



HIDDEN DISCOVERIES
AMC/AIME/USAMO
How To

GUIDE TO ALL STUDENTS PREPARING FOR AMC/AIME/USAMO

Prologue from the Author (December 14, 2008)

Hello, to students, parents, coaches, and other visitors reading this document!

First of all, I wrote this document using my experience, others' experiences and statements, and essentially any information that I could find in past four years of math competitions. By no means, this document serves to be complete guide for preparing for AMC/AIME/USAMO. It is simply a compilation of opinions and advices found mostly in Art of Problem Solving website. Because this is how-to, there is really no right or wrong about this document. What I mention here can be total rubbish to some students while it can be significant help to other students. The purpose, then, is to aid at least one student and more importantly, prevent annual question of "How can I do..." Without further adieu, please proceed.

Introduction

Although this document sets information based on Art of Problem Solving website, I put Hidden Discoveries Logo in the title page because *I* spent time researching and typing this document up. Obviously, this document is a rough draft so you will find tons and tons of mistakes. Please let them slide and look at the bigger picture instead.

During the past couple years, I have been a moderator of Art of Problem Solving Forum AMC (American Mathematics Competition) section. I have asked countless questions and saw numerous inquiries of similar type come up. So, this document genuinely tries to be that document that people can get the basic FAQ. The detailed questions, of course, can be addressed in the Art of Problem Solving directly.

Let's Talk

OK, so who am I?

My name is Ji Woong Park, a freshman in Washington and Jefferson College.

Despite my previous stated major of chemistry in previous Hidden Discoveries documents, I am officially biochemistry major (chemistry was just a plan for me). I am enrolled in pre-med program and plan to become a doctor.

More commonly, I am known as Silverfalcon in Art of Problem Solving Forum.

I joined the site when I was in 8th grade (good ol' days) while I was playing around the Mathcounts site. By then, Art of Problem Solving Forum still used HTML codes to type math symbols. There was no such thing as LaTeX (imagine that!), WOOT, and certainly, no MathLinks. Art of Problem Solving Forum was rather a small site back then. It was still an impressive in that epoch but was nothing close to the immense size that it is now. Anyway, not long after I joined, I learned that there was a math contest for high school called AMC. The rest is just history afterwards. So, nothing too interesting...

But I introduced my little anecdote because I want to tell you (readers) that I am just like other student when writing this document. I know that there are awesome books out there to help your problem solving skills (I will mention them, don't you worry ☺) but this is more of a peer guide. Treat this document as your upperclassmen

buddy telling you how to find a date for prom. This document is meant to be humorous and yet educational. The fact that I've been in AoPS (Art of Problem Solving acronym) for moderately long time is used to show that things in the document are highly factual, rather than just random data gathered over past two or three weeks. As I stated earlier, this is not just my opinion but of many others, and I am sure it will be helpful to you.

Mindset

Most of you guys are probably thinking, “Is this guy going to say anything important?” Yes, I am about to do that now. Before I go on to direct mathematical ways to improve problem solving strategy, there is much important objective, which is to fix your mindset. Let us direct toward three questions.

- Do you like to solve math problems?
- Is there any other hobby you rather do than solving math problems?
- Will you be doing math rest of your life?

They are certainly some basic but important questions. I cannot stress this enough.

For those students who are reading this document, do you really enjoy doing math? Or are you just solving math problems to look good on your college applications or just get that award or title of “USAMO Participant”? This is seriously important question.

Solving math problems seems different from other activities but really, there is not much difference. You have to enjoy doing the problems. One peer of mine at AoPS mentioned that he enjoys spending all days just with math! That’s great! If that is your attitude, I do not see a problem. But if you are just doing for the glory, you might get ahead but... you will hate every moment that math will turn away from you, and that is not a good thing. At all.

Back in my high school days, I played video games, tennis, soccer, and lots of other hobbies. I did math competitions too but I had many other things to do as well. One of well-known moderators in AoPS, if I remember correctly, was in cross country in high school. Certainly, he and I are not just two people who have life beyond math. It seems, however, that many younger students and some zealous high school students are only focused on math, math, math. Why? Get out and do something fun. If you are spending your summer just doing math and nothing else, you are not truly enjoying your summer (unless this is what you want to do). Try to have at least one hobby that you like to do other than math. If you do not like sports, I highly recommend reading. Reading is definitely a crucial skill for life, and it does not hurt to rest your math brain now and then.

I knew early in my high school that I loved to do math. Math was just really fun thing to do. But I also had an epiphany that told me that I did not want to do math for my life. It was something that I did for fun – and I did not want to risk my chance of disliking it by making it my job occupation.

Of course, some people love doing math for life. Others are not, like myself. But just keep in mind that you do not know what you will be doing with your life so keep open mind for lots of activities in high school. Who knows? You might one day be

one of the justices in the Supreme Court. Or, you will be that lucky person (I guess, lucky?) to travel to Jupiter for the first time in the history of mankind. Whatever your future may be, math may or may not be the center of it. So, enjoy math, do other things, and keep open mind about life. Do not think that scoring poorly on math competitions will prevent you from becoming someone you want or getting a job that you desire. You never know what you will be.

Problem Solving Skills

Once you have done everything non-math, you are now ready to venture into developing your problem solving strategies. There are two crucial texts for this journey (I sound like college professor in the first day of course now, hehe!) – Art of Problem Solving Volume I and II (with solutions).

For AMC, I recommend Art of Problem Solving I and parts of II. For AIME, it varies, and I am going to quote what Richard Rusczyk, one of two authors of the books, mentioned in the site: “For AIME preparation, rough prioritizing of AoPS Volume II goes like this:

High: 1,2,3,4,6,7,9,13,15,16,17,18,19,23

Medium: 5,10,11,12,14,24

Low: Everything else

& Geometry Chapters of AoPS Volume I”

The importance of geometry, especially even at AMC level, cannot be ignored. One very erudite user in the website said, “Geometry is probably the most heavily weighted topic on math contests in general, so you can’t really do very well if aren’t at least fairly strong in geometry. So if you have limited time, study geometry the most.”

I have seen several, not many, students who are naturally good at geometry.

They are often decent at algebra as well but geometry is what made them stand out most. But for most students, including myself, geometry was the weakest subject for me. I remember reading somewhere that it is ironic that geometry, which is one of the most important subject in the field of mathematics, has only one year in high school curriculum while algebra receives three (at least two). Indeed, it is somewhat perplexing but that is just the way things are. Not surprisingly, many students seem to like algebra better because they know more about it and understand better. Geometry, however, is the weakness.

There is really one “method” for better geometry skills – PRACTICE, A LOT. As with any other material in math competition, you have to practice with very large number of questions to become good at it. There is no easy way to simply become good at it but here are some helpful guides:

1. Art of Problem Solving Geometry Course

This course is extremely helpful. I remember that the first day of class covered about two weeks of my high school math. Yes, one night covered two weeks of high school math. It is an excellent course, and I highly recommend it.

2. Art of Problem Solving Introductory/Intermediate Books

Not just for geometry but for many other topics, Art of Problem Solving publishes

books for specific topics. I never used any of them but I've only heard positive feedbacks from them. So, if you have extra money or Christmas cash that you did not use (assuming this is really what you want to do!), get one of the books. It will help your skills.

All of these books and courses (which include other subjects and include up to Olympiad level) help you to think differently and build experience. I remember reading that some exceptional Olympiad problem solvers know exactly what lines to draw when they see geometry problem. Those lines may not always be the right ones but they usually find the right one after numerous attempts. But to have them explain on how to find the lines is another issue. They simply know how because they had many experiences. It is not one of those things that there are often methodical steps. Another user in AoPS said:

“Knowing the tools is only part of the battle. You must also be creative, playful, calm, and patient. Also, you need lots of experience with solving AIME type problems. The experience comes from practice!”

Bravo! See I was not lying to you. ☺ With both AMC and AIME, one often question is just how much one should study. Does student should focus on doing mock exams every day or just questions on unlimited time everyday or little bit of both? The

answer is yes to some mock exams and yes to some questions. You definitely want to have enough experience in real exam situation. I often ask students to find someone to proctor them because that gives them sense of real atmosphere. But as always, you do not want to get sick of the practice exams so mock exams should occur now and then. It is much more important to build some skills through problems and then do the practice exams. **Remember that you will not always receive better scores on practice exams so do not be discouraged. It happens.** As that guy said, you want to be “creative, playful, calm, and patient.” All of those four adjectives describe qualities of great problem solver.

For higher scores, you can also seek AMC/AIME Problem Series. I’ve been to AMC Problem Series, AIME Problem Series, and AIME Problem Series Seminar (it’s like one day class). All of them are very intense, filled with kids who score 1 to 2 to 14 or 15 on AIME. You cannot just go to class and expect to have your scores raised. It is very pivotal that you spend sufficient time wrestling with the problems and solutions.

Art of Problem Solving Website and Solutions

Continuing with the problem series class, Art of Problem Solving is definitely like the best place in Earth for math. There are SO many things that you can do, starting from just hanging out in the forum to learning some Olympiad level theorems. But wherever you go, expect this: “Be ready to feel slightly uncomfortable at your position.” Many novice users often ask how dumb or stupid they feel once entering the website. They contemplate whether they learned anything in high school because even though they are top of class in their areas, they are below mediocre in the website. For those students, keep in mind that this site has some exceptional students (I am definitely not one of them), and you will and have to adjust to this uncomfortable feeling. As a result, you must never compare yourself to other community members. Just make sure that you did your best and that is all that matters. But really, how can you tell if you did your best? Practice. Always.

Some students come to the website thinking that they will be OK because they did well in middle school. I have heard so many students who ask, “I placed (insert high number) in Mathcounts (national/state) round. Why do I not get high score in AMC?” The truth is that Mathcounts and AMC are two very different ballgames. It is almost like comparing SAT to LSAT or MCAT... You can't. While some high scorers from

Mathcounts end up doing well in AMC as well, that is not ALWAYS the case.

Furthermore, those who do well have practiced enormously to reach where they are now.

So, I recommend people to forget Mathcounts and start a whole new game because everything is different, a lot different.

Solutions are another issue that come up every now and then. Most people think that solutions are just something that you look and go, “Oh, so that is how you do that problem. Okay” or, “Dang, I got that question wrong! Arg!” Etc.. But it is another textbook, not just something to correct your answers for scores. MCrawford, a former administrator of AoPS, mentioned this crucial thing for solutions:

“When reading the full solution for a problem that you did not solve on your own, walk through the solution as if you plan on teaching other students how to solve it *tomorrow*. This will ensure that you ask the important questions such as “how would I have thought to do *that*?”

This is very important! I cannot agree with him enough. I wish I have done more of this in my high school years but I was just too indolent. The temptation to simply treat solutions as a way to correct answers always exists. But, it has a vast importance. Another user in the site made a very stunning point about solutions:

“Make sure you understand the solution to each and every problem. If you have

to, memorize the solutions. As humans, we tend to create trends. Something that worked in one problem will likely show up again.”

So you get my point? Right. Now, what can you do BEFORE you look at solutions deeply? You always want to try the problems you did not answer or get wrong again. You should seek the solutions once you have done everything you could. Only then you will truly understand the solution. Another user is in accord with my view.

“Also, it is usually a good idea to, after the test, try your best to solve the ones you didn’t answer.”

Also, another user spoke:

“Do every problem until you get it right. Even if that means doing the same logic and the same calculations twice.”

This statement, at least in my opinion, applies after you looked at the solution. After you looked at the solution, do the problem again (without looking at your solution) to see if you can solve the problem again. Do the calculations. Do not just think you have the problem down because what usually makes sense by reading can be completely different thing when actually done by hand.

Individual Skill: Speed, Thinking, Etc

For speed, people often recommend Mu Alpha Theta problems because they are short and quick answers. For problem solving skills other than AMC/AIME, ARML is often recommended. More importantly, if you can be part of ARML team in your state, definitely do it! I did this in my sophomore year, and it was one of the best experiences I had for math competitions. It is both surprising and interesting to meet people who are at your age and at same or higher level of math than you. Other additional sources of problems are Harvard/MIT Tournament questions (HMMT), and Mandelbrot questions. There are much more like Lehigh University questions, University of South Carolina Math Questions, North Carolina State Math Questions, and many others. I highly recommend you doing the search once you did all the problems available. Most problems are available in Art of Problem Solving as well.

Just like becoming a better runner, there are stages for you to go through in the training. After Art of Problem Solving Volume II, you have several options: Art and Craft of Problem Solving by Paul Zeitz, Engel book (look up the name of book in the internet), and couple other Olympiad books by Zuming Feng or other renowned trainers. Art and Craft of Problem Solving and Engel have tons of algebra but are rather softer on geometry. AoPS and ACoPS (Art and Craft of Problem Solving acronym) books are

more of AIME (ACoPS can be used for some Olympiad as well) while Engel is often used for Olympiad mainly.

With AMC, there is not really too much you can do. You just have to practice with older exams, and keep doing the problems on AoPS Volume I. Note that, however, AHSME (older name for AMC-12) was much harder in 1980's. Furthermore, AHSME do not measure a correct score for you because AHSME are 30 questions whereas AMC are 25 questions.

With AIME, I am going to cite what MCrawford said, which essentially comes from the idea that doing hard problems help you to prepare for the easier real exam.

“If you get 3-4 on AIME: keep studying AIME problems;

If you get 5-8 on AIME: studying hard AIME and some easier Olympiad level problems (including Putnam)

If you get 9-12 on AIME: study the hardest AIME problems and a lot of Olympiad level problems

If you get +13 on AIME: either working on Olympiad problems or else really bored (hehe!)”

Conclusion and Thanks

I want to first thank many users and administrators for their countless contributions to the forum in the past. Those advices have certainly helped me, and I have no doubt that it did same for other prospective students as well. Art of Problem Solving Forum was not just a website to learn math but it was more of a network that provided a vast of fun. Math no longer existed as just one of the four main academic disciplines in school but rather, it became a lifelong hobby. Certainly, this epiphany would've never happened without the presence of those people.

This document now meets its conclusion. I sincerely hope that this has been a rather helpful experience to readers. There is no easy way to get better at *anything*. My advisor at college said to me, "I tell folks this analogy often about studying. When you practice for athletic game, you practice to win. But the key thing is that even when you do not win, you still continue to practice for the next game, and ones after that." I want to say the same thing to students. You may or may not do well on AMC/AIME but there is always next year (except for seniors but then you have college!). Furthermore, there is life after high school math, and do not ever forget that either.

It has been a great pleasure for me to write this and feel free to comment anything about this article.

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