Study Skills in Mathematics

From the Skills Team, University of Hull

Studying maths

Studying maths is different from studying other subjects. A very important part of learning maths is doing problems. Do the work set in good time; don’t leave it until the last minute when there is no time to get help or you may rush and make careless mistakes. The problems help you learn the formulas and techniques you do need to know, as well as improve your problem-solving prowess.

A word of warning - most modules build throughout the semester. You must keep up with the work, falling a day or two behind puts you at a disadvantage. Falling a week behind puts you in deep trouble. If you miss a lecture for any reason make sure you get the notes as soon as possible and get help if you need it.

You will probably find modules will overlap to a certain extent. Many of the ideas hang together. Identifying and learning the key concepts mean you don’t have to memorise as much.

University maths

University maths is different from school/college maths. At University you will cover material at a much faster pace than you did at School/College. In pre-University courses a topic is developed and then usually followed by a period of practice, with your teacher present, to consolidate the learning. Although most University classes have tutorials between lectures, each successive lecture will go on to new material. You are expected to absorb new material much more quickly and may not have set work checked in such detail as you had at School/College.

- Take responsibility for keeping up with all your work. Make sure you find out how to do it. Don’t ignore problems, they will get worse.
- You probably need to spend more time studying per week - you do more of the learning outside class than before.
- Exams may seem harder just because they cover more material.

Study Time

You may know a rule of thumb about maths (and other) classes - at least 2 hours of study time per lecture hour. But this may not be enough!

- Take as much time as you need to do all the work set to get complete understanding of the material. You may find it helpful to find similar examples in textbooks to practice on.
- Work with your friends in an informal study group. You may find it helpful to meet at a regular time each week. Go over problems you’ve had trouble with. Either someone else in the group will help you, or you will discover you’re all
stuck on the same problems. Then it's time to get help from elsewhere such as your lecturer or from the Mathematics Adviser from the Skills Team.

- The more challenging the material, the more time you should spend on it.

**Problem Solving**

**Types of Problems**

As you study Mathematics you will meet more complex problems: in early work, problems often require just one step to find a solution; as you progress you will tackle problems which require several steps to solve them. Break these problems down into smaller pieces and solve each piece - divide and conquer!

**Problem types:**
1. Problems testing memorisation,
2. Problems testing skills,
3. Problems requiring application of skills to familiar situations,
4. Problems requiring application of skills to unfamiliar situations (you develop a strategy for a new problem type),
5. Problems requiring that you extend the skills or theory you know before applying them to an unfamiliar situation.

- When you tackle problems, write out complete solutions, as if you were taking an exam. Don't just scratch out a few lines and check the answer in the back of the book.

- If your answer is not right, rework the problem; don't just do some mental gymnastics to convince yourself that you could get the correct answer. If you can't get the answer, get help.

The practice you get doing set work and reviewing will make Exam problems easier to tackle.

**Tips on problem solving**

In most cases you cannot solve a problem just by looking at it! If you cannot see how to start then you need to use a pencil and paper and try various things.

**Apply Pólya's four-step process:**
1. The first and most important step in solving a problem is to **understand the question**, that is, identify exactly which quantity the problem is asking you to find or solve for (make sure you read the whole question).
2. Next you need to **devise a plan**, that is, identify which skills and techniques you have learned can be applied to solve the problem at hand.
3. **Carry out** the plan.
4. **Look back**: Does the answer you found seem reasonable? Also review the problem and method of solution so that you will be able to more easily recognise and solve a similar problem.

Some problem-solving strategies: use one or more variables, complete a table, consider a special case, look for a pattern, trial and improvement, draw a picture or diagram, make a list, solve a simpler related problem, use reasoning, work backward, solve an equation, look for a formula, use coordinates.
"Word" problems
The term "word problem" has only negative connotations. It's better to think of them as "applied problems".

These problems should be the most interesting ones to solve. Sometimes the "applied" problems don't appear very realistic, but that's usually because the corresponding real applied problems are too hard or complicated to solve at your current level. But at least you get an idea of how the maths you are learning can help solve actual real-world problems.

Solving a Word Problem
- First convert the problem into mathematics. This step is (usually) the most challenging part of an applied problem.

- If possible, start by drawing a picture. Label it with all the quantities mentioned in the problem.

- If a quantity in the problem is not a fixed number, name it by a variable.

- Identify the goal of the problem. Then complete the conversion of the problem into math, i.e., find equations which describe relationships among the variables, and describe the goal of the problem mathematically.

- Solve the maths problem you have generated, using whatever skills and techniques you need (refer to the four-step process above).

- As a final step, you should convert the answer of your maths problem back into words, so that you have now solved the original applied problem.

Tests and exams
(In this section rather than say test/exam each time, they are all called exams)

Preparation
- **Everyday study is a big part of exam preparation.** Revision of any topic should start, no later, than the week after you've been taught it!

- Good study habits throughout the semester make it easier to study for exams.

- Do all the work **when it is assigned.** You cannot hope to cram 3 or 4 weeks worth of learning into a couple of days of study. Doing the work set is the best way to get practice.

Studying for the exam
- Start by going over each section, reviewing your notes and checking that you can still do the work set (actually work through them again). Use any worked examples you have in textbooks and notes - cover up the solutions and work out the solutions yourself. Check your work against the solutions given.
• Put yourself in an exam-like situation, work at problems from review sections at the end of chapters or sample exams (if you can find some) and work to a time. It is important to keep working at problems the whole time you’re studying.

Also:

• Start studying early. Several days to a week before the exam (longer for the final), begin to allot time in your schedule to reviewing for the exam.

• Get lots of sleep the night before the exam. Maths exams are easier when you are mentally sharp.

**Strategies in the exam room**

Just as it is important to think about how you spend your study time (in addition to actually doing the studying), it is important to think about what strategies you will use when you take an exam (in addition to actually doing the problems on the exam). Good exam-taking strategy can make a big difference to your mark!

• **First read through the full paper.** You'll get a sense of its length. Try to identify those problems you definitely know how to do right away, and those you expect to have to think about, possibly grade them A, B, C.

• **Make sure you know how many questions you need to answer.** Are some questions compulsory?

• **Do the problems in the order that suits you!** Start with the problems that you know for sure you can do (the As). This builds confidence and means you don't miss any sure points just because you run out of time. Then try the problems you think you can figure out (the Bs); then finally try the ones you are least sure about (the Cs).

• **Time is of the essence.** Work as quickly and continuously as you can while still writing legibly and showing all your work. If you get stuck on a problem, move on to another one - you can come back later.

• **Work by the clock.** On a 120-minute, 100 mark exam, you have about 12 minutes for a 10 marks question. Starting with the easy questions will probably put you ahead of the clock. When you work on a harder problem, spend the allotted time on that question, and if you have not almost finished it, go on to another problem. Do not spend 20 minutes on a problem which will yield few or no marks when there are other problems still to try.

• **Show all your working.** Make it as easy as possible for the person making the exam to see how much you do know. Try to write a well-reasoned solution. If your answer is incorrect, you will get partial credit based on the work you show.

• **Never waste time erasing!** Just draw a neat line through the work you want ignored and move on. Not only does erasing waste precious time, but you may discover later that you erased something useful (and/or maybe worth partial credit if you cannot complete the problem).
• In a multiple-step problem, **outline the steps** before actually working the problem.

• Don’t give up on a several-part problem just because you can’t do the first part. Attempt the other part(s) - if the actual solution depends on the first part, at least explain how you would do it.

• Make sure you **read the questions carefully**, and do all parts of each problem.

• **Verify your answers** - does each answer make sense given the context of the problem?

• If you finish early, **check every problem** (rework as many as possible from scratch on a separate piece of paper).

**Summary**

**Use all the resources you have available**

• Get help as soon as you need it. Don’t wait until an exam is near or an assignment is due to be handed in. New material builds on previous sections, so anything you don’t understand now will make future material difficult to understand.

• Ask questions as often as you need to. You get help and stay actively involved in the class.

• Visit your lecturers in their ‘office hours’. They like to see students who want to help themselves.

• Ask friends, members of your study group, PASS group or anyone else who can help. The classmate who explains something to you learns just as much as you do, for he/she must think carefully about how to explain the particular concept or solution in a clear way - so don’t be reluctant to ask a classmate.

• All students need help at some point, so be sure to get the help you need.

**Asking questions**

• Don’t be afraid to ask questions. Any question is better than no question at all (at least your lecturer will know you have a problem). A good question will allow your helper to quickly identify exactly what you don’t understand.

• A comment such as: "I don’t understand anything in this topic" is too vague and the best you can expect in reply to such a remark is a brief review of the topic, which will probably overlook the particular thing(s) which you don’t understand.

  o **Good comment:** "I don’t understand why \( f(x + h) \) doesn’t equal \( f(x) + f(h) \)." This is a very specific remark that will get a very specific response and hopefully clear up your difficulty.
o Bad comment: “I can’t do integration.”

o Good comment: “I have difficulty in integrating $\sqrt{x}$.” This may really mean “I’m not sure how to write $\sqrt{x}$ in index form.”

o Good question: "How can you tell the difference between the equation of a circle and the equation of a line?"

o Acceptable question: "How do you do question 17?"

o Better question: "Can you show me how to start question 17?" (which means that you hope that given the start you think you’ll be able to complete it), or, even better "This is how I tried to do question 17. What went wrong?" The focus of attention is on your thought process.

- Right after you get help with a problem, work another similar problem by yourself.

You control the help you get
Helpers should be coaches, not crutches. They should encourage you, give you hints as you need them, and sometimes show you how to do problems. But they should not, nor be expected to, actually do the work you need to do. They are there to help you figure out how to learn maths for yourself.

- When you go for help, have specific questions to ask. You should run the session as much as possible.

- Do not allow yourself to become dependent on others, they cannot take the exams for you. You must take care to be the one in control of tutoring sessions.

- You must recognise that sometimes you do need some coaching to help you through, and it is up to you to seek out that coaching.

- Don’t fall into the trap of copying a fellow student’s work and handing it in as your own. You will be found out! Also you will not learn any maths to help you later in the exam!