Math problem solving

Solving problems tests your ability to apply theoretical concepts. You'll need to think theoretically as well as do the calculations to do well in math-based courses.

Helpful habits

Math is about creativity and making sense of the world. It's also about connections and communication. It's not just about getting the right answer. One of the most effective things you can do is to try to shift your thinking---about math and about your own ability.

Spend enough time on your math courses.

- See how you do by putting in 8-10 hours per week on each course (this time includes time you spend in class, labs, etc.).
- Spread out your work; do some math every day. It will add up.
- Keep up with the homework. Concepts later in the term build on the ones from earlier in the term.
- Having trouble managing your time? Make an appointment with a learning strategies advisor; we can help!

Be thorough. Don’t just rush through problem sets.

- Take a systematic approach (e.g., Polya’s problem-solving techniques).
- Read and define the problem first; this takes time, but it’s worth it.
- Look for and understand the underlying concept (the "why" or "big picture") of each question, not just the procedure for solving it.
- Produce a complete and well-reasoned solution, not a superficial one.
- Aim for accuracy before you aim for speed.
- Spend time on challenging questions, not just familiar ones.

Recognize repeat concepts.

- Most math courses ask you to do hundreds of problems, but the problems usually fall under a handful of fundamental concepts that you’ll revisit in different forms over the term.
- Learn to identify and understand these few concepts and their relationships to each other, and recognize them when they take different forms (e.g., how are the concepts similar, how are they different?).
- The learning objectives of a course syllabus often tell you what the key concepts are.

Self-assess and reflect.

- Monitor your thought process while solving problems (e.g., by using decision steps).
• Reflect on how you present your thinking. Is it clear and purposeful?
• Monitor your progress and change course if necessary.
• Use incorrect answers and failures to motivate a change in strategy.
• Ask, “does this make sense?” and, "did I solve the problem/answer the question?"
• Check the reasonableness of your answer.

Don’t give up.
• Expect math to be a challenge and to take time. Keep trying.
• Mistakes are valuable! They aren’t a sign that you’re bad at math; they’re a necessary part of the process.
• Questions are important. Get help when you are stuck. (And take a break when you feel frustrated.)
• Be optimistic. The problem does have a solution.
• Don’t assume you’re not a math person. Everyone can do math at a post-secondary level.

What to do when you’re stuck
Math can be challenging and takes time to master. To keep going, even when it’s difficult, you need to use your resources. You don’t have to figure this out on your own!

• Ask questions: TAs, professors, and peers want you to succeed and will generally welcome questions.
  o If you don’t know where to start with a problem, you can still explain in general what you know about the concept, and what you’re thinking of doing.
  o If you’re stuck in the middle of a problem, but know what to do next, make up an answer for the step you’re stuck on and use it to solve the rest of the problem. Then get help. Your attempt at a solution will get you better feedback from your TA/professor and will mean more than no attempt at all.

• Self-assess throughout your course as an active way to monitor your own understanding. Think about
  o where you need to be (see learning objectives from the course syllabus),
  o where you are now (your background knowledge, past experience, etc.), and
  o how to get where you need to be.

• Use the concept summary and decision steps tools to deepen your understanding and awareness of the key concepts, and to improve your ability to recognize and solve problems related to those concepts.

• Make math more social to boost your skills, motivation, and confidence. Work with others: share resources, talk through solutions, and explain concepts to each other.
• Check out other SASS resources: academic skills resources, subject-specific academic resources, workshops, and appointments.

How to solve problems

Practice problems are for figuring out, and then practicing, new and different ways to solve a type of problem. The process is what matters. Thinking through a problem will deepen your understanding and help clarify the questions you will ask peers, TAs, or profs.

Before you start your homework questions, review your class notes and/or the relevant textbook chapter, and identify the key concepts that they describe. Try working a sample problem from your notes or text, without looking at the solution, to see if you understand the idea. Then try the homework problems:

• Think of problems as a way to communicate, from the problem-setter to you. Ask: what do we know (givens)? What can we do? Are there clues or keywords in the problem that point to a particular concept?
• Try to identify a key course concept that applies to the problem. See our concept summary tool.
• Diversify your thinking; there’s often more than one way to solve a problem.
• Accept mistakes as a valuable part of the learning process.
• Identify where you get stuck and, if you can, why.
• Prepare questions to bring to your TA / prof / help desk.
• Model the problem: draw it, talk it out, use analogies, change something (e.g., the scale), or ask “what if...” as ways to see the problem in a new way.
• Predict/explain as you go, to understand more analytically. See our decision steps tool. Similarly, you can use a two-column approach to your notes: one for the solution steps and one for your explanation of why you’re taking each step.
• Work out loud; notice what strategies you’re using and why.

Problem solving tools

Concept summary

(Fleet, Goodchild, & Zajchowski, 2006)

Concepts are general organizing ideas. A course usually covers a few main concepts, along with their many applications. Key concepts may be identified by:

• reading the learning objectives on the course outline or the course description,
• referring to the lecture outline to identify recurring themes,
• thinking about the common aspects of problems you are solving.

Learn and understand the small amount of information essential to each concept. If in doubt, ask the professor what is important for you to “get.”
PDF: Concept summary. Example of a concept summary for Equilibrium of a Rigid Body (Physics).

Decision steps

(Fleet, Goodchild, & Zajchowski, 2006)

This tool is suitable for use in statistics, accounting, and other applied problem solving situations.

During the lecture or when reading course notes, focus on the process of solving the problem, instead of on the computation. When your professor is lecturing, listen to their comments on how steps are linked from one to another. This helps you identify the decision steps that lead to correct application of a concept. Ask yourself, “why did I move from this step to this step?”

PDF: Decisions steps

Studying

In math-based courses, the goal should be to focus on problem solving, not reading. For example, if you have six hours a week to study, spend one hour reading and five hours doing problems.

Use problem sets effectively

- Do problems to mastery. Once you’ve mastered one kind of problem set, don’t worry if you haven't finished every single problem---move on to the next type, or apply what you've learned in a different context.

- Use the answer key strategically. Avoid looking at the answer key while you work on a problem, but then check to see if your answer is correct.

- Ask for help when you need it.

- Work backwards. For problems where you are given the answer but don't know the starting point, begin at the end and work backwards to undo the problem step by step.

- Use images. What can you draw to help yourself understand and solve the problem? Can you make a mental picture or otherwise visualize this problem?

Study techniques

- Interleaving: Mixing up problem types supports your learning. The aim is to arrange problems so that consecutive problems cannot be solved by using the same strategy. Retrieval Practice has a guide that can help you get started: Interleaved mathematics practice.

- Self-testing (including the range of problems strategy) helps you anticipate different kinds of difficult problems for exam preparation, and solve some practice problems to test yourself. Don't wait until the night before the exam! The more frequently you self-test, the better your learning.

- Explaining to / teaching others are great ways to make sure you’re thinking aloud, describing the problem, and working with others. Use study groups to compare completed solutions to assigned problems. Teaching someone is a very effective learning and study technique.

For more study strategies, see our test and exam preparation section.
Resources


McMaster University’s academic resources website, which features three videos on problem solving:

- **Problem Solver I**, general ideas
- **Problem Solver II**, differences in applying concepts vs. formula chasing
- **Problem Solver III**, applying the Decision Steps strategy