

# MATHEMATICAL BATTLES

## SET OF GUIDELINES

Math battle is a combination of problem-solving competition and debate. It is a team contest which aims to challenge the academic ability of the teams to:

- solve non-standard maths problems, working in a team
- propose creative solutions and constitute good presentations
- monitor and assess opposing teams' solutions

### TEAMS

Mathematical battle tournament is a student team contest. Each team comprises of 4 to a maximum of 6 contestants. The competition can be entered by three different age brackets: 6<sup>th</sup> – 7<sup>th</sup> graders, 8<sup>th</sup> – 9<sup>th</sup> graders, and 10<sup>th</sup> – 12<sup>th</sup> graders. To register for the completion, each team has to complete a registration form and provide the following information:

- *age group of the participating team*
- *name of the team*
- *captain of the team, grade and school*
- *full list of participants, specifying the grade and school of each contestant*

The captain can be replaced with the jury's granted permission upon announcing the reason for the required replacement.

### CAPTAINS

The captain of the team acts as an intermediary between the team and the jury and has the following duties:

- announces the venue which his/her team has chosen for solving the problems and is responsible for complying with the set of rules and regulations of the competition
- participates in the captain's contest (upon the captain's decision another team member might be nominated to participate in the captain's contest)
- presents the challenges, demands one-minute breaks, determines the team's speaker (provided the team is to present a solution), and the opponent (provided the team is to oppose).

## GENERAL INFORMATION

In the early morning of the competition day the teams receive a list with normally 8 to 10 problems. Each team is allotted approximately 5 to 6 hours to solve the problems. The actual problem solving takes place at a suitable for the contestants venue which is to be announced to the jury beforehand. The chairperson of the jury occasionally visits the teams and answers questions if such have been raised. During problem solving the contestants are prohibited from using any computers, the internet or the help of anyone outside of their team. However, they are allowed to use specific literature such as reference books and compendia of mathematics which are to be approved by the jury prior to the start of the competition.

If any serious violations of the tournament rules are to be found (e.g. internet browsing, support received by external sources), upon the jury's decision tough penalties may be imposed on the team. Those can vary between subtracting points and recording the victory for the opposing team within the captain's contest.

The second part of the mathematical battles commences in the afternoon. The teams draw lots to decide on the two opposing teams. They enter the contest with two or three members of the jury. The other contestants can also attend the event, without practically being involved in it.

The math battle commences with the captain's contest.

## PROBLEM-SOLVING

For the sake of good fellowship and fair play before the start of the mathematical problem solving, the teams inform the jury if they happen to know the answers to some of the problems (mathematical battle is not a "club for know-alls"). As soon as the jurors find evidence to corroborate that the team's idea of the solution is previously known, they have the responsibility to change or omit these maths problems.

A juror occasionally visits the teams and answers questions related to the math problems. Whenever this happens, each clarification on the text of the problems that has been provided to one team is announced to the other teams as well.

The jury is not allowed to disclose information about the level of difficulty of the problems. While the teams are solving the problems or during the mathematical battle, the opposing teams are not let to interact with each other and record the number of the problems solved by the rivalling team.

## CAPTAIN'S CONTEST

In order to choose which of the two opposing teams will make a presentation of their solutions first, a captain's contest is held. A representative of both teams (usually the captain) appears at the whiteboard and gets an easy problem-solving task which checks his/her quickness of the mind. Whoever gives a correct answer wins (no feedback on solving is to be provided). In case an incorrect answer is given, the captain loses.

The winning captain has the right to choose whether his/her team will be the challenging one or vice versa.

## TEAM DUELLING

The captain of the team challenging first announces the number of the problem which solution his/her team wants to discuss. The opposing team responds whether or not the challenge is accepted.

The two teams challenge one another by taking turns, except in the case presented below in which a check for correctness is introduced and the duelling/challenging turns out to be unfair.

If the challenge is accepted, the team is presented by a speaker, and the opposing team appoints an opponent.

The speaker presents the team's solution. During presentation delivery, the opponent and the jurors may pose questions for clarification. However, the jury's interference is relatively small and is kept to a minimum. For example, what the jurors can say is "*this is an obvious fact*", "*it is not necessary to provide feedback*", "*can you repeat this part of your proof*". As soon as the speaker delivers the team's presentation, *the opponent may ask questions*, if he/she happens to perceive that additional mathematical proof is required. Then the opponent voices his/her opinion to the jury, e.g. "*I agree with the solution*", or "*The solution is incorrect as a comprehensive and clear report failed to be delivered*". All contentious issues that have been raised during the debate between the speaker and the opponent are resolved by the jury.

As soon as the opponent states his/her final opinion on the presented solution, the SPEAKER is asked questions by the jury. The presented solution is quite likely to contain random errors, not detected by the opponent, but by the jury. Finally, the jury decides how many points to award to each team and to itself. The overall score that can be obtained per a correct solution of a problem is 12, and the jury is supposed to base their decision in front of both teams. The speaker is also awarded points according to the factual correctness of the solution presented and the opponent's conclusion. The opponent is awarded points in accordance with the detected gaps and faults in the solution. The jury is awarded points if it happens to detect gaps and faults in the solution which have not been noticed by the opponent. The results are kept in a record in a chart format (with the names of the speaker and the opponent and the number of the relevant problem presented).

While the debate is conducted, the jury is allowed to penalize a team for making noise, for prompting or for unsportsmanlike conduct (the penalty imposed might be

elimination of a particular contestant or even a whole team for some time. Points may be subtracted from the team's overall score as well).

Anytime during the discussion, whenever the team decides that either their speaker or opponent needs practical guidance, each team can take a one-minute break. Within the allocated time for the presentation of one problem, each team can get a maximum of two one-minute breaks.

A correctness check of the challenge might be asked for (when the challenged team demands the problem to be presented by the challenging team). In this case the two teams swap places.

Upon the launch of the challenge correctness check: **Team A challenges team B and team B demands from team A a challenge correctness check**, the following options may arise:

*1<sup>st</sup> case: If team A refuses to present a solution, both team B and the jury are awarded 6 points, and the challenge is deduced to be incorrect, so team A has to challenge team B again.*

*2<sup>nd</sup> case: If team A presents a solution which the jury awards with a maximum of 6 points and team B rejects the arguments of the jury and refuses to take its decision, the challenge is considered to be incorrect which means that in the next round team A will challenge team B again.*

*3<sup>rd</sup> case: If team A presents a solution and receives at least 7 points, the challenge is correct and in the next round team B has to challenge team A.*

*4<sup>th</sup> case: If team A presents a decision which is awarded with a maximum of 6 points, and team B consents to the jury's decision, the challenge is considered to be correct and in the next round team B challenges team A.*

It is possible for a particular team to ignore challenging. Then the other team is submitted an opportunity to present the solution of any of the remaining problems it picks for discussion, but the rejected one. A speaker and an opponent are nominated by the teams for the presentation of each solution and points are awarded by applying the method mentioned above.

The team that has refused challenging becomes the so-called "eternal opponent", which means it can no longer present solutions and can be awarded a maximum of 6 points for the remaining problems.

## **A W A R D I N G P O I N T S**

Each problem carries 12 points /this is to avoid prompting the level of difficulty of the problems/. These points are divided among the speaker, the opponent and the jury /the jury is awarded the retained points between the speaker and the opponent/.

Points are awarded for positive contribution to the problem solution as well as for gap and fault detection in the solution. For the complete solution of the problem 12 points are awarded, and for a mathematically rigorous opposition 6 points are awarded /in case the opponent has proved that the speaker does not have any practically positive ideas for problem solution/.

Initially the jury determines the value /in points/ of the presented by the speaker part /and the speaker gets these points/ as well as the value of any gap in the solution. Per each detected gap the opponent gets half the value of this gap /in case the gap is detected by the jury, the points are awarded to it/. The second half of the value of this gap will be awarded to the one who can fill it – the speaker /if he/she happens to answer the opponent’s question/; the opponent /upon role-swapping/ or to the jury /if none of the above mentioned succeeds in filling it/. The same reflections are provided upon summation in role-swapping.

## **Paradigm 1:**

*The speaker has presented the solution. The opponent has found gap 1. The jury has asked the speaker questions and has found two other gaps – gap 2 and 3, but the speaker has managed to fill gap 2 on the board.*

*The jury has shared the points as follows: 2 points for the presentation; per gap 1 – 6 points; per gap 2 – 2 points; per gap 3 – 2 points.*

*The opponent has been provided the opportunity to talk about gap 1 – which means that the so-called role-swapping has been carried through /this gap’s value is 6 points, 3 of which have already been awarded to the opponent; so there are 3 points left to be played off/. Moreover, “the new opponent” /who is actually the former speaker/ has detected gap 4 in the opponent’s presentation.*

*The jury has assessed the contestants’ performance as follows: 1 point out of three per the presented solution; 2 points out of three per gap 4.*

### Overall score:

*Speaker: 2 points/presented solution/ + 1 point /half the value of gap 2 because the speaker has managed to fill it on the board/ + 1 point /half the value of gap 4 because the speaker has managed to detect it, being an opponent after the swap/ = 4 points.*

*Opponent: 3 points / half the value of gap 1/ + 1 point/per the opponent’s presentation when they swapped roles with the speaker/ = 4 points.*

*Jury: the remaining 4 points are awarded to the jury.*

*If a highly creative or a beautiful solution is presented and a strategic debate is conducted, the jury might award 1 point as a bonus /it is not part from the total of 12 points/.*

*While the jury announces the overall score, it is obliged to offer a detailed explanation of its decision - why points have been awarded or subtracted, etc.*

*At the jury’s discretion a particular team can be penalized with 1 point after deductions for making noise or unethical conduct /this may only happen after formal admonition/. However, the **punishment** inflicted for prompting might be even harsher – for example, the presentation might be repudiated and the prompter ejected.*

*If there is extra time left after the presentation delivery, the jury can hear other solutions and award bonuses.*

## **Paradigm 2:**

*Team A presents a solution which contains a gap or fault. Team B cannot detect the gaps or faults or deliver them concisely. In the meantime team B challenges team A, as it is ready to present a solution of their own which is practically correct. In this*

*case team B IS NOT allowed to present their solution.*

## **RESULTS**

After each challenge the jury announces, explains and records the overall score of each team. A record of the math battle is kept in the form of chart which indicates the contestants' surnames; the number of the problem presented and discussed; the direction of the challenge, the one-minute breaks that have been taken and the points awarded to the teams as well as the points awarded to the jury. A simpler chart is drawn on the whiteboard without the contestants' surnames.

After the math battle is held, the points awarded to each team and the ones awarded to the jury are summed /the number of the points awarded to the jury demonstrates the level of difficulty of the problems and the teams' potential/.

**If the difference between the overall scores of the teams is smaller than or equals 3, the battle is considered to have ended in a draw.**

If there is extra time left, the jury can either present the solutions to the problems that have not been solved during the battle or show more effective solutions to the problems discussed.

## **JURY'S DUTIES**

- Sets the problems for solution during the tournament. The jury has to know the solutions to all problems suggested.
- Formally approves the reference books which may be used by the contestants. The jury is obliged to observe whether the participating teams comply with the set of regulations.
- Instructs the contestants in terms of rules and regulation and explains what their rights and obligations are.
- The jury does not interfere or interrupt in terms of subject matter while the debate between the speaker and the opponent is conducted.
- If the jury (after the opponent's questions) detects a gap or fault in the presented mathematical proof, it is obliged to find out whether the speaker is able to fill it.
- In case the speaker talks complete nonsense, the jury encourages the speaker to propose a plan and a neat solution to the problem discussed. This may only happen after the opponent has posed his or her questions.
- During the competition the jury must strive for making conscious decisions in similar situations so as to ensure fair play and judge the teams accordingly without penalising them unreasonably.
- Upon settling any contentious issues that have been raised during the math battle but not described in this set of guidelines, it is the jurors who have the final decision.

## **JURY'S STATUS**

The jury is the supreme interpreter of the math battle and as such may make the contestants act in conformity with the competition regulations. If the situation is not under the competition regulations, the jury has the right to exert its authority the way it pleases. The jury's decision is final and obligatory for all the teams.

The jury has the propensity to cut the opponent off provided that the question is out of subject matter, to deter the speaker's presentation or the teams' debate if it fails to progress. However, the jury has to state their reasons in any case that needs consideration.

All jury's decisions taken upon the discussed problems are considered after the math battle.

## **INTERPRETER'S DUTIES**

- The interpreter acts as an intermediary between the two opposing teams, and each team and the jury as long as the interpreter's appearance in the debate is necessary and required.
- The interpreter has to clarify the regulations to any team as well as to define their rights and obligations in the relevant language when necessary.
- The interpreter does not interrupt the debate between the speaker and the opponent over a particular math problem, and can hardly participate in the debate unless it is necessary.
- During the competition the interpreter is required to translate only upon the explicit request of the speaker, opponent, the captains and jurors and can in no way affect the outcome of the competition or deteriorate its sportsmanship aspect. Neither is he/she allowed to ruin or damage any teams' reputation.

## **STATUS OF THE PRESENTER**

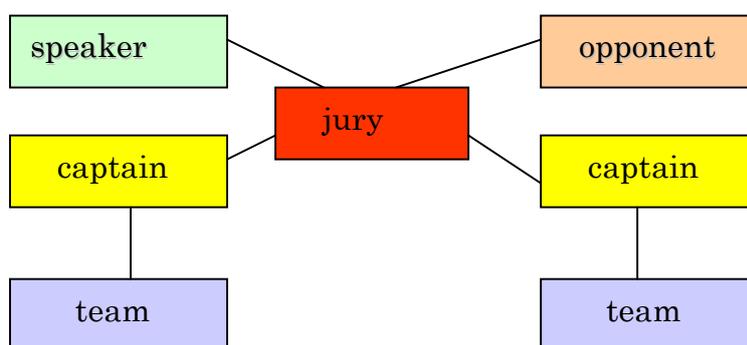
The presenter (usually a member of the jury) is obliged to monitor and follow the order of discussion, and in particular:

- to submit the word to the speaker
- to announce the end of the presentation and the transition to discussion
- to announce the beginning and end of the one-minute break if requested by the particular team
- to formulate the questions of the opponent and the answers of the speaker / for example, the presenter may ask the opponent: "Are you satisfied with the answer?", etc./
- to restate the opinion of the speaker of the presentation / "Is the solution accepted?" or, if the solution is overturned – "What makes you dissent from the solution?"/

- to announce the end of the discussion and the transition to the next stage of the competition: the jury's questions to the speaker
- to not allow the opponents to interrupt the speaker
- to not let the discussion go beyond the scientific research
- to announce the way the points are allocated to a particular problem, explaining why they have been awarded or taken.

## MATH BATTLES PROCEDURE

There are some limitations imposed upon interaction between contestants as shown in the diagram below (e.g. the opponent can interact only with the speaker and the jury whereas the captain interacts only with the jury and his/her team)



*Participants in the debate are the two opposing teams, the jury and the interpreter, if there is such. As for the rest attendees, they act as observers and can neither interfere in the battle nor affect in any way the performance of the contestants in it.*

## PARTNERSHIP AGREEMENTS

1. Each contestant is limited to a maximum of **2** appearances at the whiteboard /the captain's contest does not count/.
2. Maximum number of one-minute-breaks during the **whole tournament** – **3** (per problem – max 2 breaks).
3. Allotted time for reporting /after its expiry, the jury decides whether to allocate extra time to the reporting team or to let the opposing team have the floor / - **15 minutes** / the time for answering the questions of the rivalling team does not count/.
4. Allotted time for presenting – **10 minutes**/ the time needed for the explanation of the solution by the speaker does not count/.
5. What difference in the overall score is considered a draw? **0, 1, 2 or 3**.
6. Contestants are allowed to use reference literature during problem solving provided that they have received the prior approval of the jury.
7. Contestants are permitted to come to the board with a written solution of the problems.