

## Math 184, Fall 2023, Midterm 2 study guide

Details are the same as Midterm 2. Reminders:

- It will take place during lecture, Pepper Canyon 122, on **Monday**, November 20.
- This is a closed-book, closed-note exam. Just bring something to write with.
- Bring your ID.

I think there is enough time in our schedule that the lecture on Friday, November 17 can be used as a review / open office hour for the exam. This is a good opportunity to ask about any details or computations that are still confusing.

### 1. CONTENT

Midterm 2 covers the contents of Homeworks 3 and 4, and part of Homework 5 (the first 2 problems). In the course notes, this is Sections 3.2 through 6.3. In terms of lectures this is October 13–November 6. I will not explicitly put problems related to what was in Midterm 1, but I can't completely separate it either since the material builds on itself.

The actual topics:

- Falling factorials: change of basis to powers (in both directions) and their connection to Stirling numbers (of both kinds)
- Cycles in permutations
- Binomial and multinomial theorems: statement, how to simplify sums
- Formal power series: algebra of FPS (addition, multiplication, derivatives, composition), extracting coefficients of terms, general binomial theorem
- Ordinary generating functions: finding simple expressions for generating function given a sequence (either as an explicit formula or as recurrence)
- Linear recurrence relations: using characteristic polynomial to find closed formula, solving some basic inhomogeneous recurrence relations
- Integer partitions: definitions, basic bijections, partition generating functions
- Getting linear recurrence relations from rational functions
- Catalan numbers and how to deal with “quadratic” recurrence relations

Understanding how to do all of the problems (by yourself, without referencing notes) in the homework is the best way to prepare. All of the problems will be related to something in the homework.

Homework solutions are posted in Canvas, under “files”.

I prefer to emphasize methods and techniques rather than formulas. Of course, remembering formulas is important, but you should think of it as secondary to understanding *how* to solve the homework problems.

You can review the podcasted lectures through the “media gallery” in Canvas.

### 2. STUDY ADVICE

Here are some miscellaneous tips:

- Start early. Generally speaking, spreading out your studying across many days is much more effective than cramming the night before.
- When studying problems, it is best to try to do them without looking at any notes and only look at them when you get stuck. This is the best way to develop intuition.

- Form study groups. I've created a `midterm2` channel on the Discord server to discuss studying and practice problems.
- Try to think up your own problems and exchange with friends.
- Tianyi will have extra office hours over Zoom on November 19 (Sunday). Time and link to be released later.
- Take advantage of office hours to clear up any confusions, no matter how minor.

### 3. SPRING 2023 PRACTICE EXAM

I've posted Midterm 2 from Spring 2023 on the course site:

<https://mathweb.ucsd.edu/~ssam/184/sp23-mt2.pdf>

Some differences:

- That was a 75 minute exam. You will have only 50 minutes, and so the exam will be shorter.
- The schedule was shifted a bit. So it covered set partitions, but not partition generating functions or Catalan numbers, so keep that in mind. Also, we did not go over cycles in permutations last quarter.
- If you want some extra problems for the missing topics, see <https://mathweb.ucsd.edu/~ssam/old/23S-184/practice-final.pdf> questions 10, 24, 25 are relevant.

I recommend working through this old exam only after you have made a serious effort to study the material. You only get one chance to use it to test your level of preparation.

### 4. EXTRA PRACTICE FROM BÓNA

If you want additional practice with the material, I have highlighted relevant exercises from the **4th edition** of the textbook.

All of these have solutions in the book:

- Chapter 4: 3-4, 18-19, 26-28
- Chapter 5: 6-7, 11
- Chapter 6: 3, 5-6
- Chapter 8: 1-2, 5, 8-9, 11

The following do not have solutions in the book. I will not provide a solutions manual due to time constraints. However, I am happy to discuss these problems either in office hours or over Discord.

- Chapter 4: 41, 43-47, 50
- Chapter 5: 22
- Chapter 8: 25-28, 38-40