Study Tip # 37: VCE Exam Advice – Unit 2 Maths Methods

VCE Mathematics Study Design

A Mathematical Methods revision program should commence by ensuring that you have an idea of all the mathematics that will be included, as outlined for Unit 1 on page 31 and Unit 2, page 37, of the VCE Mathematics Study Design. (Accreditation period – 2016-2020). If you have not already seen it, the Study Design is a very helpful document and can be found on the internet by entering the VCAA website (www.vcaa.vic.edu.au). On the home page, find the VCE Study Design under Students, Senior Secondary (Years 11-12), VCE (Victorian Certificate of Education), VCE Studies, Index to Studies, click M for Mathematics, Mathematical Methods, Curriculum, then Study Design. For Units 1 and 2: the accreditation period has been extended until 31 December 2019. For Units 3 and 4, the accreditation period has been extended until 31 December 2020.

It is vital that you understand that 2016 was the start of a new Study Design and as such incorporates new material. So revision material from previous years may be slightly at odds with the new Study Design.

For Unit 1

In undertaking this unit, students are expected to be able to apply techniques, routines and processes involving rational and real arithmetic, sets, lists and tables, diagrams and geometric constructions, algebraic manipulation, equations, graphs and differentiation with and without the use of technology. They should have facility with relevant mental and by-hand approaches to estimation and computation. The use of numerical, graphical, geometric, symbolic and statistical functionality of technology for teaching and learning mathematics, for working mathematically, and in related assessment, is to be incorporated throughout the unit as applicable.

For Unit 2

In undertaking this unit, students are expected to be able to apply techniques, routines and processes involving rational and real arithmetic, sets, lists and tables, diagrams and geometric constructions, algebraic manipulation, equations, graphs, differentiation and anti-differentiation with and without the use of technology. They should have facility with relevant mental and by-hand approaches to estimation and computation. The use of numerical, graphical, geometric, symbolic and statistical functionality of technology for teaching and learning mathematics, for working mathematically, and in related assessment, is to be incorporated throughout the unit as applicable.

The Study Design contains a comprehensive list of dot points that is the 'go-to' document explaining to teachers the detail of all of the mathematical content of the course. Make sure that you have covered every dot point during your classes at school, and talk to your teacher if there is something that you think may have been overlooked, (using as much tact as possible; the work may have been covered, and you may not remember it in the words and symbols in which it is explained in the Study Design).

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It is also vital to have the most up-to-date operating system, OS, on your CAS calculator. Talk to your teacher also about this and find out how your particular school deals with providing calculator updates.

Students often feel there is a big 'jump' between Year 10 and Mathematical Methods Units 1 and 2. It helps to know that you will feel more comfortable with the material as Unit 1 progresses and more and more graphs and functions are learned and patterns observed.

Mathematical Methods Units 1 and 2 are designed as preparation for Mathematical Methods Units 3 and 4.

The four Areas of Study listed in detail in the Study Design are:

1.   Functions and graphs

2.   Algebra

3.   Calculus

4.   Probability and Statistics

Anything that you studied last year in Year 10 Mathematics can be examined in Year 11 Maths Methods.

Exam Technique

- When you complete a question, get into the habit of checking that you have actually answered all aspects of the question in the required format.

- Take care with your writing as work that is illegible will be disadvantaged. Assessors who cannot decipher between -6 or $1/6$ will award NO marks. Or between $[2,3]$ or $[2,3)$. Or between an open or closed circle as an endpoint on a graph.

- Your solutions must show a logical development throughout the solution. Assessors are warned to watch for 'fudging' lines of working. Be careful to identify which is your final answer (underline, highlight, draw square around…). If it is not clear what the answer is, VCE assessors will use the last thing you have written down as the answer.

- Take care to match the number of marks a question is worth with the amount of working you show. A 3 mark question where your answer is just, say, $x = \dfrac{\pi}{6}$ will only get 1 answer mark and no method marks, even if you have cleverly done the working in your head.

- 'Show that' questions require **all** steps of working. Again, Assessors are warned to watch for 'fudging' lines of working.

- 'Show that' questions do NOT mean starting with what you have to show. Nor does it mean substituting a value in. If you do this substitution, then you have only shown the answer for one set of values and not all. What you have to 'show' becomes the last line, not the first.

- Answer questions in exact form unless you are told otherwise. If you give the exact answer and then go further to give the approximated decimal answer when you have not been asked to, you will NOT be given that answer mark. Typical of this is the mistake of writing $x = \dfrac{2}{3}$ (correct) $= 0.67$ (incorrect).

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- When solving any equations, never divide through by a function that could equal zero. A common example of this is dividing through by a trig function like $\cos(x)$. If you do that, several solutions may be missed.

- If there are straight line asymptotes, make sure you rule the lines so that they are straight. Make sure that the curves approach the asymptotes, and don't curl away from them. Label the equation of the asymptote on your graph, don't just state it somewhere on the page.

- Ensure that you are able to sketch neat graphs clearly showing all key features, such as intercepts, stationary points, and asymptotes with their equations. Watch for when coordinates are specifically asked for.

- Make sure you always use pencil when sketching graphs so that you are able to make changes if needed. If your graph is in stages, (as in the transformation of trig graphs or addition of ordinates) leave your early stage graphs there. Don't erase them. If needed, use an arrow or a different colour to identify your final graph.

- If you run out of time during Exam 2, (the technology active exam) make sure that you record an answer for each multiple choice question, even if your answer is a guess. You do not have marks deducted for incorrect answers!

Exam Preparation

- Thoroughly revise all the basic graphs such as:

  - $y = x^n$ for $n \in N$ and $n \in -1, -2, \dfrac{1}{2}, \dfrac{1}{3}$

  - Graphs of polynomial functions to degree 4 and other polynomials of higher degree such as $g(x) = (x+2)^2(x-1)^3 + 10$

  - Graphs of inverse functions

  - Graphs of circular functions of the form $y = af(x) + c$ where f is the sine, cosine or tangent

  - Graphs of $y = Aa^{kx} + C$ where $a \in R^+$

  - Logarithmic functions, $y = \log_e(x)$ and $y = \log_{10}(x)$ and the relationship $a = e^k$ where $k = \log_e(a)$.

  - Circular functions $y = \sin(x)$, $y = \cos(x)$ and $y = \tan(x)$

- Be able to correctly use transformations from y to $y = af(n(x+b)) + c$ in all of the above graphs. Make sure you understand and can perform these transformations algebraically as well as in words. Transformations include **D**ilation, **R**eflection, **T**ranslation. The short-hand **DrT** helps to decide which transformation to do in which order.

- When sketching curves, asymptotic behaviour must look asymptotic, so practise actually drawing some of the curves mentioned above so that all the features actually look accurate and the curve is smooth and symmetrical and doesn't flip away from the asymptote.

- Many students think that exponential and log graphs have 2 asymptotes each: THEY DON'T!. Exponential graphs have one horizontal asymptote and and log graphs have one vertical asymptote.

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- Specifically prepare circular functions and exponential and logarithmic functions as two topics in their own right because extended answer questions in Units 3 & 4 often concentrate on these topics.

- Matrices is a problematic topic as this previously has often been studied at length in Specialist Mathematics Units 1 & 2. Matrices is used quite extensively in Year 12 exams for the topic of Transformations and therefore is wise to be thoroughly understood in Year 11. Your teacher may teach you beyond what specifically is required for Year 12 Mathematical Methods, but this provides a fuller understanding of how they are used. Old exams will have Matrices used for three different topics: simultaneous equations, infinite and no solutions to a series of straight lines and Transformations. It is Transformations where Matrices are only mandated now, although they are still useful for the other topics.

- It is essential that you enter information into your calculator correctly to obtain the desired graph. For example, you must remember to place brackets around all denominators or use the fraction key, and your window must be appropriate for the section of the curve you wish to view. Calculator practice must occur all year and not just before exams.

- Practise using special angles in Circular Functions, especially angles as multiples of 30°, 45° or 60° as these are the ones that will most usually appear, especially in Exam 1. Learn your exact values for 30°, 45° or 60°, and $\dfrac{\pi}{6}, \dfrac{\pi}{4}, \dfrac{\pi}{3}$ radians.

- Probability and Statistics contains significant new material for 2016 so make sure that you cover all that is new. This means that past exams that schools already have, either internally written or externally purchased, will have none of these new questions in them. Discuss with your teacher how your class will deal with this lack of practice material.

- Probability and Statistics material includes in Unit 1, random experiments, sample spaces, and Probability rules and in Unit 2, Permutations and Combinations and their applications to Probability. The **newly introduced** topics are in Unit 1: **Simulation**, using simple random generators and the display and interpretations of results including informal consideration of sample proportions.

- Know how to use the relationships $a^{\log_a(x)} = x$ and $\log_a\left(a^x\right) = x$

- Understand solutions of polynomial equations using numerical methods (this is new from 2016).

- When revising from a range of material, attempt the short-answer questions first. These are technology and note free and will usually have a formula sheet attached.

- If you have to refer to your text book or note book to find the appropriate rules to solve a particular question then you need to make note of these rules, learn and memorise them. Hopefully, you will have built up all the essential skills after you have completed the majority of these short-answer questions.

- It is assumed that all students use a CAS calculator in Exam 2 (technology active) and questions are written to test that you can use it efficiently and accurately. The best CAS student is one who can 'pick-up' and 'put down' the CAS with ease to suit your own skills. This is called using 'elegance' with CAS. What you choose to use your CAS for, or not, may be different from your friend, and your teacher.

- When working through multiple-choice questions, use your calculator. It is important to learn to recognise the types of questions that are best solved using technology and those where a few by-hand lines of working would be more efficient.

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- Learn to answer multiple-choice questions in approximately 2 minutes. Some will be shorter, some longer and take more steps of working. Some can be answered at a glance.

- As soon as you have finished enough topics, commence working on extended answer questions. When working through these questions, resist the temptation to consult solutions too quickly. It is best to complete a whole question before checking answers. Some students refer to solutions too quickly and don't spend enough time pondering possibilities – which means their learning is not as robust. You need to 'push through' to the solution.

- Make use of your calculator and reference materials for these types of questions. Hopefully the more questions you work through, the less time you will need to spend consulting your reference materials! The extended answer questions are worth half (60 marks) of your total marks for both examinations combined (120 marks), and as they tend to require more effort, can be neglected during times of revision and preparation. (These mark ratios are the ones used in Units 3 & 4, your school may not use exactly these marks in Unit 1 & 2 examinations.)

- Complete as many other practice examinations as possible, either from your teachers, from on-line school resources, or outside published resources, under examination conditions, in order to establish an appropriate pace. Use your calculator and Reference Notes for Exam 2.

- Consider whether you will attempt the extended answer questions first or the multiple-choice questions first in Exam 2. Students can be tempted to spend too much time on multiple-choice questions which are only worth 20 out of 80 marks in Exam 2.

- Every year VCE assessors **always** comment on students' inability to correctly deal with simple fractions, algebraic processes, solving equations and negative signs. Year 11 is the year to make sure you know that a minus in front of a bracket changes the sign, that a common denominator will make fractions easier, that collecting like terms is expected and how to correctly take terms from one side of an equation to the other. Many Practice exams will help you fine-tune these details. If you feel you haven't enough exams to practise, ask your teacher, or they can be ordered from outside companies.

- During your practice examinations, read each question carefully, paying attention to the requirement of the final answers such as exact value, the number of decimal places, etc. and check to see whether you have answered all parts of the question. For example, in a maximum/minimum worded question: is the answer the x-value or the volume that is required for the answer?

    Have you labelled coordinates and equations of asymptotes?

    Have you fully answered the question that was asked?

    Have you checked if you can cancel that fraction further?

    Have you drawn a neat and large enough graph that can be read clearly?

    Are you sure you have shown which are open and which closed dots?

    Have you written the domain of the function when defining it?

    Have you shown necessary working out for questions worth more than 1 mark?

    Have you made sure the assessors can see the difference between your 9 and your 7, and your 2?

    Have you made clear what is your final answer?

    Have you attempted every question?

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- Your textbook is not the only resource available so don't limit yourself to it. A new publication for Victoria that came out in 2016 is the Nelson range of textbooks for Units 1 & 2 and 3 & 4 for all of the three Maths streams. The advantage of these texts is that they don't have slabs of writing before the exercises but just concentrate on the main points. They have been written with the student in mind and mostly have exam style questions as their focus. The Units 3 & 4 books have all relevant VCE questions from past years categorised per topic with answers, and how all Victorian students scored on these questions in that year.

- On the day of the examination, make sure that you have all required materials, you have fully charged your CAS calculator or have a spare set of fresh batteries for Exam 2 and that you are well rested. Do not try to complete last minute revision or get involved in stressful discussion with your friends about what may be on the exam.

Good luck with your exam preparations!

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Dates: Saturday 22nd September – Sunday 21st October 2018
Venue: The University of Melbourne