

MATH 401: INTRODUCTION TO ABSTRACT ALGEBRA

EMILY RIEHL

What is algebra? Is it a branch of mathematics, a method or a frame of mind?

- Igor Schafarevich, *Basic Notions of Algebra*, §1

Instructor:

- Emily Riehl, eriehl@math.jhu.edu, she/her, Wednesdays 3-4:30pm in Krieger 312

TA:

- Hanveen Koh, hkoh5@jhu.edu, she/her, Mondays 11am-12pm in Krieger 201, help room Thursdays 11am-1pm

Lectures: MW 12-1:15, Hodson 211

Section: F 12-12:50, Hodson 203

Textbook: *Groups and Symmetry*, M.A. Armstrong

Course website:

- Grades etc will be posted on the Blackboard website for AS.110.401.SP19 Introduction to Abstract Algebra.
- Problem sets and supplemental materials can be found at www.math.jhu.edu/~eriehl/401

What you can call me. You are welcome to address me as “Professor Riehl,” “Dr. Riehl,” or “Emily.” I use she/her pronouns.

Problem Sets. A problem set will be due each week in class on Monday, with the exception of the first Monday meeting and the Monday after the midterm. At the end of the semester, the lowest problem set grade will be dropped. Late homework will be accepted only with an exceptionally good excuse. If there is a week during which you are simply too busy to turn in the homework on time, do not panic. It’s not a big deal to take a zero one week, especially if it’s just one week, because that problem set will automatically be dropped.

Collaboration on written homework is allowed and encouraged. However, each student must write up their solutions to the problems individually and in their own words, and must acknowledge their collaborators by name on their written assignments. Copying from another student or any other source is prohibited.¹

Class participation requirement. To satisfy the class participation requirement, each student must ask one question or make one comment in class at least once before the midterm and at least once after the midterm. An acceptable question might be: “would you remind us what X means?” or “could you explain why you are using this notation?” I will do everything I can to help everyone satisfy the class participation requirement.

Exam. There will be one midterm exam in class on Monday, April 1 (no joke).

Final paper. In lieu of a final exam, there will be a final paper, that should be somewhere between two and five pages either typeset or handwritten, due in class on Wednesday, May 1.² The paper should take the form of “A letter to X about Y .” Here X is a specific individual or coterie of people with no prior acquaintance with group theory and perhaps little familiarity with abstract mathematics, while Y should be a topic in group theory, either something covered in this course or something outside the scope of this course. For example, “a letter to a housekeeper about the Klein four group” could discuss a schedule for mattress rotation.³ The challenge is to interest your intended audience in the topic you’ve chosen and then to describe it in language that they will be able to understand.

¹Date: Spring 2019.

²The policies of the Johns Hopkins Ethics Guide will apply to this course: <http://e-catalog.jhu.edu/undergrad-students/student-life-policies/>

³Despite the short length, it is recommended not to wait until after turning in the final problem set, on April 29th, to start this paper.

⁴This connection will be explained at some point during the semester.

Classroom Climate. I am committed to creating a classroom environment that values the diversity of experiences and perspectives that all students bring. Everyone here has the right to be treated with dignity and respect. I believe fostering an inclusive climate is important because research and my experience show that students who interact with peers who are different from themselves learn new things and experience tangible educational outcomes. Please join me in creating a welcoming and vibrant classroom climate. Note that you should expect to be challenged intellectually by me, Hanveen, and your peers, and at times this may feel uncomfortable. Indeed, it can be helpful to be pushed sometimes in order to learn and grow. But at no time in this learning process should someone be singled out or treated unequally on the basis of any seen or unseen part of their identity.

If you ever have concerns in this course about harassment, discrimination, or any unequal treatment, or if you seek accommodations or resources, I invite you to share directly with me or Hanveen. I promise that we will take your communication seriously and to seek mutually acceptable resolutions and accommodations. Reporting will never impact your course grade. You may also share concerns with the department chair (David Savitt, savitt@math.jhu.edu), the Director of Undergraduate Studies (Richard Brown, brown@math.jhu.edu), the Assistant Dean for Diversity and Inclusion (Darlene Saporu, dsaporu@jhu.edu), or the Office of Institutional Equity (oi@jhu.edu). In handling reports, people will protect your privacy as much as possible, but faculty and staff are required to officially report information for some cases (e.g. sexual harassment).

Personal Wellbeing.

- If you are sick, in particular with an illness that may be contagious, notify me by email and you will be excused from coming to class. Rather, visit the Health and Wellness Center: 1 East 31 Street, 410-516-8270. See also studentaffairs.jhu.edu/student-life/support-and-assistance/absences-from-class/illness-note-policy
- All students with disabilities who require accommodations for this course should contact me at their earliest convenience to discuss their specific needs. If you have a documented disability, you must be registered with the JHU Office for Student Disability Services (385 Garland Hall; 410-516-4720; web.jhu.edu/disabilities) to receive accommodations.
- If you are struggling with anxiety, stress, depression or other mental health related concerns, please consider visiting the JHU Counseling Center. If you are concerned about a friend, please encourage that person to seek out our services. The Counseling Center is located at 3003 North Charles Street in Suite S-200 and can be reached at 410-516-8278 and online at studentaffairs.jhu.edu/counselingcenter/.

Support.

At key times, it is more useful to take stock of what one knows than blindly march forward hoping for the best. A difficulty at this time signals the need to reread the previous material carefully. *If the mystery persists, that's what office hours are there for.* But typically you should be able to find your way out on your own, based on the information we have given you, and you will most likely learn more this way. You should give it your best try before seeking professional help. -Paolo Aluffi,
Algebra: Chapter 0, §1.3

If you are stuck on a problem on the homework or confused about something that happened in class, my first recommendation is to ask one of your classmates. If they know the answer, you'll give them an invaluable opportunity to reinforce their knowledge by putting it into words. If they don't, chances are you'll be able to figure it out together, and both learn more via the process of self-discovery.

If you need further guidance, my office hours will be held on Wednesdays from 3pm-4:30pm in Krieger 312. Hanveen's office hours will be held on a time to be determined. If you'd rather not wait to see us, the Math Help Room is open from 9am-9pm Monday-Thursday and 9am-5pm on Friday, and I assure you that the graduate students who staff it would much rather talk about group theory than calculus. In particular, Hanveen will be staffing the Math Help Room on Thursdays from 11am-1pm.

Grades. A numerical grade will be assigned based on the following formula:

- 1/10 class participation (full credit received if the class participation requirement is satisfied)
- 1/2 problem sets

totaling 60% of your final grade, plus

- 1/5 midterm
- 1/5 final paper

Schedule. In the first few weeks of the course we will discuss general proof techniques and the rudiments of set theory. For those itching to explore groups and symmetries, I highly recommend checking out “Illustrating Group Theory: A Coloring Book” by alex burke, available here:

www.coloring-book.co

The following schedule is aspirational and subject to change.

- January 28: mathematical statements, logical operations, quantifiers
- January 30: proof techniques, proof by induction
- February 4: sets, functions, bijections, cardinality
- February 6: well ordering principle, ordinals, cardinals
- February 11: arithmetic, division
- February 13: gcd, primes
- February 18: symmetries of geometric things (§A.1)
- February 20: groups, examples (§A.2-3)
- February 25: elementary properties of groups, integers modulo n , order (§A.3)
- February 27: dihedral group (§A.4)
- March 4: subgroups and generators, cyclic groups (§A.5)
- March 6: symmetric groups I (§A.6)
- March 11: homomorphisms, isomorphisms (§A.7)
- March 13: symmetric groups II
- March 25: Plato’s solids and Cayley’s theorem (§A.8)
- March 27: Matrix groups (§A.9)
- April 1: MIDTERM (in class)
- April 3: Lagrange’s theorem (§A.11)
- April 8: partitions, conjugacy classes (§A.12)
- April 10: conjugacy (§A.14)
- April 15: quotient groups (§A.15)
- April 17: homomorphisms, first isomorphism theorem (§A.16)
- April 22: actions, orbits, stabilizers (§A.17)
- April 24: Cauchy’s theorem (§A.13)
- April 29: counting orbits (§A.18)
- May 1: finite rotation groups (§A.19)