Mathematical Rumble
OFFICIAL RULES

The rules below broadly follow those of a "*Mathematical Battle*" as given in Appendix A of *Mathematical Circles (Russian Experience)* by Fomin, Gengkin and Itenberg. Adaptation provided by Sam Vandervelde and Jon Ziegler. Further adaptation by Steve Dunbar in November 2010. Revision and adaptation to a Math Rumble by Steve Dunbar, Julie Kreizel, Anne Schmidt in January-February, 2011.

Preliminaries

- A jury consisting of two judges keeps time, decides scores, and presides over the Rumble. The decisions of the judges are final.

- A "*Mathematical Rumble*" occurs between two equally-sized teams of students. Each team is further divided into squads of three students each. (The manner of division into teams and squads is left open to the Rumble organizers. One way is use random assignment, another way is to have teams assigned or grouped by the judges, a third way would be to have the teams "choose up" or self-organize. Other ways of organizing the teams are acceptable. Depending on the number of students available for the teams, squads of two or four will also work.)

- One team is designated as *Sharks* and the other team as *Jets*.

- The judges present both teams with a set of problems prepared in advance. The number of problems is about two-and-a-half times the number of rounds scheduled, one round for each pair of squads for the Rumble. Problems should span a range of topics and difficulty levels.

- The solution to each problem will involve an explanation (not just a numerical answer) which requires a relatively short amount of time to present.

- Immediately prior to the Rumble each team is sequestered for a reasonable amount of time to work on the problem set in squads.

Procedures

- The Math Rumble commences with a coin flip by the judges. The team designated by the result of the coin flip decides whether to begin with a *challenge* or an *acceptance* (similar to football, either kicking off or receiving). The opposing team then respectively accepts or challenges.

- At each round of the Rumble the on-deck squad from the team with the right to challenge chooses a problem from among problems that have yet to be presented and challenges the opposing team to present a solution. After the initial problem challenge and presentation, the right to challenge alternates between the two teams.

	Sharks	Jets
Round 1	Squad A	Squad A
Round 2	Squad B	Squad B
Round 3	Squad C	Squad C
Round 4	Squad D	Squad D

  Tip: It helps to have a prepared judge's score card arranged approximately like the above to keep score and record what problems were discussed in each round and which team challenged, presented and critiqued.

- When challenged, the opposing team may choose to *accept* the challenge, in which case they present a solution. They may also opt to *return* the challenge, in which case the original team must attempt to present a solution. The potential point value of a returned challenge increases, see the scoring below.

- The squad presenting a solution has a member selected at random by the judges to provide an explanation. This person has up to five minutes to present as complete a solution to the problem as they are able. Time spent drawing diagrams or writing equations is included in the five minutes. The presenting squad may have 2 minutes to discuss the problem prior to the selected squad member stepping to the board, but may not consult with their squad or team while describing their solution. Furthermore, the presenter should address *only* the given problem, without discussing generalizations or other extensions of the problem.

  Tip: It helps to have a clock or countdown timer visible to keep track of the time. These are available as software on computers which

can be projected or a digital clock as used for sporting events.

- The opposing squad then selects a member who has not spoken to respond to the solution just presented. This person has up to two minutes to give a critique. A critique points out any flaws or omissions in the explanation or illustrates how that explanation might be shortened or made more elegant. *The critique must address the solution presented.* Therefore, the rebutting squad must be listening attentively to the solution presentation. In particular, an alternate solution should not be given in a critique.

  Tip: If presenting on a whiteboard, it helps to leave the original solution on the board, and have the critique presented in a different coler marker. If using white paper projected with an Elmo, or overheard ransparencies with an overhead projector, the same remark applies with different color pens or markers.

- On the other hand, the opposing squad may concede that the solution is complete (or close enough) As with the presentation of the solution, the rebutting squad member can discuss the response for two minutes with their team, but may not consult with their team while speaking.

- Once both squads have presented and rebutted the chosen problem the judges announces scores as described below.

- Each problem is initially worth 7 points. Assuming that a team accepts a challenge to solve a problem and the other team then provides a critique, the judges will award a portion of the available 7 points to each team based on their progress. For instance, if the critique indicates how to finish an incomplete proof, the judges would split the points between the teams as warranted. On the other hand, the judges might award 0, or just a portion of the total points if neither squad makes significant headway on a problem.

- Once all pairs of squads have presented the Mathematical Rumble comes to a close. The judges announce the final scores and declares a winner.

- Presenters should speak loudly and clearly, and avoid "speaking into the board." For large rooms, the use of a microphone is strongly encouraged. Presenters should also address their solution to the judges. In particular, a critique should be directed to the judges, as opposed to the other team. Team members should listen attentively or consult with one another quietly as solutions or responses are being presented. Heckling or interrupting is prohibited.

- A critique should refer respectfully to the work done by their peers. For instance, a response might begin "The opposing team has made significant progress towards a solution to this problem. I would now like to propose a nice approach that circumvents the algebraic difficulties they encountered."

- All students should honor the decisions made by the judges, who will act impartially to the best of their ability and encourage all team members in their efforts.

Strategy

- It is important that all squad members understand solutions to multiple problems since they may be called on to present to any challenged problem.

- In theory a squad should challenge with a problem which they already understand, but a squad might select a problem they have not solved.

- Should a team return a challenge, then the problem increases in value to 10 points. The allocation of points then proceeds as before.

- A team that is challenged to solve a particular problem is faced with a dilemma if they do not have a solution. If they accept the challenge anyway, then they lose the opportunity to score a full 7 points, although they might have at least a partial solution. However, if they return the challenge and the original team has a proof, then they might fall behind by up to 10 points. If the challenging team was bluffing without a solution and has the challenge returned to them, then the critique has passed to the originally challenged team, so they will still have an opportunity to present a solution. Therefore, accepting or returning a challenge requires insight into the difficulty of a problem and the capability of the opposing team.

- Prizes (when provided) are distributed to all team members equally. It is also recommended that everyone celebrate together afterwards, preferably with delicious snacks.