

MASTERING MATHEMATICS

**“Truth is ever to be found
in simplicity, and not in the
multiplicity and confusion
of things.”**

Is. Newton

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Extension 1 and 2 Mathematics are *the* highest scaling subjects in the HSC. Being just average in Maths Extension courses can boost your ATAR significantly.

In this article, David Sadler (co-author of the Cambridge Mathematics textbooks) provides some tips and strategies for succeeding in the demanding NSW HSC Mathematics courses – 2U Advanced, Extension 1 and Extension 2.

In this article, I examine the main issues facing HSC students studying mathematics. Like English, almost all students study some level of mathematics.

The most common questions confronting students are:

- What level of maths should I study and how do each of the different subjects scale?
- How can I improve my marks and eliminate careless mistakes?
- How difficult is Extension 2 Mathematics and what strategies can I use to tackle the course?

We address these questions in this article.

What level of Mathematics should I take?

One of the first decisions confronting HSC students is

“How many units of Maths should I study?”.

In deciding, you need to consider your own ability in mathematics, which subjects you are passionate about and the relative scaling of each subject.

The Mathematics Extension courses are the highest scaling subjects in the HSC, and this has significant implications for your ATAR. For instance, as Richard’s article makes clear, if you wanted to score an ATAR of 99, you would only need to be about average in Maths Ext 2 and in the top quarter of Maths Ext 1. In contrast, you would need to be in the top 3% in 2U Maths to achieve an equivalent mark. What is even more astounding is that if you wanted to score over 97, you would only need to be in the top 80% of the Maths Ext 2 course, and 50% of the Maths Ext 1 Course, that is, you could be below average and still be on track for a top ATAR.

It is therefore clear that Maths Ext 1 and 2 are a must if you are good at maths. Even if you are average in the Preliminary Mathematics Extension course, Extension 2 is still worth considering simply because it scales very well.

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HOW CAN I IMPROVE MY MARKS AND ELIMINATE CARELESS MISTAKES?

While there is undoubtedly a certain amount of natural acumen involved in mathematics, with the correct technique you can dramatically increase your marks. Here are three of the things that have worked for most students:

1. Understand your formulae

One of the most important (but also most tedious) parts of preparation for a mathematics exam is being familiar with all the formulae in the course. 'Knowing' is more than just memorising. You need to understand the formulae, know when and where to apply them, and use the formulae without making mistakes. You should build familiarity with your formulae through repeated practice.

Practice gives meaning to your formulae and will make it clear when and how to apply a formula to a given situation.

Very soon, doing questions will become second nature. However, memorisation without context and practice will not help because you won't know what formulae to use and when to use them. For this

reason, at Talent 100, every time we teach a formula we apply it to a variety of HSC style questions so students know exactly what formula to use and how to apply them.

It is also useful to remember how a formula is derived. When you can see the logic behind a formula, it will be much easier to understand and to remember. Take for example, differentiation from first principles. Even if you forget the formula, you can quickly derive it once you realise it is the gradient of the line joining any point on a curve to another point that is a very small distance “ h ” away from it. This formula gives the gradient of the tangent, which is the limiting position of the line described above as the two points become progressively closer, that is, as $h \rightarrow 0$.

$$\frac{dy}{dx} = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

This same principle for remembering formulae can, and should be, applied to as many formulae in the courses as possible. You will notice that you get a much better understanding of the underlying maths and are able to memorise your formulae quickly and effectively.

2. Set your work out properly

One of the most important ways to improve your marks in mathematics is to set out your work properly. Just as an Economics or English essay requires you to structure your paragraphs in clear and logical fashion, structuring your working clearly is important in Mathematics.

Clear setting out helps you:

- Avoid making careless mistakes in the first place.
- Give your examiners a clear picture of the logic and flow of your argument.
- Provide a strong platform for “cracking” the harder questions.

If you are making a lot of careless errors, you should avoid skipping too many steps. Take the time to write a few extra lines and avoid giving away cheap marks.

Also, it is important to understand that Extension exams (especially the Extension 2 exam) require more than just a correct numerical answer for most questions – they require an explanation as to how you arrived at your answer. My most important piece of advice when taking the Extension 2 exam is to include all your working out and set out your solutions so that they are easy to follow.

Some simple tips to make your proofs clearer include:

- Write your equations down the page rather than in a single line, thereby ensuring that you have enough space for each equation.
- Explain what the variables you introduce mean by either indicating them clearly on a diagram or by writing at the top of your proof **Let x be the ...**
- Explain the steps in your proof, that is, talk to your examiners rather than making them guess your logic. For example, in a harder permutations and combinations problem, don’t just state the answer but briefly explain where the answer comes from, or in an induction proof, clearly indicate where you used your assumption for $n = k$ when proving true for $n = k + 1$.
- Draw LARGE diagrams. In geometry questions a large diagram allows you to mark in more angles and see things more clearly. In curve sketching questions, you are able to indicate the important features more accurately. Drawing a decent diagram can make the difference between seeing how to solve a problem and failing to solve it.

HOW CAN I IMPROVE MY MARKS AND ELIMINATE CARELESS MISTAKES?

Doing these things will help you maximise your marks; not only will clear and logical setting out help reduce your chances of making careless errors, but the examiner is more likely to award you partial marks if you do end up making them.

At Talent 100, we know the best way to improve your exam technique is to repeatedly put it into practice. This is why our homework each week is set in examination style, structure and graded difficulty to give you weekly feedback as to the types of mistakes you make under exam conditions.

3. Perfect practice makes perfect

Once you have revised all your theory, the most effective way to study in the final few weeks before the HSC exam is to do as many exam papers as possible under exam conditions. It is important that you aim to completely eliminate ALL your careless mistakes as you sharpen your focus and learn to concentrate more effectively. I would often lose marks in the routine sections of an exam because I would forget the constant of integration or not change the limits when making a substitution. However, after doing full exams for practice I was able to completely eradicate these annoying mistakes.

When you add up the marks lost in an exam due to careless mistakes, you may find that you have squandered up to 10 marks or even more - the difference between a good mark and a great mark and perhaps costing you a top band result. You MUST find a way to avoid careless errors.

At Talent 100, we aim to develop perfect exam practice through exam-style homework and rigorous mock-exams. Students are strongly advised to write out corrections to their homework, to ensure they never repeat those mistakes in the future. In addition, our HSC Students sit 10 weeks of mock-exam papers to discover any shortcomings before they sit their Trials and HSC Exams (which collectively account for 70% of their final result).





SNAPSHOT INTO AN HSC MATHEMATICS EXTENSION 2 EXAM

Sitting an Extension 2 paper can be a daunting prospect: it is arguably the hardest high school maths paper in Australia. While considerable mathematical ability may be required to score the very top mark, with the right approach even average students can achieve a strong result.

The three hour Extension 2 paper consists of ten multiple choice questions worth one mark each, followed by six 15-mark questions.

In this section, we break down the exam question-by-question and try to give you a realistic snapshot of how an average Extension 2 student can score 65-75/100, which corresponds to a high Band E3 or a Band E4. As Richard's article suggests, this will give you a scaled mark equivalent to the top 4% of students in Physics, Chemistry, Economics, and English and put you well on track for an ATAR of 99+.

BREAKING DOWN THE EXTENSION 2 EXAM



Questions 1 - 10

(aim for 7-8/10)

The multiple choice questions are by no means trivial. They are graded so that the later questions are more demanding than the earlier ones. Some questions are best done by just solving the problem with pen and paper in the usual way. However, you can often see what the answer has to be without writing out the entire solution. Another useful strategy is to work backwards from each alternative to eliminate the wrong answers. Sometimes you can eliminate an alternative very quickly.

Remember that the wrong alternatives are 'distractors'. They are designed to 'distract' you from the correct alternative, so don't jump in without some careful thought.

Questions 11 - 13

(aim for 35-40/45)

These questions are relatively straightforward, but you must never underestimate them as they can still be a bit tricky in places. They usually focus on the more routine aspects of Integration, Complex Numbers, Polynomials, Conics, Graphing and Volumes. Most of these questions will be very similar to questions you have seen before; either in class or in the homework assignments or in the past papers. Although you probably found these topics challenging when you first encountered them, you should be very familiar with the standard questions by the time you do the HSC exam.

It is important not to forfeit any marks to careless errors in these routine questions as the later questions get progressively harder. You will almost certainly encounter problems you cannot solve towards the end of the paper.

Questions 14 - 16

(aim for 23-27/45)

The final three questions contain a high proportion of non-standard problems.

There are still plenty of marks that can be obtained by the average Extension 2 student, but he or she has to be prepared to fight for them. Considerable tenacity is definitely required!

Often the questions are long, multi-step problems consisting of a couple of routine parts followed by a couple of harder parts. A student should never spend too much time trying to get out the difficult bits – this is bad exam technique. If you are completely stuck with little prospect of success, you should move on. You can come back later for a second attempt if time allows.

Some of the questions here are based on Ext 1 Topics, such as Circle Geometry, Mathematical Induction, Inequalities, Motion and

Probability, but with a much higher level of difficulty. The emphasis is on proof, rather than the usual ‘calculating’ or ‘finding’ or ‘solving’. One of the main areas of confusion is that many schools don’t actually teach ‘Harder Ext 1’ as an Ext 2 topic. Rather, they simply expect you to be able to apply your Ext 1 knowledge to much harder questions. This may work for the top students, but for the average student, the best way to prepare is to practice as many different questions as possible and familiarise yourself with the common question types.

The final questions of the exam are notoriously difficult, even for the top students. Rather than getting flustered, it is important to remember to stay vigilant in your approach and attempt as many questions as time permits. It is often easy to gain marks by attempting the early parts of a long question (e.g. proving the

base case of an induction question even if you cannot prove for $n = k + 1$). Sometimes you can even pick off marks in the later parts of questions. For instance, a question may ask you to prove a result. Even if you cannot prove this result, later parts of the question may require you to utilise this result to deduce further results. If you cannot solve the hardest part of the question, you may be still able to gain an extra mark or two very easily. These few marks can quickly add up to something significant.

If you have done the earlier questions well, and can score around half marks in the last three questions, you are on track for a top band performance.

Final Score: Raw Score 65-75/100 Band: High E3 or E4. ATAR: 99+

MEET THE HEAD TEACHER



DAVID SADLER

Teaching Experience - 30+ years

In the world of HSC Mathematics, David Sadler hardly needs an introduction. Holding a Bachelor of Science from the University of New South Wales, as well as a Diploma of Education and a Masters of Pure Mathematics from the University of Sydney, David has co-authored 4 Cambridge University Press Mathematics Textbooks. David's teaching pedigree is second to none: He has 36 years of teaching experience under his belt at Sydney Grammar School, where he was also Head of Mathematics for 7 years. He brings his considerable talents as both an educator and a thought leader in the mathematical industry to his new role at Talent 100 as Head of Mathematics. David's top tip for HSC students? There is no substitute for hard work. There are no shortcuts to success.

Qualifications

- Bachelor of Science from UNSW (Double major in Pure Mathematics and Computer Science)
- Diploma of Education from the University of Sydney
- Master of Arts in Pure Mathematics from the University of Sydney
- Taught undergraduate Mathematics at UNSW in 1991

Achievements

- Co-author of 4 Cambridge University Press Maths Textbooks
- Mathematical industry thought leader
- 36 years Mathematics teaching experience at Sydney Grammar School
- Head of Mathematics at Sydney Grammar School for 7 years

QUESTIONS

Trust in your natural ability. If you have done the hard work you should be feeling confident.

What were your secrets of success in Mathematics?

I was passionate about mathematics and was prepared to devote a lot of time and effort to it. I enjoyed the challenges that the subject presented and always felt like I had achieved something significant when I managed to solve a difficult problem. If you don't love learning and just see your high school education as something that you have to put up with then you won't get much out of it. The all important thing is your attitude.

How did you deal with stress and challenges?

Some degree of stress is inevitable whenever there are assignment deadlines and exam blocks. We all have to deal with time pressure and the fear of failure. I always told myself that I could only do my best. I would only be critical of myself if a lack of organisation or motivation was to blame for a poor outcome. If a task was particularly stressful or challenging, I would comfort myself with the knowledge that most of my peers would probably be in a similar predicament. We should always try to view a challenge as an opportunity to learn and grow, rather than something to be scared of. Setbacks or mistakes are inevitable from time to time, but they never define you. Rather, they should motivate you.

What is your advice for HSC students?

You will be better at some subjects than you are at others. Organise your time so that you can spend more on the subjects which you are not as strong at. Ten units count towards your ATAR, so it is better to be good at all your subjects than to be excellent at some and poor at others.

This is your last year of schooling so put in your biggest effort.

Why do you like to teach at Talent 100?

The academic culture at Talent 100 is very impressive. There are lots of clever and highly motivated people working in the organisation, and the main focus is always on assisting and supporting our students so that they develop a love of learning and achieve to their full potential.

TALENT'S HSC SUBJECT GUIDE

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WEEK
FREE
TRIAL**

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