

2019 Samuel Beatty Report

60th International Mathematical Olympiad in Bath, UK

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The International Mathematical Olympiad is the pinnacle of high school math competitions. It started in 1959 with only seven countries, and now more than 100 countries participate in IMO each year. In fact, the 2019 IMO is record-breaking, with 621 contestants from 112 countries coming to the United Kingdom to participate.

This year, there were 4 returning members and 2 new members on the Canadian IMO team. William Zhao, Victor Rong, Thomas Guo, and Howard Halim are returning members, with a combined 8 previous IMO medals between them. Sebastian Jeon and David Tang are first-time IMO participants. These individuals were chosen based on their scores in the following three Olympiads: the Asia-Pacific Mathematical Olympiad, the Canadian Mathematical Olympiad, and the United States of America Mathematical Olympiad. The students had to qualify for these contests through the Canadian Open Mathematics Challenge held in November 2018.

The training camp took place from June 30 to July 13. The Mexican team joined us for training. The University of Waterloo generously provided accommodations and food. We had rooms in St. Paul's residence with a quick elevator trip taking us either to the classroom on the ground floor or the cafeteria in the basement. Also located in the basement was a games room with ping-pong, pool, and foosball tables.



Every day, we had 1-2 lectures from many past IMO contestants. The Canadian trainers, Matthew Brennan (Leader), James Rickards (Observer A), Sarah Sun (Deputy Leader), Byung Chun, and the Mexican trainers, Daniel Perales, Juan Carlos Ortiz, Adan Medrano, Enrique Treviño, David Cossio, gave lectures on all four main math categories: Number Theory,

Algebra, Combinatorics, and Geometry. In addition to the lectures, we did a mock Olympiad exam every other day that simulates the actual conditions during the IMO.

After the lectures, we had free time as a team. Together, we played card games like Coup, board games like Codenames, and a word game called Contact. On some days, we went out to play basketball at the basketball court or ultimate Frisbee on a field near the residence. On Canada Day, we went to watch fireworks at Columbia Lake near the University of Waterloo.

On July 5th, we went on a full-day excursion to the nearby city of Toronto, the largest city in Canada. We went up the CN Tower, which used to be the tallest freestanding structure in the world. From there, we got a beautiful view of the entire city. Then, we took a ferry to Center Island for a picnic. By the time we returned at 9 pm, all of us were exhausted.

On July 13th, we took an overnight plane flight to London Heathrow, which allowed us to sleep on the flight to minimize the jetlag. Then, we had an eventful day exploring the beautiful city of Bath, including The Circus, which was just a circular roundabout. The opening ceremony took place in The Forum, an auditorium in the centre of Bath. During the ceremony, we had a flag parade, where each country takes its flag and walks up on stage.



After a good night's sleep, it was time for the contest! The format of the IMO is a full-solution two-day contest, with three challenging questions to be done in 4.5 hours per day. Each question is worth 7 points, awarded for both the right answer and a rigorous proof, so the entire contest is out of 42 points. These questions span across the four main subjects of math: Number Theory, Algebra, Combinatorics, and Geometry. Each subject has a shortlist of around seven problems and the IMO jury voted on which problems to put on the contest.

Since recent IMOs usually didn't have a geometry question for problems 2 or 5, we were all surprised to see that problem 2 was a geometry problem. There were many different solutions

to this problem, and only two members of the Canadian team were able to solve it. Problem 1 was a straightforward functional equation and all of team Canada got full points on this question. Problem 3 was a very difficult graph theory problem. Only 28 solutions to this problem were awarded all 7 points. Only one member of the Canadian team got points on this problem.

On Day 2, Problem 4 was a Diophantine equation involving factorials and powers of two. Most members of the team were awarded full points for this problem but one person, unfortunately, lost 3 points due to not checking a few cases. Problem 5 was a combinatorics problem that felt really similar to a problem on AIME. All members of our team were awarded 7 points on this problem. The last problem was a geometry problem. It was the most difficult problem on the exam this year, with only 27 people getting all 7 points. Only two people on our team were able to get points on this problem.

After the contest, the contestants were able to rest. We went on a comedy tour to explore the historical city of Bath. Then, we went on an excursion to Stonehenge, a famous English landmark, and then the city of Salisbury to see the cathedral, which contains the best-preserved copy of the Magna Carta. At night, we played Avalon and other card games, and speculated about medal cutoffs and our team's placing.

While we were having fun, our leaders were busy doing coordination. They had to negotiate with the problem coordinators over how many points our solutions deserved. Due to their diligent efforts, our team was awarded 1 gold, 1 silver, and 4 bronze medals. This placed Canada at 24th place out of 112 countries with 144 points. USA and China tied for first with 227 points and South Korea was a close third with 226 points.

During the Closing Ceremony, we were awarded our medals and socialized with other teams. We gave out pins and received many souvenirs from other teams. At the farewell banquet, the realization settled in that this would be the last year of IMO for four of our team members. Although these brilliant students will not be able to participate as contestants in the next IMO, I hope they come back as trainers and wish them luck in their future endeavours.



The International Mathematical Olympiad was a contest that I dreamed for since middle school. I feel honoured to be part of Team Canada this year and had the time of my life during training camp and the competition. I would like to thank all the trainers, leaders, organizers, the Canadian Mathematical Society, and sponsors such as the Samuel Beatty Fund and the University of Waterloo, for letting me and other high school students have this unforgettable experience.