

American Regions Math League

Power Contest

Dear Coach:

Welcome to **Round 1** of the **2022–2023 ARML Power Contest**. The topic for this contest is paths of squares from one side of a grid to the other. A few parts of this problem are amenable to brute force computation, while other parts need more delicate logic or the assembly of several earlier pieces. All teams should be able to make some progress while only the most experienced teams are likely to earn top scores, and even they will be challenged by a few of the problems.

As always, at the ARML competition in June we will be awarding plaques to the top teams, through the generous donations of ARML's sponsors and supporters. Please see the arml.com website for a list of ARML's supporters. But we know that your students are in it for the fun and challenge of solving interesting problems, so let's get to it!

This page should be the first in a seven-page document consisting of the items below:

1. This letter.
2. (2 pages) Rules and Directions.
3. Student Instructions.
4. Grading sheet.
5. Answer sheet.
6. Comment sheet.

The contest itself is in a separate file on the contest website. All materials are available online for download from your team's page at the ARML website. Go to www.arml.com, click on the Power Contest link, then the Team Login link and log in to access all materials.

This is the tenth year that I have been in charge of the ARML Power Contest. I have had a lot of fun creating these challenges for the students, and I love hearing the feedback from the students and their coaches about what they like and don't like so I can keep fine tuning the problems to get the most students exposed to the most mathematics!

Warmest Regards,
Micah Fogel

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2022–2023 ARML Power Contest

Round 1

Rules and Directions

Teams working in-person

Before the contest, please make adequate copies of the contest problems and blank answer sheets. Students may also want to see the score sheet and write comments on the comment sheet, so provide a copy or two of those as well. Students may use scratch paper and any non-electronic materials like whiteboards, chalk boards, compass and straightedge, etc. Students may also use electronic language translators, if the device has no other computational or communication capabilities.

Once you are ready to begin, please read the student instructions (next page) to the students, distribute the problems, and give them 45 minutes to work on the problems. At the conclusion of the time, please collect the students' solutions and any comments. Assemble their solution packet with the score sheet on top, followed by the comment sheet, then the solution pages in the order that the students think is best.

Teams working online

Teams should only work online if required by local pandemic restrictions.

A team that is working online may choose any online meeting software, such as Zoom, Microsoft Teams, GoToMeeting, Slack, etc. They may also use any collaboration software they find useful for creating their solution file. This could include GoogleDocs, Microsoft Office 365, Overleaf, and so forth. Teams are on their honor **not** to use any other software tools. In particular, they should not use computational or graphing software such as Desmos, Mathematica, SageMath, MatLab, and the like.

Online teams have the same time restriction as in-person teams. The coach should distribute the scoring sheet ahead of time, so that the contestants know the point distributions of the problems. When students are ready, the coach should distribute the questions (via email or shared group document) and timing begins. At the end of the time, the students should deliver to their coach a PDF of their work, including any comments they may wish to make about the contest on the first page of their document.

Submitting Your Team's Work

There are two options for submitting the students' responses: mail and online. Online is highly preferred!

Submission by mail

Once you have collected your students' solution packet as described above, simply mail it to me at the address below. Submissions should be sent in time to reach me by Friday, November 18; if that will not be possible please contact me to make alternate arrangements. It is highly encouraged that you make a copy of student work before mailing, as packets have been lost or delayed in the mail before! If you want your hardcopy returned, please include a comment to that effect on the scoresheet. Otherwise I will scan and e-mail your graded work back to you when it is ready. The mailing address is:

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Electronic submission

Using electronic submission makes grading much easier and you will get more complete comments this way. Please follow these steps:

1. Scan your students' work into a single submission file. This file should be in PDF format. A scanner with automatic document feeder is ideal, but there are also numerous smartphone apps such as CamScanner and Adobe SmartScan that will make reasonable scan files using your smartphone's camera. You may have to adjust scan settings to achieve a readable result. Especially note that some scanners have a very difficult time reading pencil-on-paper as graphite pencil marks are somewhat reflective.
2. If you do not already have a student account on www.gradescope.com you will need to get one. Go to the website, click the "Sign up" button and create a *student* account. You may use a student account you already have on the system; if you only have an instructor account you will need to create a new student account (probably using a different e-mail address).
3. Log into your GradeScope student account and join the ARML Power Contest class by using the join code **2KEXD3**. Note this is a different code than previous years!
4. You will now be able to submit your students' work by uploading the PDF of their responses.
5. GradeScope will now guide you in selecting the part of each file that corresponds to your students' solution to each problem. For each problem, you will select a page or portion of a page where the students have solved that problem. If your student skipped a particular problem, there is an option for that as well. The software also allows you to adjust your PDF (e.g. re-order or rotate pages) if necessary.
6. Click "Submit" and wait for GradeScope to e-mail you (probably around November 30) that the paper has been graded.

Please note step 5. Several teams did not define where in their paper each solutions was located, so the graders had to search through the paper looking for answers. If the graders accidentally miss your students' work on a given problem because of this, there is unfortunately no redress. The GradeScope website hosts a number of short videos outlining how to work with their software, as well as advice on getting good scans or pictures of your students' work.

Instructions to be read to the students prior to the start of the contest:

This is the first round of the 2022–2023 ARML Power Contest and should take place between Saturday, October 29 and Sunday, November 13.

You will have 45 minutes to complete this set of problems. During this time you are encouraged to work together, communicating and sharing ideas. It is important that everyone understands the problem before splitting up into smaller groups. In particular, make sure each person understands how the various computations work and the meanings of the vocabulary terms and notation introduced in the problems.

If you are taking part in this contest in person, language translators may be used, but no other electronic devices are allowed. This includes, but is not limited to, calculators, computers, tablets, and smartphones. If you are participating online, you may use meeting and collaboration tools, but you are on your honor not to use any other tools. In particular you should not use any mathematics-related software.

The topic of the first contest this year is paths in grids. There are neat formulas that count particular kinds of paths through a grid of squares as well as unexpected relationships with other areas of math. A few of these will be explored in this contest.

Please pay careful attention to the directions in each contest question, as that may save you quite a bit of writing! Remember that this is a contest of mathematical writing, and many problems require mathematical justification or proof. Be clear and concise. You may refer to the result of an earlier problem in your work—even if you didn't solve that problem. You may also refer to your work from an earlier problem. You may not refer to later problems, however, even if it does not create circular arguments.

Use dark pencil or ink and please be legible. *Write on only one side of each answer sheet.* You may submit several answers on the same answer sheet, but be sure to submit only one solution for each problem! Answers on the backs of sheets that are not seen by the graders will receive no credit. If multiple answers to a single problem are found, all will be graded and the team will earn the *lowest* score for any of their solutions. At the conclusion of the contest, submit your solutions *in order* to your coach. Problems that are out of order (except when multiple solutions are written on the same page) have sometimes been overlooked by graders, and there is unfortunately no way to give credit retroactively if this happens.

The contest has a total of 40 points possible. You will be given a copy of the scoring sheet; the point value of each problem is also listed on the problem sheets.

You are encouraged to include any comments or concerns about the problem on the comment sheet.

Contests will be mailed in or submitted electronically, and scores will be posted online as soon as possible. The solutions will also be posted for coaches to download.

Good luck, and enjoy!

(Proctors: please distribute the contest materials and begin the 45-minute contest period.)

2022–2023 ARML Power Contest
Round 1
Grading Sheet

Team Name: _____

1. _____ [2]

7. _____ [3]

2. _____ [3]

8. _____ [2]

3. _____ [2]

9. _____ [4]

4. _____ [3]

10. _____ [2]

5. _____ [2]

11. _____ [4]

6.a. _____ [3]

12. _____ [3]

6.b. _____ [3]

13. _____ [4]

Total score: _____

We have complied with the rules of this contest. _____

(Coach's signature)

(Date)

2023–2023 ARML Power Contest
Round 1
Answer Sheet

Page ____ of ____ . Problem(s) _____.

2022–2023 ARML Power Contest
Round 1
Comment Sheet