Report on the
53rd International Mathematical Olympiad

Mar Del Plata, Argentina, July 4-16, 2012

Wong Yan Loi

The Singapore National Team to the 53rd International Mathematical Olympiad in Mar Del Plata, Argentina consists of the following members:

Team Leader	: Wong Yan Loi	(National University of Singapore)
Deputy Leader	: Ng Boon Leong	(Anglo-Chinese Junior College)
Contestants	: Lim Jeck	(NUS High School of Mathematics and Sciences)
	Ang Yan Sheng	(NUS High School of Mathematics and Sciences)
	Kor Chong Luck Ryan	(Raffles Institution)
	Lee You Jun	(Raffles Institution)
	Li Er Lu Lawrence	(Raffles Institution)
	Ling Yan Hao	(NUS High School of Mathematics and Sciences)
Observers	: Teo Teck Kian Thomas	(Raffles Institution)
	Chiam Jia-Han	(Observer sponsored by MOE)
	Low Tian Wen Daniel	(Observer sponsored by SMS)

The IMO

The pinnacle of high school mathematics is at the level of solving the competition problems of the International Mathematical Olympiad (IMO). The IMO was first launched in the year 1959 with the aim of promoting exchange in high school mathematics and to honor those students who have outstanding performance and talent in elementary mathematics. The 53nd IMO was held in Mar Del Plata, Argentina from 4th to 16th of July, 2012. The contest lasted for 2 days. Each day, 3 problems were to be solved in 4.5 hours.

Singapore's Participation in the IMO

Singapore had its first participation in the IMO in 1988. Since then, Singapore has been actively involved in training and selecting students to participate in the IMO. Each year about 20 students are selected for the national team training a year before the IMO. Students are then trained by the past IMO contestants. After 3 rounds of selection tests in May, 6 students are selected for the national team. The final phase of the training consists of a training camp in June and an additional 2 weeks of in-camp training at NUS High School of Mathematics and Sciences. The 2 weeks of in-camp training enables the students to free from their school commitment and focus their effort on the training. Training continues during weekdays at NUS from 9AM to 5PM until a few days before departing to the IMO.

The Jury

The jury is formed by the leaders of this year's 100 countries chaired by Juan Carlos Dalmasso of the host country. The primary job of the jury is to select the 6 competition problems from a book of short-list of problems, ranging from 4 main topics - algebra (A), geometry (G), combinatorics (C) and number theory (N).

At the meetings, the jury proposed and selected the problems by means of a systematic elimination and voting procedure. The jury first selected 2 easy problems, followed by 2 hard problems and finally 2 medium problems. In the end, two algebra problems (A1, A3), 2 geometry problems (G1, G5), 1 combinatorics problem (C6) and 1 number theory problem (N7) were selected. The problems for each day were then decided to be G1,A3,C6 for the first day; and A1,G5,N7 for the second day in this respective order. Next, the problems were translated into German, Russian, French and Spanish. Based on these, individual country translated the problems into their own country's language.

The Competition Problems

My (initial) assessment of the 6 chosen problems is that: problem 1 (G1) and problem 2 (A3) are easy and straightforward; problem 4 (A1) is very tedious and students may take quite some time to finish and this may affect their performance of the later problems; problem 5 (G5) is not too difficult and could be straightforward too; problem 3 (C6) is a very hard combinatorial problem - probably the hardest in recent years; and problem 6 (N7) may not be as hard as it is.

Assessment of Answer Scripts

On each day after the contest, the leaders were given the answer scripts of their own students. I went through the answer scripts of our students carefully aiming to achieve as many points as possible. Everyone should get full mark for problem 1. For problem 2, four of our students got it easily. You Jun tried to prove a stronger inequality and did not manage to complete the final step. Yan Sheng used a harder approach which we could only complete it using analytic method. Lim Jeck was very impressive. He solved problem 3 completely. Ryan also solved the first part of problem 3, and Lawrence would get 1 mark for solving a special case of the first part. Our performance for the first day was quite alright.

For the second day's competition, all except You Jun got the solutions of problem 4. However, all except Lim Jeck could lose 1 to 2 marks in problem 4 as they did not verify the solutions. For problem 5, an initial assessment showed that only Lim Jeck and You Jun solved it. Ryan had some progress and should get some partial credits. Yan Sheng's solution using inversion was extremely sketchy. It took me and Daniel quite some time to understand and figure out his solution. Because it was extremely sketchy, we were not sure how many marks we could get. Only Lim Jeck solved problem 6. In fact he had a very simple solution.

(See Lim Jeck's solutions on Page 55-60)

Result and Coordination

The assessment of the answer scripts was done by Daniel, Jia-Han, Boon Leong and myself. The coordination involved presenting the solutions if necessary and getting the agreement with the coordinators of the host country for the proposed marks of the problems awarded for each student.

The coordination of problems 1, 3 and 6 were smooth and we got the marks we proposed. For problem 2, we managed to show the coordinators that You Jun's approach would lead to a solution though he did not complete it. In the end, You Jun got 6 marks for problem 2. However for Yan Sheng's problem 2, his work only translated to a restatement of the problem. Though we were able to complete it with analytic method, the coordinators did not agree to give mark to his work. In the end he only got 1 mark.

For problem 5, we explained to the coordinators about Yan Sheng's solution by inversion. In the end we got 6 marks for him. His solution was too sketchy that basically all arguments were based on figures that he drew.

For problem 4, we encountered the same problems as many other countries did because of the lack of evidence in verifying the solutions by our students.

Finally, we finished the coordination of all the 6 problems and our total mark was 154.

Final Jury Meeting

The chairman gave a report on the result of the competition. The guidelines for awarding the prizes are: about 1/2 of the total contestants will get a medal; and the number of gold, silver and bronze medals will be approximately in the ratio 1:2:3. Based on these guidelines, it was proposed and approved that the cut-off for gold was at 28, for silver at 21 and bronze at 14. Singapore gets 1 gold, 3 silvers, 2 bronzes and ranked 7th among 100 countries. There were a total of 51 golds, 88 silvers, 138 bronzes and 148 honorable mentions awarded to 548 contestants. Detail results can be found at the end of this report and at the IMO official website.

Among the 6 problems, problem 3 is very hard, only 8 contestants can solve it. Problem 6 is still a hard problem and 10 contestants solve it. Surprisingly, problem 2 and 5, are not so easy as contrast to what I predict. Problem 4 is tedious and is more controversial. We did very well in the 2 easy problems. In the end the result is good for Singapore as we are still ranked 7th. Lim Jeck is of course very impressive. He obtains the first Singapore perfect score in IMO and is the only one in this IMO. He is ranked first in this competition.

The IMO Advisory Board Meeting

The IMO advisory board gives advices and coordinates the organization of the IMO. The current chairman is Nazar Agakhanov who is also the team leader of Russian Federation. This year, two positions: 1 secretary and 1 member, are open for election. Gregor Dolinar of Slovenia is elected to be the secretary of IMO advisory board. Rafael Sánchez

of Venezuela is elected to be a member of IMO advisory board. It is reported that IMO 2016 will be hosted by Hong Kong, and IMO 2017 by Basil.

APMO

The APMO meeting was held in the evening of 19 July 2012 and was chaired by Ito Yuji of Japan. The dates of the APMO 2013 were decided to be in the afternoon of Monday 11 March 2013 for countries in North and South Americas, or morning of Tuesday 12 March 2013 for countries in Western Pacific and Asia. In the meeting Kazakhstan, Japan and New Zealand were appointed as the senior coordinating country, assisting coordinating country and the moderating country respectively. The new chair is Prof Nargozy Danaev of Kazakhstan.

Concluding Remarks

Overall I am pleased with the performance of our team at this Olympiad though some of the contestants could have done better. It is an outstanding performance of the Singapore team. Lim Jeck's perfect score is impressive. I received congratulations from friends and colleagues about his brilliant performance.

Each year the IMO gives me a chance to make new friends as well as to meet old folks. It provides an opportunity to build up our connection, to exchange ideas and training methods on Math Olympiads with other countries. We can see there are great improvement from other teams which are weaker in this competition in the past. To maintain and catch up with our performance, we must work harder and search for a wide pool of talented students. The training for this year like last year pin-points and focuses on some of the weaknesses of the individual student and is a key factor in the improvement for this year's good result also thanks to the 2 dedicated trainers Jia-Han and Daniel. The additional 2 weeks of in-camp training at NUS High School of Mathematics and Sciences enables the students to focus on the training, and free them from any distraction.

		1	2	3	4	5	6	Total	Rank	Rank(%)	Award
	Singapore Team's Results										
Lim Jeck		7	7	7	7	7	7	42	1	100.00	Gold
Ang Yan Sheng		7	1	0	6	6	0	20	140	74.59	Bronze
Kor Chong Luck Ryan		7	7	3	6	4	0	27	52	90.68	Silver
Lee You Jun		7	6	0	2	7	0	22	96	82.63	Silver
Li Er Lu Lawrence		7	7	1	5	0	0	20	140	74.59	Bronze
Ling Yan Hao		7	7	0	6	3	0	23	85	84.64	Silver
		42	35	11	32	27	7	154	7	93.94	G,S,S,S,B,B

There are 548 contestants from 100 countries.

Further result can be viewed at the official website:
http://official.imo2011.nl/team_r.aspx?code=SGP&year=2012

Team photos taken during the closing ceremony
in the Auditorium Theater From left to right:
The guide, Leader: Wong Yan Loi,
Observer: Chiam Jia-Han,
Contestants: Kor Chong Luck Ryan, Ang Yan Sheng,
Lee You Jun, Lim Jeck, Ling Yan Hao, Li Er Lu Lawrence
Observers: Low Tian Wen Daniel, Teo Teck Kian Thomas.

The contestant Lim Jeck from Singapore who has
a perfect score and is ranked 1st.

The author is an Associate Professor at the Department of Mathematics, National University of
Singapore, and the Team Leader of the Singapore IMO 2012 Team.