

# The International Tournament of Young Mathematicians

## REGULATIONS\*

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### 1. The language

The working language is English.

### 2. The teams

- a. Each team represents one country. However, the Organising Committee (OC) reserves the right to accept more than one team from the same country.
- b. The team is composed of 4, 5 or 6 high school students and headed by a captain chosen among the students.
- c. The team is accompanied by one or two team leader(s).

The team leaders have to register their teams by sending an email to [oc@itym.org](mailto:oc@itym.org) until **May**. An official invitation will be transmitted shortly after the registration.

### 3. The problems

The list of 9-12 problems is selected by the OC and published on the website <http://www.itym.org/> in **March-April**.

The problems for the ITYM are estimated as difficult, containing parts with no known solution. The participating students are supposed to solve them by themselves, working with other members of their teams and supervised by their team leaders and teachers.

Conversations with individual mathematicians are allowed. However, public collective help (such as internet forums) is not allowed and any cheating team may be disqualified from the tournament by the OC.

### 4. Preliminary written materials

The teams should type their intermediate solutions and send the preliminary written materials to [oc@itym.org](mailto:oc@itym.org) **before the date indicated by the OC**. Note that after sending the preliminary materials, teams may continue working on the problems and make modifications until sending their final materials (see section 5).

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The preliminary materials will be checked by experts, and the teams will be ranked according to the quality of their materials. The division into Groups for Round 1 will be made by the following rule. If, for example, there are 15 teams ranked from 1 to 15, then the groups will be

Group A	Group B	Group C	Group D
1	2	3	4
8	7	6	5
9	10	11	12
	15	14	13

Files with extensions PDF are accepted, a separate file per problem, named in the following manner: “**Team-ITYM2017-ProblemN-prelim.pdf**”. There is a **30 page** and **5 MB** limit per problem (**A4, 11pt**). The pages should be numbered.

The first page of each file should contain the number and the name of the problem, the name of the team, the authors and an abstract (a brief summary of results and methods, about  $\frac{2}{3}$  of the page). A model for the first page:

<p style="text-align: center;"><b>Problem 4: A Baby Chess</b></p> <p style="text-align: center;">Team: <i>France 2</i></p> <p style="text-align: center;">Authors: Ivan Ivanov, John Johnson</p> <p style="text-align: center;"><b>Abstract</b></p> <p style="text-align: center;">In this paper we classify the winning strategies for the first player in the case...</p> <p style="text-align: center;">1</p>
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## 5. Final written materials

The teams should type their solutions and send their final written materials to [oc@itym.org](mailto:oc@itym.org) **four days prior to the tournament**. It is not required to send solutions on all the problems. However, at least **six** problems must be investigated.

Files with extensions PDF are accepted, a separate file per problem, named in the following manner: “**Team-ITYM2017-ProblemN.pdf**”. There is a **30 page** and **5 MB** limit per problem (**A4, 11pt**). The pages should be numbered. The first page should be presented according to the model above.

**These and only these written materials will be discussed during the tournament and no text editing will be permitted.** An exception is in the case of correcting minor errors, which should be mentioned during the presentation. Moreover, during his/her performance the Reporter (section 9) is only allowed to present:

- parts of the written materials with no modification, e.g., exact statements with their original numberings, figures and diagrams;
- sketches of solutions and proofs, and ideas used in the written materials.

All paper and electronic sources (books, articles, etc.) directly involved in proofs should be mentioned in the end of the written materials. For instance, if the team uses an already known and non-obvious result, the result must be stated explicitly and a reference must be provided with citations where it is involved in the solution.

## 6. The Jury

The Jury for the Rounds and the Final is nominated by the OC. The Jury consists of at least five members and may include team leaders. The team leaders cannot be members of the Jury in the Group where their teams participate.

## 7. The structure of the ITYM

The ITYM consists of a **Quiz**, two **Rounds** and the **Finals** (Grand and Small).

The **Quiz** is a written test of 2 hours. The aim of the quiz is to check team's understanding of the problems of the ITYM, competence in involved mathematical fields and solving skills. It consists of 3 questions for each of the problems: a theoretical question, a particular case of the problem and a question indirectly related to the problem (deviation or generalisation). Each team (high school students only) is gathered in a separate room and works together. Written materials, electronics, literature or other sources are *forbidden* during the quiz, as well as any external help.

In each **Round**, the teams are divided into groups of 3 or 4 (see also section 11). In the **Finals**, there can be 3, 4 and 5 teams selected after the rounds.

Group or Final of 3				Group or Final of 4				
	1st stage	2nd stage	3rd stage		1st stage	2nd stage	3rd stage	4th stage
Team 1	<b>Rep</b>	Rev	Opp	Team 1	<b>Rep</b>	Obs	Rev	Opp
Team 2	Opp	<b>Rep</b>	Rev	Team 2	Opp	<b>Rep</b>	Obs	Rev
Team 3	Rev	Opp	<b>Rep</b>	Team 3	Rev	Opp	<b>Rep</b>	Obs
				Team 4	Obs	Rev	Opp	<b>Rep</b>



## 9. The roles

**The Reporter** presents the main ideas and results obtained while solving the problem. The presentation should be based on the written materials (see section 5). Black or white boards, a laptop and a projector will be available so that the Reporter may use slides. One of the main goals of the Reporter is to make his performance understandable by the audience. Every team member can present any problem, even if his/her name is not among the authors.

**The Opponent** analyses the Reporter's solution and presentation pointing to inaccuracy and errors in the report, as well as to advantages of Reporter's proofs. For the purpose of revealing possible shortcomings, the Opponent draws the Reporter into a discussion of the presented results. The results must be evaluated as follows:

- correct and proven,
- correct with minor inaccuracies,
- correct but not proven (a proof is missing or there are crucial mistakes),
- doubtful,
- wrong.

However, the Opponent should not turn the discussion into an explanation of his/her own solution.

**The Reviewer** evaluates the presentations of the Reporter and the Opponent by studying positive and negative aspects. One of the main intentions of the Reviewer is to detect whether the Opponent said anything wrong or overlooked Reporter's faults.

**The Observer** only makes important and useful remarks missed by other participants, otherwise should not participate in the discussion. If the Observer wastes time, the Jury may evaluate the performance by negative marks.

Only one team member may take the floor during each stage, other members of the team are allowed to make brief remarks if the chairman gives permission to the captain of the team.

Within each Round and Final, the roles of Reporter, Opponent and Reviewer must be performed by different members of the team. For instance, the same person cannot be Reporter and Opponent in the same Round, but he/she can be Reporter and Observer.

## 10. The written reviews

Before each Round and the Final, the Opponent, the Reviewer and the Observers prepare **written reviews** of the Reporter's materials (see section 5) indicating the mistakes they found (one-two pages). In addition to a critical evaluation, a review's author may assign the work a merit rating by enlightening both positive and negative points. A model written review is given in section 16.

Files with extensions PDF are accepted, each written review must be in a separate file and named in the following manner: "TeamReviewing-TeamCriticised-ProblemN.pdf". There is a **2 page** and **5 MB** limit per problem (**A4, 11pt**).

The written reviews are graded by the Jury (see section 12).

## 11. The draws

The composition of the Groups for the first Round is determined by preliminary written materials. In order to decide which problem each Reporter presents in a Round/Final, a draw is held at least a day before the Round/Final. The captains of the teams from the same Group draw alternately cards with problems' numbers. A team cannot present the same problem twice in the tournament.

A team may reject up to **six** different problems without penalty during the first two draws, and also up to **six** different problems without penalty during the third draw. For any subsequent rejection, the coefficient  $k$  for the report (see section 12) is decreased by **0.5**. The problems presented by the team earlier in the tournament don't count, as well as the problems rejected by the team earlier in the draw.

Within several hours after the draws, the corresponding written materials (see section 5) are distributed to the teams and to the Jury.

**The first draw** is organised online **three days prior to the tournament**. A public chat will be open, so that everybody will be able to follow the draw under the link <http://www.itym.org/first-draw>. Only the captains of the teams will have the permission to post messages.

The teams are divided into Groups according to their preliminary written materials. A separate draw will decide the order within each Group. During the first draw, the following action is performed:

**Step (Problem's Number).** An organiser places  $P$  cards with numbers from 1 to  $P$  in a row, where  $P$  is the number of problems. A captain picks an integer  $n$  from 1 to  $P$ . The organiser suggests the problem numbered by the integer written on the  $n$ -th card.

- If the problem has been previously presented by the team, then the captain has to choose another card.
- If the captain accepts the problem then the card is taken away.
- If the captain refuses a problem which he/she has already refused in the same draw, then the captain has to choose another card.
- If the captain refuses a new problem, then the card is turned back over and all cards are shuffled. Step is repeated for the next captain within the Group.

**The second draw** is organised after the first Round. The teams are divided into Groups according to the following rules:

First Round				⇒	Second Round		
	Group A	Group B	Group C		Group A	Group B	Group C
1 <sup>st</sup> place	A1	B1	C1		A1	B1	C1
2 <sup>nd</sup> place	A2	B2	C2		C2	A2	B2
3 <sup>rd</sup> place	A3	B3	C3		B3	C3	A3
4 <sup>th</sup> place	A4	B4			B4		A4

A separate draw will decide the order within each Group. The step above is applied to determine problems presented by the teams.

**The third draw** is organised after the second Round. The steps 1 and 2 are applied.

If during the third draw a team has no problem left to present (all problems solved by the team have already been presented in previous rounds or chosen by other teams in the same draw), then the team is disqualified from the final. The final score of such a team will be that from the rounds.

## 12. The grading

After all stages the Jury grades the teams, taking into account the written review ( $x$ ) and the performance together with the participation in the discussion ( $y$ ). Each Jury member shows an integer mark  $y$  from 0 to 10 for the Reporter and integer marks  $x$  and  $y$  for the Opponent, the Reviewer and the Observer, according to the table below.

	Written review $x$	Performance and discussion $y$	Jury's marks	Coefficient $k$	Resulting points
Reporter	0	$0 \leq y \leq 10$	$y$	3 or less	$x + ky$
Opponent	$0 \leq x \leq 4$	$0 \leq y \leq 6$	$x$ and $y$	2	$x + ky$
Reviewer	$0 \leq x \leq 4$	$0 \leq y \leq 6$	$x$ and $y$	1	$x + ky$
Observer	$0 \leq x \leq 4$	$-3 \leq y \leq 3$	$x$ and $y$	1	$x + ky$

To calculate the resulting points of a team in the Stage, all marks of the Jury members for the team are summed, multiplying the marks  $y$  by the coefficient  $k$ . An exception: If there are at least six members in the Jury, then the highest and the lowest marks are not counted.

## 13. The rating

The rating  $Q$  of a team in the Quiz is calculated as the ratio of the sum of the resulting points of the team to the maximal possible score.

The rating  $R_n$  of a team in the Round  $n = 1, 2$  is determined by the formula:

$$R_n = S / S_{\max},$$

where  $S$  is the sum of the resulting points of the team in the Round and  $S_{\max}$  is the maximum of such sums among the teams in its Group.

The rating  $R$  of a team before the Final is calculated by the formula:

$$R = \frac{1}{2}Q + R_1 + R_2,$$

where  $R_1$  and  $R_2$  are the ratings of the team in the first and the second rounds respectively.

## 14. The Finals

Three, four or five teams are selected for the **Grand Final** in the following order:

- the teams winning the both Rounds,
- the teams with the highest ratings  $R$ .

Among the remaining teams, 3-5 teams may be selected for the **Small Final** by the same rule.

The final team rating  $FR$  in each Final is defined by the following sum:

$$FR = R + \pi R_F,$$

where  $\pi = 3.141593$  and  $R_F$  is the rating of the team in the final, it is calculated in the same way as the round ratings.

## 15. Moot points

Any moot point during the tournament is subject to consideration by the Organising Committee and the Jury. If there is a moot point concerning the prizes, then a decision is taken by the International Organising Committee through voting.

## 16. Appendix – A Model Written Review

File name: **TeamReviewing-TeamCriticised-ProblemN.pdf**

Written review by the team: *your team*

**Problem:** *number*

**Title:** *title of the problem*

**Reporter:** *reporting team*

### **Summary of the solution**

Here, in a few lines, a brief summary of the written material, including which questions have been answered, which one have not been treated, and any remark that may be useful to value the work of the reporting team.

### **Mistakes and inaccuracies**

This is the most important part of the review. Here, the reviewer should make two lists, with precise reference in the written material, of the mistakes he/she found in the document:

- the first one should contain the most important mistakes,
- the second one those, which have a lesser impact.

Both should be listed starting by the most important ones. The reviewer is not to list all typos and irrelevant mistakes. This should be of mathematical interest. The reviewer may explain in a few words how it would be possible to correct the mistake (but not rewrite the whole solution).

### **Formal remarks**

In this part, the reviewer may make a few remarks about the form of the written material, mainly if it has negative consequences on the understanding of the paper. This part is optional.

### **Qualitative rating of the solution**

Here, the reviewer is expected to give his/her opinion on the reporter's work. One should point out positive and negative aspects of the work, and emphasize interesting ideas and methods used in the proofs.

**Evaluation.** The reviewing team is expected to evaluate the reporting team's work by one of the following adjectives: *excellent, good, sufficient, poor*. The main objective of the reviewer's work is to explain in the previous parts why they give such an evaluation.