examples will convince students of the truth and usefulness of each rule. Extension 1 candidates are encouraged to consider these proofs as appropriate.”

p 68 Data Analysis. This section appears to require some significant revision. Different symbols (S, σ_x) have been used for standard deviation without any real explanation why. The distinction between sample standard deviation and population standard deviations is not written clearly. The distinction between correlation and causality is not well defined. The range of values given for the correlation coefficient is incorrect. Teachers require significantly more clarity and direction in this whole section, particularly as it is a new section, before they could program this particular topic.

p 71 Dot point 4. This should read “the variance of a sample is S^2 ”

p 79 The term ‘binary sequence’ may not be as well understood as saying the link between the ‘geometric sequence’ 1, 2, 4, 8, ... and the binary numerals.

p 93 The Trapezoidal rule seems to be presented as a stand alone topic – why not include Simpson’s Rule?

p 97 The Use of Technology: We would suggest saying that “The need for detailed curve sketching by hand in this course is reduced by the availability of such tools.” It is clear that students in the Extension 1 and 2 courses need to have a much more detailed knowledge of curve sketching by hand.

p 112 Dot point 1. The variables (x and h) appear to have been changed half way through the third limit in this dot point.

p 113 Dot point 6. Typically, this would be described as the calculation of the derivative of $\tan x$ rather than the derivation of it.

p 125 Dot point 2. “How many different numbers can be formed from the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9?” seems a less than useful example - because the answer is really all the integers! Perhaps this was supposed to be something more specific such as three digit numbers?

Appendix B: Other specific comments from members (Mathematics Extension 1)

p 40 Stretching graphs. This section appears to be a little misleading as the examples appear to indicate that students are also expected to study some shifts as well as stretches (such as $y = 5 + \ln 3x$ and $y = x^2 - 9$). Whilst translations (or shifts) appear in the Advanced course, it is currently unclear whether Extension 1 students need to be able to combine these two sections and relate the graph of $y = f(kx + c)$ to the graph of $y = f(x)$. Possibly this is intended to be covered in the Extension 2 course, but this isn't clear either. This needs to be clarified.

p 41 Dot point 4. Not sensible to sketch these particular exponential graphs in the Preliminary Extension course when e is not introduced in the Mathematic Advanced course until the HSC course.

p 45 Dot point 6 (iii) Several members commented that this should more specifically say that “At least one local maximum or minimum ...”

p 47 Dot point 5. One member asked the question about whether there was a more succinct statement than the three separate statements (3), (4), (5) in this section?

p 47 Dot point 7. Whilst the restriction of polynomials with integer coefficients seems appropriate for this course, it is unclear why we are also restricting the syllabus to integer roots as well. This excludes the use of simple factors such as $(2x - 1)$ which seems an unnecessary simplification. An alternative may be to say something like “Since all coefficients are integers, any integer root a must be a factor of the constant term in $P(x)$.”

p 61 Dot point 4. If the logistic growth equation remains, then the notation of P_n and x_n must be uniform in the example given. It would also be better to provide an example that clearly fits into the standard form of the logistic difference equation provided above, $P_{n+1} = a(1 - P_n)P_n$.

p 66 Dot point 4. It might be clearer to actually write $\binom{n}{r}$ rather than just ‘combinations’ here as it this word is not particularly clear.

p 70 and following. A number of MANSW members raised the question of whether some of this content that currently appears in the Extension 2 course may be too hard to be moved back to the Extension 1 course, particularly for the weaker candidates. This needs to be considered in light of other amendments that may alter the overall difficulty of the Extension 1 course, but perhaps may need to be removed.

p 74. The introduction to this topic appears to have no relevance at all to the content of the section, referring to differential equations and complex numbers when the topic is actually about trigonometry.

p 79 Dot point 2 (ii). The solution statement seems to have omitted the other solutions:

$$\theta = (2k + 1)\frac{\pi}{2} \text{ for integer values of } k.$$

p 83 Dot point 5. It seems a poor choice of example to encourage students to use a trigonometric substitution to find $\int_0^2 \sqrt{4 - x^2} dx$ when it is simply the area of a quarter of a circle.

p 88 Dot point 6. Incorrect limits for b . It should be $|b| \leq 1$ in both instances.

p 89 Dot point 2. The incorrect domain is provided for the definition of $\sin^{-1} x$. It should be defined over $-1 \leq x \leq 1$.

p 91 Dot point 6. It seems unclear whether we also mean to include sums, difference and function of a function rule in conjunction with the establishment of the new inverse trigonometric functions. This needs to be clarified.

p 93, 97 both make reference to implicit differentiation in the list of terminology and in the example provided, but this technique is not specific in any of the content dot points as far as we can find. Is this a technique that the students are required to know? If so, it should be explicated stated as a dot point of knowledge, skills and understanding that students acquire.

Appendix C: Other specific comments from members (Mathematics Extension 2)

p 29. A number of members indicated that one of the examples in this section should refer to inequalities that relate to integrals, if these are to be retained in the course.

p 33 Dot point 3. The use of the notation $\sqrt{a+ib}$ seems to be more ambiguous than required. Also the examination of the curves mentioned for different values of a and b , will be made more complicated without any formal study of conics elsewhere in this course.

p 39 Dot point 4. Is it the case that we now want students to factor suitably chosen cubic and quartic polynomials with real coefficients over both the real and complex numbers or any such polynomials?

p 43 Dot point 6. It seems somewhat surprising that throughout both the Advanced and Extension 1 draft syllabus the standard notation of $\ln x$ is used for the natural logarithm, but then in this section (and again on p45) we revert back to $\log_e x$. Many members commented that the notation should be standardised wherever possible and many held the view that $\ln x$ was certainly preferable.

p 49 Dot point 2. Again, with the removal of the conics section from the existing Extension 2 course, it seems that examples such as $x^2 + 2y^2 = 4$ may also need to be removed from this list of examples, or alternatively the graphs of these conics need to be added to the list of knowledge, skills and understanding elsewhere in the course.

p 53 Dot point 2. Some members commented that the integral $\int \frac{x}{\sqrt{x^2+1}} dx$ would provide a better example of a simple substitution and hence would be better used in the third dot point.

p 53 Dot point 7. Some members commented that with the inclusion of other recurrence relationships in these courses, it may be better to refer to these as integrals.

p 56 Dot point 6. A significant number of our members agreed that this dot point was one of the most important in the Volumes topic as taught to our most capable mathematicians. However, the volumes question provided in the sample examination questions (Extension 2, Question 4) appeared to contrast strongly with this specified content where the focus was simply on the integrals rather than the reasoning and choice for a particular method.

p 63 Dot point 11. The statement over the calculation of the terminal velocity is not correct.

p 66 Dot point 2. Perhaps is overly complicated. Perhaps it would be better to say something like “recognising that in general there are infinitely many functions which solve differential equations and that in order to find particular solutions, initial conditions are necessary”

p 70 Dot points 1, 2, 5. The verb to ‘recognise’ seems to appear repeatedly throughout this section and it is unclear about what students might be required to demonstrate. This verb should be replaced with a clearer indication of the mathematical skills that students are required to demonstrate as is typically characterised by mathematical verbs such as solve, verify, prove, find, differentiate or integrate to name just a few.