Mathematics, Extension 1 and Extension 2
Piecing together the puzzle

Studying mathematics is like arranging the pieces in a jigsaw puzzle. You learn about different pieces, and the more pieces you learn about, the clearer the bigger picture becomes. Knowing how to simplify, evaluate, solve, differentiate and integrate is certainly necessary, but paying attention to the links between topics is the way to push your results into the higher performance bands. For instance, knowing that solving a linear equation is the same as finding where a line intersects the x-axis can turn *knowledge* into *understanding*. Understanding mathematics means you can answer any question put in front of you, not just ones you have already seen – in other words, you see the picture, not just the pieces.

Each year the Board of Studies (BOS) publishes "Notes from the Marking Centre" for each subject. They contain invaluable, detailed comments from those who marked the papers, including common errors, methods of solution which were successful in gaining full marks, and examples of how those who could not do a whole question still gained part marks. The Notes, which also contain marking guidelines, can be accessed by clicking the "HSC Exam Papers" link on the top left of the main page of the BOS website (http://www.boardofstudies.nsw.edu.au/).

The Mathematics section of the NSW HSC Online website (http://hsc.csu.edu.au/maths/) has links to tutorials and websites for each topic area of each Mathematics course, examination advice, online mathematics dictionaries and software to help visualise sections of all three calculus-based courses. If you click on the "News" link at the top, then scroll down to "Ongoing Node Information" you can also read previous years' tips on preparing for the Mathematics exams. The main section of the site also has tips for study, note-taking, summarising, time management and memorisation techniques that are particularly useful for mathematics students.

Communicating ideas

To achieve a mark in the highest bands (Band 6 for Mathematics, or E4 for the Extensions) you must be able to communicate mathematical ideas effectively and in an extended way. This means using correct notation, terminology and diagrams to support your answer. If you make an error, cross through it with a single line – markers often use your mistakes as well as your solutions to award you marks. Also remember to show your working as part marks may be awarded for solutions that contain an error or which do not reach a final conclusion.

The examination paper is also attempting to communicate with you – take careful note of the words used as they guide you towards a particular method or type of answer. *Evaluate* or *calculate* means give a numerical answer, whereas *simplify* means to use rules or conventions (such as algebraic, index, surd and logarithm laws or trigonometric identities) to break down a complex expression into the simplest answer, which is often a single term. *Prove* or *show* means you need to write down your solution as a logical sequence of steps – try to imagine you are explaining it to someone else, but in mathematics rather than just words.

Make sure you use your time wisely before the Higher School Certificate examinations begin. Practise past papers under timed examination conditions, somewhere quiet where you won't be disturbed. When you get to the exams, use the reading time to identify questions you can do well, whilst also noting questions that might require more time. Work

quickly through the first few questions (they are usually easier than the later ones), but don't sacrifice accuracy for speed. Pay attention to the marks allocated to each part – they indicate how much work should be shown. Questions that have parts labelled (i), (ii), etc often indicate you may need to use something you did in part (i) in some later part. Write clearly, draw large diagrams in pencil (a whole page is NOT too big) and don't forget the page of Standard Integrals at the back of the papers, which can also be used for some differentiation questions by remembering that differentiation is the reverse operation to integration!

The Mathematics paper

The first few questions usually require you to correctly use algebra, recall formulae and find derivatives and integrals/primitives of simple functions. Write down any substitutions you need to make before calculating the answer. If a question asks you for an answer correct to a certain number of decimal places or significant figures, it is telling you to use your calculator! Remember to write down the entire calculator answer first in case you make an error in rounding, and only round off once you have finished the whole question.

Transcription errors (incorrectly copying information from the paper to the answer booklet) may make it difficult for the marker to award you marks. Do not assume something is true unless either the question says so, or there is information on a diagram which tells you so – if there is neither, you may need to find out for yourself. For example, do not assume a triangle is right-angled or that a sequence is arithmetic just because it looks like it might be.

Seeing the big picture and not just the pieces in the exam paper means that you know things like: a stationary point is where the tangent is horizontal, that to find the rate of population change, you differentiate the population equation and that distance and displacement are not the same thing. Knowing both how to do something and also what it means will certainly help you answer the more challenging questions towards the end of the paper.

The Mathematics Extension 1 Paper

The relationships between ideas, or the way that the 'puzzle pieces fit together', is a common feature of this examination paper. Early questions are still easier than the rest of the paper, and typically involve applying ideas from the Mathematics course that use results from the Extension 1 course – like factorising using the double angle trigonometric results, or differentiating after having used the binomial theorem to expand an expression. Many students can do individual parts, but higher marks come from making the required connections between the parts.

Care must be taken with integrals involving substitution (remember you may need to alter the limits for definite integrals), and also with telling the difference between a permutation (order is important) and a combination (order is unimportant). Questions that ask you to *use* or *consider* a piece of information usually require you to manipulate a given expression via algebra or trigonometry to prove something else.

For circle geometry questions, draw a large diagram in your writing booklet (don't use the exam paper since you take that out of the exam room with you) and use theorems to mark in the sizes of any angles – often this simple technique will help you find what you seek. Then write down the required steps in a clear, logical manner, giving reasons for every step. Assume nothing!

Simple harmonic motion questions often require interpretation of a given situation by "translating" a word question into a mathematical equation. Understanding the practical significance of various derivatives in rate of change questions is essential. For example, if *A* is the area and *r* is the radius then $\frac{dA}{dr}$ refers to the rate at which the area is changing as the radius changes.

The Mathematics Extension 2 Paper

"Many parts in the Extension 2 paper require candidates to prove, show or deduce a result. Candidates are reminded of the need to give clear, concise reasons in their answers to convince the examiners in such questions."

So begin the "Notes from the Marking Centre" each year. The word *deduce* usually means to show something. The word *hence* is also used often – it means "using what you have just done".

For complex numbers, a geometric approach using the Argand diagram is usually easier and more successful than an algebraic approach, particularly with locus questions. Note that complex numbers also appear in polynomials and conics questions, so remember all of the puzzle pieces and look for the big picture. There are many useful resources on complex numbers at the NSW HSC Online site (http://hsc.csu.edu.au/maths/).

Circle geometry questions often involve cyclic quadrilaterals. For mechanics questions, drawing force diagrams from which equations can then be developed is a good starting point.

Listening to the comments from the markers, it is the puzzle pieces themselves which need attention by Extension 2 candidates – careless errors in algebra, forgetting constants of integration, not remembering that complex roots of real polynomials occur in conjugate pairs and not identifying all features of a graph. Time efficient methods gained from practising as many Extension 2 examination questions as possible before the HSC are the goal, since no student wants to be writing pages of algebra only to realise their solution isn't going to work!

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