Minimise Study Time
Maximise Scores

VCE Exam Advice – Unit 3 & 4 Specialist Maths

A Specialist Mathematics revision program should commence by ensuring that you know all the mathematics that is listed as assumed knowledge, as outlined in the VCE Mathematics Study Design. 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 Senior Secondary, VCE (Victorian Certificate of Education), Study Designs, click M under Index of Studies, Specialist Mathematics under Mathematics and Study Design under Curriculum.

From the Study Design, students are assumed to be familiar with the key knowledge and skills from Mathematical Methods Units 1 and 2, the key knowledge and skills from Specialist Mathematics Units 1 and 2 topics 'Number systems and recursion' and 'Geometry in the plane and proof', and concurrent or previous study of Mathematical Methods Units 3 and 4.

From the 'Number systems and recursion' topic the following is essential:

- Definition and properties of complex numbers C, arithmetic, modulus of a complex number, the representation of complex numbers as points on an argand diagram, general solution of quadratic equations, with real coefficients, of a single variable over C and conjugate roots.

From the 'Geometry in the plane and proof' topic the following is essential

- geometric objects and relations: point, line, parallel, perpendicular, plane, angle, polygons, circles and semi- circles, arcs, chords, segments, sectors, secants, tangents, similarity and congruence
- The sine and cosine rules
- Students should be familiar with facts such as:
    - the angle at the centre subtended by an arc (chord) of a circle is twice the angle at the circumference subtended by the same arc (chord), in particular the case of semi-circle and right angle
    - angles at the circumference of a circle subtended by the same arc (chord) are equal
    - the opposite angles of a cyclic quadrilateral are supplementary
    - chords of equal length subtend equal angles at the centre and conversely chords subtending equal angles at the centre of a circle have the same length
    - the alternate segment theorem

As well as providing assumed knowledge, 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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In 2020 the five Areas of Study listed in detail in the Study Design are:

1. **Functions and graphs**
2. **Algebra**
3. **Calculus**
4. **Vectors**
5. **Mechanics**

It is really worth the time going through these areas of study, identifying where each section relates to your own notes that you have prepared throughout the year.

Exam Technique

- Use reading time well. You can often begin formulating answers to questions in your head. This is especially true in the case of some multiple choice questions.
- Don't do things that are not required. For example, if you are asked to find the gradient of the tangent to a curve, do not give the equation of the tangent.
- Questions will sometimes specify the form in which the answer must be given. In this case answers must be in this required form. If the form of the answer is not specified, you should perform any obvious simplifications. Some students spend too long simplifying, factorising, rationalising denominators etc when this is not required.
- Make sure that you read questions very carefully. 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.
- Make sure your answers to questions are reasonable.
- 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 include appropriate equal signs and identify which is your final answer (underline, highlight, draw square around…)
- Highlight important pieces of information in each question.
- In questions where units are given, eg seconds, cubic centimetres, etc., make sure all units are consistent. For instance, time could be expressed in both minutes and hours in a question.
- 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, $x = \frac{\pi}{6}$ 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 substituting the answer. What you have to 'show' is the last line, not the first.

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- 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 $x = \frac{2}{3}$ (correct) $= 0.67$ (incorrect).
- 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. Students often forget to label horizontal asymptotes, especially $y = 0$. Make sure that the curves approach the asymptotes, and don't curl away from them.
- Recognise the shape of a region in the Argand plane by the description given, especially know the algebraic equations that result in circles (there are 3 of them), the perpendicular bisector and ellipses.
- 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 addition of ordinates, or reciprocal functions) leave your early stage graphs there. Don't erase them. If needed, use an arrow to point to your final graph.
- Ensure that you are familiar with the Formula Sheet. It is the same for both Examinations. Refer to the formula sheet when doing (for example) trigonometric identities problems. Students sometimes write down and use incorrect formulas even when they are written down on the formula sheet! A quick check is always advisable.
- If you run out of time during Exam 2, 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 $f(x) = ax^m + bx^{-n}$ for $m, n = 1, 2$
- Reciprocal functions $f(x) = \frac{1}{ax^2 + bx + c}$
- Ellipse $\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$ and Hyperbolas $\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$ circles, ellipses, hyperbolas, reciprocal circular functions, inverse circular functions, lines and curves as well as relations and regions in the complex plane.
- 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 where it needs to be).

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- Be able to deduce the equation of a reciprocal or inverse circular function curve once you have been given the graph.
- 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.
- Ensure that you can do the 'arithmetic' involving complex numbers and vectors correctly. Practise converting complex numbers into Polar form, especially where the angles are 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°.
- Know and understand what linear independence means in both 2 dimensions and in 3 dimensions.
- Practise recognising the different methods needed to complete an integration, and then practise completing such integrations getting the calculus correct and the numeric processes correct. Make sure you have the *dx* or equivalent in the integral and that you include "+c" in your answer (unless you are asked for "**an** anti-derivative").
- If you are completing a definite integral using the substitution method, you must change the terminals to match the new variable.
- Know the different types of differential equations that you are required to be able to solve, especially if they are described rather than given as an equation (e.g. the rate at which the temperature changes with respect to the pressure is inversely proportional to the square of the pressure.)
- Be able to use implicit differentiation, the Euler approximation and know how to draw up and use a slope field, both with and without a calculator.
- Ensure you understand what forces will be needed to be included in a described problem or one where the diagram is provided. Is friction to be included, if so, is it the maximum, $F_{\max} = \mu N$, or is it less than this. Does the sum of the forces vectorially add to give zero or do they equal *ma*. Is the acceleration constant (and so you can use the 'Physics' formulas) or is it a variable of *x, v or t*? Know how to deal with 'lift' problems.
- The next step is to work through Examination revision texts such as Specialist Notes (A+), or Exambusters (Cambridge), which provide valuable advice regarding exam techniques and examiner expectations. Make sure that you have the VCAA formula sheet with you whilst working through these questions. There are a variety of other resources, which you and some of your friends who also study Specialist Mathematics may like to share, so that the individual purchase expense is reduced. It can also be helpful to study with a friend, although you must make sure that you stay on task and that you are not relying on your friend to do the thinking!
- When revising, attempt the short-answer questions first. These are technology and note free. 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 and questions are written to test that you can use it efficiently and accurately. The best CAS student is one where you 'pick-up' and 'put down' the CAS with ease and elegance to suit your own skills. This may be different from your friend.
- Work through the multiple-choice questions next and make use of 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 a more efficient method. Learn to solve multiple-choice questions in approximately 2 minutes.

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- As soon as you have finished enough topics, commence working on extended-response 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. 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-response questions are worth nearly half (58 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.

- Reports of previous exams on the VCAA website, written by the chief assessor, are invaluable information as to how to avoid unnecessary and common errors, and achieve the best score possible.

- Complete as many other practice examinations as possible under examination conditions in order to establish an appropriate pace. Use your calculator and Bound Notes for Exam 2.

- Consider whether you will attempt the extended-response questions first or the multiple-choice questions first.in Exam2. Students can be tempted to spend too much time on multiple-choice questions which are only worth 22 out of 80 marks in Exam 2.

- 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, number of significant figures, etc. and check to see whether you have answered all parts of the question. Have you given the correct units in your final answers? Have you labelled coordinates and equations of asymptotes? Have you fully answered the question that was asked? Have you shown necessary working out for questions worth more than 1 mark?

- 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.

. Suggested Practice Examination Papers: VCAA exams | MAV Exams | NEAP Exams | Heffernan Exams | Kilbaha Exams | Insight Exams.

More subject specific advice will be issued to students at our "VCE Exam Revision Lectures".

Good luck with your exam preparations!
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