

- State any general formulae, theorems etc before using them. That way, you should get some marks and be able to gain marks
  - Don't waste time padding out answers. You will get no marks for it
  - Leave a blank space if you get stuck and go back to it at the end.
  - Don't worry about finding the best way of expressing yourself. As long as your answer is clear, coherent and accurate it will be fine. Use diagrams, sketches, graphs (label the axes) as appropriate.
  - Make sure you answer the question actually set, not one you wanted to be set!
  - Analyse each question carefully and plan your answer before you start to write.
  - Do your best question first. This will unfreeze you. Don't spend more time on it that you should - it's easier to score a pass on a short answer than to score well with a longer one.
  - Answer all the questions required, rather than writing perfect answers to only a few.
  - Plan your time: for a 2 hour exam, reading should have taken about 5-10 minutes; allow 15 minutes at the end, and then divide up the rest of the time according to the marks. Use ALL of the time; people who leave early generally fail!
  - When the exam starts, read all of the paper, making a few notes on the paper if you want. Be clear about the rubric, especially which questions are compulsory and how many marks each question is worth. Make sure you haven't missed anything e.g. a formula sheet.
  - Listen to the invigilator's instructions.
- In the exam hall
- beforehand) and proof of identity.

Get a copy of the syllabus to see the whole picture and how things relate in broad terms. Initially you will then almost certainly feel totally overwhelmed by what you have to learn; it may feel like a huge mountain to be climbed, but don't worry about this at this stage - your reaction is normal. As you cover topics, tick them off on the syllabus.

Twenty minutes spent in real study is worth more than two hours spent aimlessly staring at notes and books. Do not read in the hope of finding something useful, but use the index to find exactly what you need. Set specific and time-limited tasks, rather than thinking of study as time to be served. Good task: look up reduction formulae and do problems 3; Bad task: read chapter 5 of ... If you do not achieve a task within the allocated time, stop and ask for help at the next tutorial.

### Lectures

Your lecturers can't teach you anything if you are not there! You must attend lectures; you cannot understand the structure of a course by merely sampling lectures. Lectures are not entertainment requiring little effort from you! Lecturers teach, but only you can learn so pay attention and put away that mobile phone!

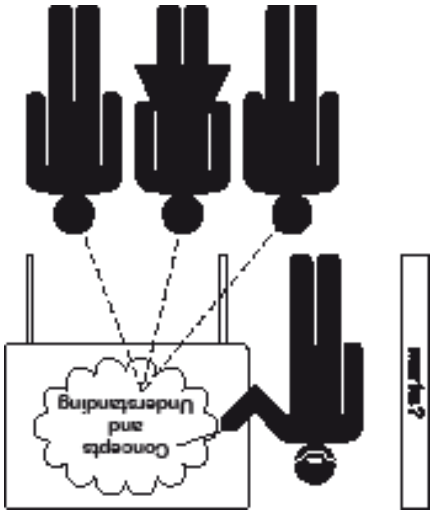
Some lecturers are inspirational, others not. That's life. The 'boring' lecturer is no excuse; the world is full of such people and you'll need to be able to deal with them when you graduate. Being able to take notes and organise them are also essential skills in employment.



**Hassan Zaidi (BSc Mathematics, Nottingham University) writes:** "University study is a lot like sport really! It needs good coaches, regular training sessions and lots of determination to be top of your game."

Pay attention to the lecture's introduction. Lecturers will not mind being asked to slow down, write larger, summarise the main points again etc. Make sure you

**Good study attitudes:** here the lecturer is on the students' side and helps them understand the concepts. With these in place, specific techniques easily follow and passing the exam is not an issue. The result is that students enjoy their studies!



<http://people.brunel.ac.uk/~mastmng/ssguide/sshome.htm>

### Further help

- When the exam is over, forget it, reward yourself(!) and then concentrate on the next one. Don't brood over what might have been.
- Your answers do not have to be long, but they do have to be legible.
- In general, don't cross anything out. Let the marker decide if it's worth any marks.
- If the algebra or arithmetic is getting out of hand, you have almost certainly gone wrong. Stop and check your workings from the start, including if you have written the question down correctly in the first place! If you can't find your error, explain your strategy for finishing the question.
- Show all steps clearly and explain them in short, but complete, English sentences.
- less likely to make mistakes when applying them.

### Study/Employment/Life balance: three lists to make and maintain

1) Prepare a colour-coded weekly study plan. For example, fill in regular commitments like lectures, seminars and workshops (about 15 - 20 hours which you MUST attend) in RED and any paid employment (< 10 hours per week) in BLACK. If you are a full-time student, remember that any paid employment must fit around your studies, not the other way round! Next, block off any travel time in GREY and some time for social, leisure and sporting activities in GREEN. If you have family commitments (in YELLOW), negotiate your study time with your family and make it clear that you are not to be disturbed during study time, e.g. child care or answering the phone. This should leave at least another 15 - 20 hours of "quality" time in BLUE for study which you must use effectively to study topics requiring your full attention. Whilst this does not have to be in office hours, it is pointless to try to start on new and challenging material late at night when you are already past your best. Spread your time **evenly** between your topics. Review your study plan periodically.

2) Make a list of all outstanding tasks and update it every Monday morning. This will show you what you have achieved and help you prioritise. Reward yourself for tasks well done.

3) Make out a plan for the semester as well as the week using a year planner (often found in the front of diaries). Mark in RED class tests and final exams and deadlines for projects and assignments. Try to finalise your work two days in advance, so that you will not fail to meet deadlines by unforeseen circumstances like printer queues or computer crashes. In any case, **HAND IN YOUR ASSIGNMENTS ON TIME**. Do not wait until they are perfect, or even complete - they may never be. Failure to hand them in means missed marks and no chance of helpful correction, feedback and guidance.

### Study

Work and play do not mix; when you are supposed to be working, then work! When you are supposed to be enjoying yourself, do just that and don't spend time worrying about all the work you have to do. Don't waste your time - enjoy it.

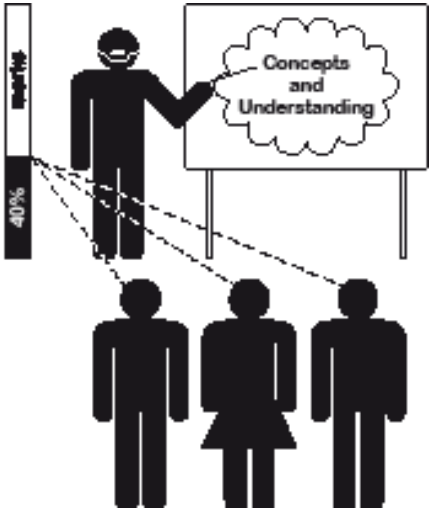
# Study Skills for the Mathematical Sciences

### Introduction

Well done for getting to university! The transition from school to university requires you to take responsibility for your studies and this is not easy. Whilst it's rare to be completely up to date with your work, if you keep your studies under control by using the advice below and quite a lot of self-discipline, life will be a lot more fun overall. Otherwise you'll lurch from deadline to deadline, learn little, get stressed and underachieve.

Your university studies will definitely be hard work, but you should also have fun and develop as a person. Since it's easy to lose momentum, especially when you are feeling fed up (everyone does at some point), write down five reasons why you are on your course.

The staff are your primary resource, so talk to them, especially your personal tutor. Establish communication early by telling your tutor three interesting things about yourself and sending him/her your c.v. Your tutor will help you understand the syllabus/curriculum, including any career implications of choices you might make, and write you a reference. NB you have no choice in this; not asking your tutor or another academic for a reference means to employers that you want to hide something! So your tutor does need to know you and you should cultivate this relationship.



**Bad study attitudes:** the students here are fixated on the pass mark and hence devise short-term strategies to achieve it. Meanwhile the lecturer is simply getting in the way and talking a lot of hot air. The result is boredom and stress!

participate fully and don't be afraid to ask "silly" questions – they are often the best ones to ask.

Maths is a very terse subject: write down everything that is written on the board, and some brief notes of what was said as well. Annotate these notes afterwards with diagrams showing connections between concepts, classes, ideas and techniques. Make sure you understand and can quote formal definitions of all mathematical and scientific terms.

Lecture notes do not read themselves - you will need to study them before the next lecture. Put question marks against things you don't understand and ask in the next tutorial.



*Kim Nolasco (BSc Mathematics, Brunel University) writes: moving away from home it can be quite scary, but don't forget that others are in the same boat. Join a club or two... this is me in the middle of my dance group! You'll soon make new friends and those on your course can be very helpful, especially by discussing difficult topics and helping you catch up with any missed work. Finally, cooking involves more than using a microwave, so learn how to cook a few basic meals!*

Set work

Problem sheets are a big part of your life now so do them – all! This is where real learning takes place. It's quite simple: if you can do most of the set problems, you will pass the exam; if not, you will fail! Be open about your problems at tutorials; the concepts **are** hard, and to understand them you will often go down false trails. This is helpful, even essential, since then you'll understand explanations.

For marked work:

- hand it in on time.
- read the feedback. If you do not understand it, ask your lecturer to explain further.
- don't cheat in any way; you will learn nothing from plagiarising others. If you use others work, reference it and put direct quotes in italics.

For written work

The ability to write good English is vitally important, both at university (especially for major projects) and in employment. If your English is poor, there is no quick fix, but reading a quality newspaper and popular science journals will help. You should also discuss any feedback on projects/essays with your lecturer and attend a Language Centre course if your English is not up to scratch.

Structure is also vitally important: all written work should contain an introduction, a main body, some properly-supported conclusions that you can defend (not a list of afterthoughts!) and possibly some recommendations. Plan this properly before you start writing.

Later in your course you may undertake a major project. This sounds quite scary, but don't be put off by words like original and independent. Usually the final year project is required to be solid, honest and display some originality such as applying a known technique to a new situation; your independence progresses from working closely with your supervisor, to executing the main parts with less help and finally generating your own ideas, planning and carrying them out. Only the very top projects are sufficiently novel to merit publication, but you will learn a great deal from a project, including what it means to do mathematics. It's fun!

There will be clear specifications of what is required, how to include references etc, but see the web site below for additional advice and examples. In particular, an extended piece of work will require 'costing' in terms of the time each item will take, so draw up a Gantt chart early on, including some contingency weeks. Don't delay starting, waiting for that 'inspirational moment' that may never arrive! Leave enough time to write it up properly, paying particular attention to a clear statement of your objectives, methodology, conclusions and recommendations.

Before you get started with a problem, can you:

- specify precisely what the question is asking? Often this involves drawing a graph, picture, diagram or flow chart.
- define all the terms in formulae and equations?
- simplify the problem further before attempting a solution?
- see any symmetry in the problem e.g. what happens if x is replaced by -x, or x and y are exchanged?

When you do get stuck, can you:

- identify what mathematics is involved from your notes and books?
- make any estimates? For example, can you find upper/lower bounds on an integral?
- do sample calculations with numbers or simple functions to see any sort of pattern?
- solve a simpler problem, perhaps by fixing one of the variables, or looking at what happens if z is real rather than complex?
- look at any sort of limiting case e.g. as x gets small or large in comparison to another parameter or variable?
- use a symbolic manipulator (e.g. Mathematica, Maple or Derive) to solve the problem and then consider why the solution is as it is?
- plot a graph of the functions involved to see what's going on (vertical asymptotes, turning points, large x behaviour etc).
- do the problem backwards from the answer to see what you can learn?

- explain to friends exactly what the problem is, and why you are getting stuck? This often results in a solution.

When you have an answer or solution:

- does it work? Substitute your values/solutions back

Giving a talk

Your objective is to communicate, rather than to impress, your audience, so pitch it at a suitable level. Seeking common ground with the audience at the start of the talk will establish a good rapport; they will not mind being reminded of things they already know before going into new material. Give your audience a 'map' of your talk's structure at the start so they know how it fits together. As for written work, make sure you conclude properly.

Plan your talk carefully and start preparation for it early so that you can improve the logic of your presentation by redrafting your first efforts, especially in the light of comments from the audience (critical friends) of a trial of the talk.

NEVER read your presentation from a prepared text - it is extremely boring for your audience and you lose eye contact. Use slides with a few key points to provide you with a visual cue on what to say next. Each slide should take about 3 minutes. Avoid flashy transitions in PowerPoint.

Use diagrams and pictures as much as possible - they convey a lot of information in a short time. Use equations, but sparingly, possibly without all the detail but stressing their overall structure.

Revision

If you have worked consistently throughout your course, exams should hold few fears for you. The purpose of revision is to revise i.e. brush up on topics that you have mastered already, not to cram in new topics and ideas at the last minute.

About 3 weeks before the exams start, draw up an exam timetable and revision plan and stick to it! As for your general work practices, spread your time evenly between your modules. It's very hard to get a mark of more than 90% in any module, but if you get 10% in another, that's only an average of 50% (which is far easier to get for each module). Spreading your time and hence passing all your exams means that you'll satisfy all your course requirements for module passes and avoid resit exams!

- Mark in all exams and assignments in RED,
- block out any time you need for sport, leisure, family

into equations, differentiate indefinite integrals, check AA<sup>-1</sup>, multiply out partial fractions etc

- is your answer dimensionally correct? If not exact, is it quoted to an appropriate level of accuracy (with an error estimate if possible) and in standard form with S.I units (e.g. 3.2 x 10<sup>5</sup> ms<sup>-1</sup>)?
- is it reasonable, both in terms of size and sign?
- if your answer is a formula, can you understand it in the limit of small or large x? Does the solution reflect the symmetry of the problem, if any?

For programming assignments:

- back it up regularly!
- make sure you really understand the structure of the problem and the flow of data before you attempt any actual coding. If you cannot draw an accurate flow diagram for the problem, stop and seek help. Do not attempt to start coding in the hope that something will become clear later - it will not - and any code you do write will be impossible to debug.
- divide the problem into blocks, write subroutines or external function subroutines for them and check each before linking into the main program which should only control the data flow by calling these subroutines and should not contain any calculations. Always check each block with a problem you can solve analytically if this is at all possible and show the results have converged.
- is your code flexible? For example, can you easily alter the function to be integrated, leaving most of the program unaltered?
- make input and output intuitive to users.
- comment you code properly as you write it, not as an afterthought.
- if your program gives unexpected results, write out most or all of the values of the variables to a file for inspection. This often identifies where the errors lie.

commitments etc. in BLACK ,

- if you **MUST** still work, put any ongoing job commitments in using GREEN,
- and then divide the rest of the time **EQUALLY** between your modules and write them in hourly blocks in BLUE, detailing a specific topic for each hour e.g. not 'calculus' but 'series convergence'.

To decide what topics to revise:

- have a good look at the syllabus for each module and some past exam papers. Which are the key areas? Think up questions which might be asked, and answer them in outline form.
- try to cover all the main areas within each topic in the first two weeks. This may seem overwhelming at first, like a huge mountain to be climbed. If you feel it is, then break the module down into separate topics and work on mastering them, without worrying about the whole picture; move on to the next topic the next day. Before you know it, you'll have 6-10 topics under your belt and will be able to pass the exam.

Remember revision involves attempting questions, writing out definitions, proofs, drawing diagrams of connections between concepts, summarising ideas etc. and not memorising your notes.

Whilst working with friends can help, find out when you can get help from staff and attend with your questions written down beforehand.

Go to bed before midnight, get enough sleep and take the odd day off to go somewhere new – don't just hang around campus!

Finally, if a disability entitles you to extra time, take it!

Exams

Before the exams

Check the timetable again to make sure there are no last minute changes. Get a good night's sleep, setting your alarm clock and getting someone to wake you. Eat some breakfast. Arrive 10 minutes before the exam is due to start with pens, allowed calculator (check types