

2024 Samuel Beatty Report
13th European Girls' Mathematical Olympiad in Tskaltubo, Georgia
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The European Girls' Mathematical Olympiad is an annual math competition for girls from around the world. The contest spans two days, with contestants attempting six problems—three problems each day over a 4.5-hour period. This year, the EGMO was held in Georgia, with 212 students from 54 countries participating. I had the honour of representing Canada along with Yifan (Emma) Tang, Ruojin (Joanna) Xie, and Katrina Liu.

In the month leading up to the competition, our leader Kateryna Tretiakova and deputy leader Kathryn Dou organized several online training sessions. They invited many trainers to give weekly lectures on a wide range of topics in algebra, number theory, combinatorics, and geometry. Kate and Kat also provided detailed feedback on our solutions to help us better prepare for writing clear solutions at the EGMO.

On April 9, our journey to Georgia began! Those of us travelling from Toronto (Emma, Joanna, Kate, and I) enjoyed dinner at the airport then arrived at Paris Charles de Gaulle Airport for a 7 hour layover. During our time in Paris, we walked around and enjoyed the sunshine, played soccer games on the PS5s, and relaxed on the cushions near a large cat sculpture. We also enjoyed some macarons, which were absolutely delicious: I had a tea-flavoured macaron, and a yellow macaron covered in chocolate! Later in the afternoon, we boarded our flight to Tbilisi, where I slept the entire way.

We arrived at the Tbilisi airport quite late. After a 4.5-hour drive, we reached our hotel at around 4 in the morning, with Kate being dropped off at the leader's hotel a bit earlier. Luckily, this was the morning of arrivals day, so we had an extra night of sleep to deal with any jet lag!

We started the next day with a Treasure Hunt. Each team received a map and booklet full of tasks to complete all around a park, and a sticker was provided for each task done. Some teams were running around in order to complete as many tasks as possible: certain tasks (such as putting together a puzzle of the EGMO logo) had many teams lining up to attempt them, so contestants would sprint towards the tasks in order to avoid having to line up for longer. Instead of trying to complete all of the tasks, we chose to focus on completing the tasks in a smaller area. We had fun playing charades and cup pong, fishing for rubber ducks, and carefully constructing tall wooden towers.

After exploring the park during the Treasure Hunt, we put on our opening ceremony outfit: a red blazer and white shirt (making us look a lot like the Canadian flag!), along with a Canadian flag headband. During the opening ceremony, each of the countries went up to the stage carrying a flag and any mascots, with some countries even throwing little mascots into the audience. We also watched Georgian dancing and singing. We loved the performances—the dancers performed impressive jumps, and the singers showcased a wide range of songs with beautiful harmonies and even brought out various instruments.



From left to right: Kate Tretiakova, Katrina Liu, Joanna Xie, Emily Ma, Emma Tang, Kat Dou

The next morning was the first day of the contest. We had breakfast together in the hotel (our hotel had the best pancakes I've ever eaten, and I enjoyed creating designs on them with syrup), then walked to the testing site. After everyone had settled down, we started trying the three problems.

The first problem involved writing integers on a board following a set of rules, and we were asked to characterize all starting pairs such that all integers could eventually be written. After carefully considering various cases, one approach to prove that all integers can be written is to use induction (for example to get the positive integers, if we can write 1, then we can use other numbers on the board to write 2, 3, and so on). Joanna and Katrina earned full marks, but due to missing a key case, Emma and I earned 3 points. Next was a geometry problem that asked us to show that two lines

intersected on a circle. Our team did very well on this question: most of us used power of a point to make a key observation, then finished the problem in various ways (I initially finished the problem using phantom points with an angle argument, which I later rephrased in terms of lengths). Emma, Katrina, and I were able to solve Problem 2, and Joanna earned 5 points out of 7 for proving the main claim. Finally, we were faced with a number theory problem where we had to prove that the greatest common divisor of four “peculiar” numbers was equal to one. Emma earned 4 points for partial progress, and I solved this problem by realizing that this condition meant that at most three “peculiar” numbers could share a prime factor, then using divisibility arguments to limit the number of times a given prime divided “peculiar” numbers.

For the rest of the day, we played card games and solved puzzles with other teams. Meeting girls from so many countries was a great experience, and we loved getting to know everyone while trying out all the activities that were conveniently located in the hotel lobby!

On Day 2 of the contest, Problem 4 was a combinatorics problem that asked us to maximize the number of “interesting” pairs in a sequence. Our team did very well on this question, earning 26 points out of 28 possible points. I spent a while figuring out the right approach for this problem, and I was confused as to why my proof was very close to working for most of the contest. In the last few minutes, I realized that my construction had to be slightly modified in the last bit, meaning I had to quickly rewrite parts of my solution. Problem 5 was a number theory problem involving a functional inequality and greatest common divisors. Although the problem seemed difficult to approach at first, by considering prime powers we were able to make some progress and guess the answer. Then, some of us used induction in different ways based on prime factorizations. We all earned points, with Katrina and I solving it, Emma earning 3 points for missing a case in her induction, and Joanna earning 1 point. The final problem was an extremely challenging polynomial problem, so we were glad that most of us were able to earn a point on it by writing out an expression for the polynomial.

Later, while discussing the problems with other teams, we discovered they also felt that the second day was much harder than the first. We joked that our reaction to the problems could be summed up as “AAA”—just like the problem distribution.

After having dinner at the hotel, we watched a traditional folksong ensemble perform in the lobby. They sang songs from different regions of Georgia, with some slower and gentle, and others fast-paced where they clapped different rhythms while singing. During one song, one of the singers started to dance and several guides, including our

guide Tekla, joined in. Everyone was clapping along and cheering, and we definitely loved watching all the energetic performances throughout EGMO!

We spent the following days going on excursions to Sataplia Nature Reserve and Prometheus Cave. At Sataplia Nature Reserve, we hiked a mountain where honey had been harvested to reach a cave. Inside the cave, we saw beautiful stalactites and stalagmites, and even a rock shaped like a human heart (we were able to touch the water that had accumulated in a small pocket of the rock). Outside, we saw dinosaur models that could move and make noise, and enjoyed a stunning view of the landscape from a glass observation deck. The next day, we walked through Prometheus Cave, where we watched a spectacular display of coloured lights and dramatic music near the end of our time in the cave.



Stalactites in Prometheus Cave

After returning to the hotel from Sataplia Nature Reserve, we enjoyed mocktails in the dining room while watching scores update. Our leaders had worked very hard to get grading and coordination done quickly, so we knew all of our scores and we were instead trying to predict cutoffs with the other girls. Later, we found out that Joanna had earned a bronze medal, and the rest of us had silver medals. In fact, Canada placed 7th out of all countries at the EGMO, which is the best that we've ever done! We tied with Germany overall, and coincidentally Emma and I both tied with girls from Germany.

At the closing ceremony, we received our medals, watched a singing performance, and took lots of photos with other teams. During dinner, we celebrated by taking lots of funny photos and videos, including one of Canmoo wearing all of our medals. We spent the remainder of our time in Georgia talking with and saying goodbye to other teams, while also giving away our awesome headbands!



Photo with the German team after the closing ceremony with our mascots

Competing in EGMO was an incredible experience, as I had the opportunity to tackle creative and challenging problems while spending time playing games and talking with some of the kindest and smartest girls I've ever met. It's truly inspiring to see so many girls working hard and giving it their all on such difficult problems, while creating such a welcoming community. I hope that EGMO can continue to inspire young girls to learn mathematics and challenge themselves!

I'm deeply grateful for the opportunity to represent Canada at the EGMO, and I really appreciate everyone that has supported me:

I'd like to thank my family and friends for always believing in me.

I'd like to thank my teammates—Emma, Joanna, and Katrina—for being so fun to solve problems and explore Georgia with.

I'd like to thank our leaders, Kate and Kat, and for giving us motivational pep talks, carefully grading our solutions both before and during the EGMO, and for making the EGMO a great time for all of us.

I'd like to thank Alex, Derek, Elnaz, Haozhe, James, Mike, Mohsen, Noah, and Victor for creating comprehensive lectures and helping us prepare for the EGMO.

I'd like to thank Dorette Pronk and everyone at the CMS for their hard work and dedication to inspiring young mathematicians by organizing countless competitions, training camps, and teams.

Finally, I'd like to thank the Samuel Beatty Fund for their generous support. Thank you so much for providing the resources for us to have this unforgettable experience!