Course Overview

Youth Euclid Association

Dennis Chen

§ 1   Overview

§ 1.1   Target Audience

This course is intended for people who have taken the AMCs for the first time and would like to do better next year, or missed the chance to this year and would like to prepare for it next year. Approximate scores on an *official* (not a mock) contest should be around 80-90, though this is a very loose guideline.

Students coming in should at least be interested in math and want to take this course of their own volition. We can teach students how to learn math and instill a greater sense of interest into them, but we are not a machine that inputs students and outputs AIME qualifiers.

§ 1.2   Parents, please read

Please do not send your kids here if they don't want to be here. You'll be doing much more harm than good. My essays allude to "don't force kids to do math" quite frequently: Escape Velocity explicitly states that parents may be some of the worst people to push their kids, Diminishing Returns is about the dangers of premature planning by people who don't know anything about what they're planning for yet,[1] and Whims is about how powerful of a force *wanting* to do something is.

If you're giving your kid a gentle nudge towards math competitions because you think they'd enjoy it and you they're good at math, that's fine. But if your kid is telling you they don't want to do it this summer, or that they just aren't interested in competition math, don't make them do it. See Zuming Feng's MPfG talk, which starts at around the 5:00 mark in the video.

Speaking of overloading, this course is very intensive. I do not recommend signing them up for this class as well as a summer camp while having a tutor teach them writing, or anything similar to that. Even if your kid tells you they can handle it, please at least be aware that what you're signing up for will require hours of work every day. This isn't a supplementary course, this is a somewhat comprehensive and intense look at beginning-level AMC competition questions.

I understand that as with all things, this is a bravery debate. But the parents considering signing their kid up for an AMC class are more likely to need to loosen up and let their kids relax.

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[1] The essay is about kids who do this, but parents do this just as much if not even more. If you want to take a role in helping your kids with competition math, it wouldn't hurt to take a few tests yourself and see what they're all about!

§ 1.3 Philosophy

This course is not intended to teach you everything you need to know to succeed in the AMCs. In fact, I think it's impossible for *any* course to do that. Instead, we aim to teach you some fundamentals and make it easier for you to grow *faster*.

I believe that after you take this course, your abilities will improve by a significant amount. But I believe that more importantly, the speed at which you improve will become much faster if you continue pursuing math competitions. For that reason we place an emphasis on good habits, like writing up clear and succinct sketches/solution to the problems you solve and typesetting in LaTeX.

§ 2 Teacher Bios

§ 2.1 Alex Zheng (molocyxu)

Alex Zheng is a rising freshman and is a member of the AoPS community hoping to help new students learn more about competitive math. Throughout middle school, Alex participated in many mathematics competitions, including the AMC series, AIME, HMMT, ARML, and more. Outside of math, Alex enjoys solving puzzles, playing Tetris, and spending too much time on Discord.

§ 2.2 Dennis Chen (dchenmathcounts)

Dennis Chen is a rising sophomore in the Bay Area. He has qualified for the AIME as an 8th and 9th grader and has achieved a score of 121.5 on the AMC 10B, receiving the Distinguished Honor Roll, and he has qualified for the USAJMO as a 9th grader with a score of 11 on the AIME I.

His works include Proofs in Competition Math: Volume 1 and Volume 2, written with Alex Toller and Freya Edholm and Exploring Euclidean Geometry, Version 2. He also runs the MAST Program for AIME qualifiers looking to improve their score on computational exams.

He runs cross-country and track, enjoys watching psychological thrillers, reading manga, and playing games.

§ 2.3 William Dai (innumerateguy)

William Dai is a rising sophomore who has been active in competition math for the past four years. He has previously made AIME three times, competed in Texas MATHCOUNTS State, was on the 2019 Texas C PuMAC team, and participated in many other mathematics contests. This current year, he made AMC 10A DHR with a score of 136.5 and scored 9 on AIME I. His favorite subject of contest math is combinatorics and he particularly likes elegant recursions.

Aside from contest math, William also has an interest in competitive programming and has made USACO Silver. He also participates in Codeforces contests. In his free time, he likes reading short stories and listening to piano music.

§ 2.4 Ethan Han (youyanli)

Ethan Han will be a freshman in the coming school year. He qualified for both the 2019 and 2020 AIMEs and helped teach AMC 10 classes at the YEA during the school year. He enjoys eating Asian food and listening to classical music as well as learning and doing math.

§ 2.5 Depsilon0

Depsilon0 is a rising sophomore who lives in the Bay Area. He has made AIME 3 times as a 7th, 8th, and 9th grader, and has achieved scores of 120 on the AMC 12 and 10 on this year's AIME II (AOIME). Depsilon0 has also taken a significant number of advanced math courses, including multivariable calculus, linear algebra, differential equations, and (most recently) real/complex analysis. Outside of math, he also enjoys physics, chemistry, and swimming.

§ 2.6 mathgirl199

mathgirl199 is a rising 8th grader. She took the AMC 10 this year, qualifying for AIME and making the Achievement Roll and she received a score of 9 on this year's AIME II (AOIME). In her free time she likes to read.

§ 2.7 Radio2

Radio2 is a USAMTS Perfect Scorer and a rising freshman at the University of Oxford. He enjoys sudoku, Minesweeper, and Latin in his free time, and his ambition is to document all future Reaper games.

§ 2.8 skyscraper

skyscraper is a rising freshman that has qualified for the AIME in middle school, and is teaching at the YEA Summer AMC 10 Course this year. He enjoys reading manga and writing problems in his spare time. (Stay tuned for the July Mathematics Competitions!)

§ 3 Course Structure

§ 3.1 Classes

Each course will have a handout, slides, and a problem set. The handout is meant to be a brief summary of everything discussed in class, the slides will be the transcript of what's typed up live during class, and the problem set is the homework to be turned in by the next week.

The handout will be distributed a week before the live lesson. We highly recommend, though do not require (for any lesson except Lesson 5), that students look at the handouts before class.

§ 3.2 Walkthroughs

In this class, we will utilize many "walkthroughs" in order to help you gain this deep intuition with problems. When going through a walkthrough, try to think about and answer the question on each step before continuing onto the next step. You need to be able to process and do each step. We'll usually do these in class, but we highly recommend reviewing them after class.

For some examples of what a walkthrough will look like, see the Intuition subsection in Pedagogy.

§ 3.3 Further Reading

We have a further reading section for students to peruse, with lots of references. The philosophy behind this *isn't* for students to burn themselves out by going through all of them in very little time. We included references and a further reading because we want the value of the class to last beyond the month or so that they're

taking it, and because we want students to have other resources to turn to while working on the problem sets.

Common resources you'll see mentioned are our Summer AMC Team's official further reading handouts, AoPS Volume 2 by Richard Rusczyk and Sandor Lehoczky, MAST by Dennis Chen, and Exploring Euclidean Geometry V2 by Dennis Chen. All of these are free except for AoPS Volume 2, which we recommend buying.

§ 3.4   Links

Anything highlighted in blue is a link. This includes the lesson number in the title - clicking it will take you to a copy of the syllabus.

§ 4   Lessons

For a full overview of the lessons, please refer to the Syllabus. If you click the lesson number in the title (in this case, "Preliminary - Lesson 0"), you will be redirected to the syllabus.

§ 4.1   Subjects

The subjects in competition math are Algebra, Counting, Geometry, and Number Theory. (These are alphabetically sorted.) Counting is also sometimes known as combinatorics, where combinatorics is usually used for identities, or colloquially as "combo." We will be covering them in that order.

§ 4.2   Lesson 5

This is going to be one of the hardest lessons. The class is generally quite intensive, but this lesson is going to be even more intense than usual.

Some things you'll need to know to be prepared Lesson 5: Unit circle definition of $\cos\theta$ and $\sin\theta$, and (optionally) Extended Law of Sines and Law of Cosines.

§ 5   Course Details

§ 5.1   Times

The class starts on July 6th. It will run for 4 weeks with two classes every week on Monday and Thursday. Here are the times for all of the USA timezones.

Timezone	Local Time
PDT	1:45-3:00 PM
MDT	2:45-4:00 PM
CDT	3:45-5:00 PM
EDT	4:45-6:00 PM

Arizona does not observe daylight savings, so the class will be at 1:45-3:00 PM in their timezone. International students should consult a timezone converter to see when the class is in their local time.

We will be sending the meeting information on Google Classroom beforehand.

§ 5.2   Homework and Grading

After each class, students will be expected to complete and submit a set of homework problems. The problem set will be point based, and the problems will have a wide range of difficulty. The point values correlate to difficulty, but they are actually meant to represent how much *value* the student will get out of solving the problem.

Students are meant to submit **solution sketches**, ideally full solutions. The rule of thumb for how much detail to include is enough so that I know you solved the problem, rather than tried to bluff your way through. For instance, you don't actually need to include the nitty-gritty for calculations, but you should still make it very obvious you solved the problem. This means **explicitly stating the numerical answer** and outlining your method.

Grading will be harsh, and even significant progress will get little credit (0+, instead of 7-). This is meant to mimic olympiad grading, where anything that's not close to a full solution will be "bottom up."

Discussion and working together on the problem set and problems is legal. If you work with someone to solve a problem, you must follow these guidelines:

1. You may not share full solutions to problems or take someone else's solution.

2. You are to work on individual problems together. There is no "I do half, you do half."

3. If you solved a problem with another student, make sure to note this at the beginning of your solution. An example:

   (Solved with Dennis Chen) We claim the solutions are $f(x) = x$ and $f(x) = -x$.

§ 5.3   Payment and Refunds

The class will cost 100 dollars. Please send the money via PayPal to the Youth Euclid Association at

<p align="center">yeaorg17@gmail.com</p>

and make sure you send the payment **as friends**. In the transaction notes, please include the student's name and specify that the payment is for the YEA 2020 Summer AMC Class.

You may drop the class anytime before the second lesson for a full refund. The payment must be made in full before the first lesson.