

# How to study for *Introduction to Algebra*

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Why were A-levels good for you? They taught you basic mathematical skills and techniques and made it possible for you to come to University and study mathematics at a higher level.

Unfortunately, A-levels in Mathematics also inculcated some habits which are quite bad for your further mathematical development. They forced you to learn recipes and procedures for how to calculate things, without much understanding of what is being calculated or why. You were encouraged to learn by template, by emulating the sample solution that was given to you. Once you passed a module, you could safely forget the material associated with it, because A-levels made sure the material would not come up again.

University mathematics is **completely different** and you will have to completely **change your attitude** in order to be successful. You should concentrate on **'why'** and not on **'how'** as before! *Introduction to Algebra* is one of your first 'thinking' modules. It is all about abstract concepts, ideas, **definitions**, **theorems** and **proofs**, and it will make you re-examine everything you thought you already knew.

Moreover, university mathematics frequently calls back on earlier material. Mathematics is built like a pyramid, with the definitions and easy results at the base holding up the hard theorems at the top. Miss (or forget) a block at the foundation level and the whole thing crumbles down.

- **Learn definitions** (and that means **exactly** as they are written in the notes)! They introduce new mathematical concepts and important mathematical language. Trying to do mathematics without knowing definitions is like trying to appreciate Shakespeare without speaking a word of English.
- **Understand!** It is not enough to try to memorise the new definitions or concepts you meet; you must become familiar with them. A better understanding of the concept usually comes through getting to know its properties. This means:
  1. think about it, try to reformulate it;
  2. try to find examples of things which do and do not satisfy the conditions of the definition;
  3. do a couple of exercises related to the new concept;
  4. study a proof of some statement involving this concept.

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Johann von Neumann said: “In mathematics you don’t understand things. You just get used to them.” If von Neumann is right, you are bound to fail to truly understand, but *getting used to* is in reach, so do not give up!

- **Know your notes!** Before trying to solve an exercise involving a concept ‘xyz\*!#’, make sure you open your notes and work around the definition of ‘xyz\*!#’ as above. Otherwise you are trying to do something before you even understand what needs to be done, which is quite impossible.

In this light, tutors will not discuss queries by students who are unable to provide the relevant definitions or locate them in their notes.

- **Work continuously!** The tutorial system is there to support your learning. You should of course exert all efforts to produce a good solution to the problem you’ve been assigned to write up. But you should attempt all the questions on the coursework before the tutorial, and then use the tutorial as an opportunity to learn how to solve the problems that you were unable to do in advance. Turning up to the tutorials without having prepared for them, or worse yet ignoring them, is not going to help you learn effectively!

Never allow yourself to skip over a concept you do not particularly like or understand, since you will not be able to build your ‘mathematical pyramid’ on top of it. You have access to your fellow students, tutors, the lecturer, and other resources; use these to resolve the problem.

- **Understanding vs. memorisation.** Do not try to solve exercises by imitating sample solutions! Instead, you should strive to understand each step (whether it follows by some definition, or some theorem proved in class). If you learn recipes and procedures, you will soon run out of memory, and disappoint yourself when the exam does not follow your templates. By understanding basic concepts, you minimise the amount of memorisation needed: I would argue that a student who understands *Introduction to Algebra* needs to memorise virtually nothing by heart in order to prepare for the exam.
- **Exam?** While a bare pass requires the knowledge of all definitions, statements of the most important theorems and a few ‘recipes’, top marks require a high level of understanding and the ability to prove all theorems.