

2020 Samuel Beatty Report

61st International Mathematical Olympiad

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The International Mathematical Olympiad is the most prestigious high school math competition in the world. Starting as a small East-Bloc competition in 1959 involving 7 countries, it has grown to now consistently include more than 600 contestants from all around the world. IMO 2020 was the 61th IMO in history, and was the first one to be hosted online. Primarily organized by Russia, the competition involved 616 contestants from a whopping 105 countries.

This year, there were 3 returning members and 3 new members of the Canadian IMO team. Thomas Guo and David Tang had both participated in the previous IMO (with this being Thomas' fourth year at the IMO!), and Zixiang Zhou had participated in IMO 2018. The new IMO participants were Edgar Wang, Michael Li, and Eric Shen.

Due to COVID-19, the selection process this year was a bit different. While as per usual the Canadian IMO team selection involved the qualifier exam of the Canadian Open Mathematics Challenge (in November 2019), a team-selection group of approximately 15 people were selected based on their performances in the subsequent Canadian Mathematical Olympiad and Asia-Pacific

Mathematical Olympiad exams. This team-selection group then underwent the new Canada Team Selection Test, which took problems that were shortlisted for IMO 2019, in June 2020. Those with the 6 highest sums of scores on this test and on the previous two Olympiads, were then selected for the IMO team.

This year before the IMO, a similar event was hosted online — the Cyberspace Mathematical Olympiad. The Olympiad, hosted on the Art of Problem-Solving, was an international competition involving an 8-question paper and many fun events. The Canada IMO team, along with two girls who participated in the team selection process for the European Girl's Math Olympiad, made up the team for this competition. In this experience, we were invited to many guest speaker sessions, and got to interact with many of the other countries' team members through online platforms. Through the efforts of our team leaders James Rickards and Matthew Brennan, along with our grader Victor Rong, Canada was able to place at an impressive 9th out of 75 countries, obtaining 5 gold medals, 1 silver medal, and 1 bronze medal. It was a fun mathematics event, and we all enjoyed participating in it.

Then came the IMO training process. Unfortunately, due to COVID-19, the usual summer training camp was not conducted this year. However, due to the delayed date of the IMO, our training process was allowed to be much more elaborate. Hosted over the entire month of August, we spent 3 hours over 4 days each week in online lectures prepared by the team leaders Alex Song and Byung Chun, along with past IMO member Victor Rong. We also took approximately 2-3 mock tests each week, each of which were 4.5 hours long.

The IMO started on September 20, 2020. The Opening Ceremony was conducted online, and included a video from team Canada that had been taken a few days before. There were no events before the competition, so we just took the time to meet with the other teams and prepare a bit for the contest!

The organization of the IMO competition was slightly different this year. Each country had a designated testing center, where all IMO participants in that country would take the test. 5 of our team members, along with a member of the Pakistan team (Muhammad Ahmad Kaleem) all took the test at the Fields Institute, which was Canada's location. One of our team members, Edgar Wang, took the test at the USA testing center instead. At the testing center, everyone was required to socially distance, and we were all proctored by both Canadian invigilators and proctors watching us from Russia through a computer!

Then came the contest. As of the last 30 or so years, the IMO typically involves two 3-problem papers given over two consecutive days. The problems of each day are in increasing difficulty, although the respective problems of the two papers are usually of similar difficulty. These problems are chosen from the topics of Algebra, Combinatorics, Geometry, and Number Theory, and are selected through a rigorous process that involves creating an approximately 35-problem shortlist paper, and then whittling the set of problems down to 6. There is a lot of work to be done here, as usual, it is preferred for there to be a reasonable difficulty gradient along with a good

distribution of problems, and the Problem Selection Committee for the IMO works very hard every year to create as comprehensive and diverse of a paper as possible.

The problems this year were slightly different from the last few IMOs. In particular, we were all surprised to see an inequality problem slotted as question 2 — the first time an inequality had appeared on the IMO since 2012! Inequalities had been growing out of fashion in most Olympiads due to the heavy theory developed to solve them, but this year's unusual inequality (which had reportedly arisen from a research project in statistics!) was less susceptible to said methods. Nevertheless, team Canada performed fairly well with 4 members fully solving the problem. The rest of the problems went relatively well, with every member solving the first geometry problem, and one person fully solving the very tricky third algorithms problem.

But our surprises did not end there. On the second day, we were met with two combinatorics problems (the last problem being combinatorics with a geometric element) — which meant that half the test was combinatorics! We also encountered a number theory problem that day, which was slotted as question 5. The team did fairly well on the first two problems, with everyone solving the fourth problem and 4 fully solving the fifth problem. The last problem was, however, monstrously difficult—indeed, in total only four competitors ended up with the full 7 points on the problem. Despite this, 5 of the 6 members were able to make quite a bit of progress, earning a point for their efforts.

After the stressful contest, we were able to relax a little bit with the events! While many of the events were held at around 4AM EST, we were still able to participate in some of the events in the morning, such as the guest interviews! We also had the opportunity to interact with many of the IMO teams of other countries through the platforms of Discord and WhatsApp. With our virtual guides, we played many games together, such as a few word games and a Kahoot about St. Petersburg. While we were all initially disappointed that we could not go to St. Petersburg in real life, the virtual events were very fun as well and the organizers did a terrific job.

During this period, our team leaders worked hard to help out our team scores. This process, called coordination, involves each country's team leaders negotiating with the coordinators from Russia to determine what scores each student should get. This year, our team leaders Alex and Byung helped us tremendously—through their help, Team Canada got many more points than expected, with two students earning about half of the points on problem 3 without fully solving it. This helped Canada immensely — we ended up 12th out of 105 countries, with three gold medals, one silver medal, and two bronze medals. This tied 2012 for Canada's best performance in terms of medals, and also gave us one of our best rankings in years.

The award ceremony was hosted on September 28, 2020. We got to meet all of the teams in little videos again, and watched as all the medalists were shown. While we were all a bit sad that the event was now over, this would not be our last goodbye — indeed, through our new online platforms all the IMO team members still interact with each other months after the competition. Nevertheless, I wish them all well in any future endeavors they may have, and hope to meet them someday.

As someone who has done math competitions for the majority of my life, making the Canadian IMO team has been incredible to me, and I am immensely grateful for the opportunity. I would like to thank all the trainers, leaders, and organizers from Canada and around the world. I would also like to thank the Canadian Mathematical Society, along with all the Sponsors, including the Samuel Beatty Fund and the University of Waterloo. Thank you all very much, for making this amazing experience possible.