MATH STUDY TIPS

ALEXANDER SIMONS AND ALLY NAGASAWA-HINCK

1. How do I study math effectively?

This document is meant to give you some tips and tricks for how to study math effectively. There will be too many things on here for you to do all of it; we encourage you to try some of these techniques and see what works for you. Everyone's brain works differently, and so while most of these study techniques have been drawn from psychological research on how to learn and remember things, each of you will find that certain things work better than others.

1.1. **What should I study?** Before we even get to the how part of studying and learning, you first have to decide *what* to study. The good news: you can use your class structure! Look through class notes, homework problems, and discussion problems. Look at the corresponding textbook chapter(s). While you are doing this, you will find some things that are uncomfortable or make you hope they aren't on the exam. These topics are a great starting point. Remember: your instructor has made conscious choices about what material to cover in lecture and put on homework, and exams are meant to measure how well you've learned the course material.

1.2. **How to study.** The following techniques are in no particular order. We tried to include what each technique is, why it works, and how to apply it to math. Note that these techniques come from the book *Make it Stick*, by Brown, Roediger, and McDaniel. We encourage you to read if you get the chance; doing so will help you become a better, more efficient learner all around.

(1) *Retrieval Practice:* Practice retrieving relevant concepts from your memory, *without looking at your notes*. The process of trying to recall something strengthens your memory of it. Check your notes afterwards, and know that remembering an incorrect answer will not set you back as long as you check your notes and correct yourself.

    What does this mean in practice? Quiz yourself! Flashcards work well for definitions. If you get to a class early and have an extra 5 minutes, try to remember a definition, a theorem statement, or a proof idea. Then check your notes to see if you were right.

    If the course has a practice exam or review questions, first attempt them without notes. If you're stuck, spend at least 5 minutes trying to work through a problem before you look at your notes for a hint. Learning takes effort, and struggling on practice problems without notes helps your brain learn the material. Failure is also a natural part of the learning process–in fact, you will remember something better if you try and fail than if you get it right the first time!

(2) *Interleaved studying:* If there are different topics you are studying, mix it up! Doing one problem from each section/topic then rotating often feels less effective than 'blocking' your practice, but that is because block practice strengthens short term memory without actually sticking well in your long term memory.

(3) *Space out your practice:* Studying a little bit each day is more effective than cramming the day before an exam. This is because spacing out your practice means it takes more effort to remember things, *which strengthens your recall of the material*. It *should* feel more difficult to challenge your memory in this way than to do the tenth practice problem in a row.

(4) *Reflect:* At the end of a study session, think about what you accomplished. Do you feel more comfortable with key definitions or theorem statements? Do you understand a practice problem fully? Do you understand why a practice problem is really hard? Reflecting on what you did to study helps the studying stick in your memory.

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(5) *Elaborate:* Make connections to what you already know and understand. When you read a theorem, find an example that fits the theorem and see why it works. Then find a nonexample (something that doesn't meet the assumptions to apply the theorem, and shows that the theorem doesn't hold if you don't have all the assumptions). What terms are being used in a theorem? Define them. Making these connections to things you already know or understand makes it easier to trace that path in your memory and ultimately remember it.

(6) *Study intentionally:* It's easy to get stressed, anxious, or distracted. If you find this happening, close your eyes and take three deep breaths. Your worth is not dependent on your performance on an exam or quiz. Stand up and stretch. Go get a glass of water. Take a walk. Time is nonlinear: 30 minutes of intentional, focused studying and 30 minutes of doing something to de-stress is often more effective for your learning than an hour of distracted, stressed studying.

1.3. **Mindset.** Remember, math is hard! Learning takes effort, and failure/setbacks are a part of the learning process. Neurologically, the process of making new connections in your brain to remember new material takes time, energy, and effort. If you aren't putting effort into a class and/or you aren't failing at least some of the time, you aren't learning the material very well. (And something that often isn't shared until too late: people who get paid to do math–like your professors–fail A LOT. All it takes is one good idea to write a research paper! No one sees the many ideas that didn't work.)

As much as you can, focus on learning the material instead of a grade. While you study, remember to pause and celebrate what you have accomplished and reflect on what you have internalized through your hard work.

1.4. **During an exam.** You've studied (or not) and now it's time to take the exam. A few parting words for you: take a deep breath. You are a wonderful human, regardless of how any exam goes.

Frame the exam as a way to show what you've learned! Most likely, you wouldn't have been able to understand what the questions were asking before starting this class. Just understanding all the questions proves that you've learned something already. If you're feeling stuck, write down what you know. You can write down definitions or theorems you remember related to the question. If asked to prove something abstract, find an example. Even showing that what you are asked to prove works for your specific example demonstrates an understanding of the material (and more often than not, you'll get an idea of how to prove the general case). You can also write down why/where you are stuck. If you can prove the problem assuming some extra little lemma or fact, then do so (but be clear about what else you are assuming).

You got this!