CAMP 2022 Application

A Note for Parents

We welcome all interested students, encourage those who feel shy to join, and offer scholarships to make attendance possible for students at all economic levels. We value the diversity of our student body, especially with groups traditionally underrepresented in the mathematical sciences.

∞

April 2022

Dear Parent,

Thanks for helping your child apply to our Creative and Analytical Math Program. We've received the first part of the application, an online form. This packet is the other part.

Please print out this packet for your child and have them complete it by hand. They may use additional pages, of course. When they are done, please scan[1] and put together their work into a single, neatly organized PDF document. Email it to us at `<hello@bardmathcircle.org>`.

Please do not help your child solve the problems!

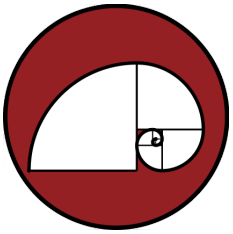
But do make sure that they understand the instructions, including that they are not required to answer all in order to be accepted into the program. Then leave the questions for your child to puzzle over. Taking a few days to ponder the problems is fine. What is more important in determining suitability for the program is whether your child enjoys trying challenges or if they find them stressful or otherwise unpleasant.

If appropriate, you may include a note about how your child engaged with this packet, and how you interacted with them throughout the process.

Sincerely,

BARD MATH CIRCLE

[1] We recommend that you use a scanning app such as TinyScanner. Such apps produce very readable PDF scans.



CAMP 2022 Application
A Note for Students

April 2022

Dear Student,

Thanks for applying to our Creative and Analytical Math Program. We've received the first part of your application, an online form. Now it's time for this Math Activity Packet. Please print this out and complete it by hand. You may use additional pages, of course. When you are done, please scan and return it as a single, organized, PDF document.

Please solve the problems on your own! Use lots of scratch paper!

You may ask your adult for help in clarifying the instructions, and it is important to know that you are not required to answer all the parts or all the questions in order to be accepted into the program. You may use a calculator on these activities, or write a computer program if you know how. (Most CAMP students have no programming experience; that's okay.) Take your time to puzzle over these problems. Taking a few days to ponder is fine.

If you enjoy working on these problems, especially the parts that you can't answer in less than five minutes, then you will probably enjoy attending CAMP this summer. If you don't enjoy this application, then you might find CAMP to be stressful or otherwise unpleasant.

Please consider asking your adult to write a note about how they were part of the application process for CAMP.

Sincerely,

BARD MATH CIRCLE

CAMP 2022 Application

Student Paragraph

Name:

Please explain your interest in the Bard Math Circle CAMP.

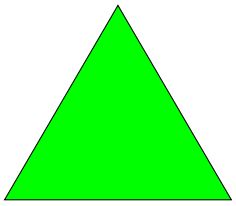
(Write 2–3 sentences, or more if you like. You may describe what math you have especially enjoyed figuring out, or any information we should take into consideration.)

CAMP 2022 Application

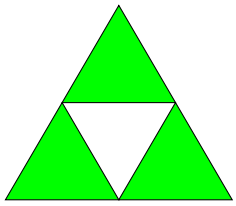
Sierpinski Triangles

A **Sierpinksi Triangle** is made by starting with a triangle, removing a smaller, central triangle, and then removing even smaller central triangles from each of the remaining triangles. This process is repeated an infinite number of times. Here are the first few stages of creating a Sierpinski Triangle:

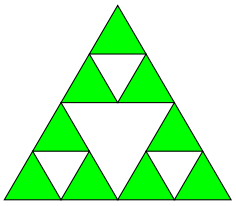
Step 0:
Start with a triangle whose area is 1.



Step 1:
Cut out a little triangle.



Step 2:
Now cut smaller triangles from each remaining triangle.



Instructions: Solve the following problems, and write out both your answers *and* your reasoning. We're very interested in *how* you solved them, so please write out your steps. Feel free to be creative, except don't search the internet. You may use a calculator and/or write a computer program. If you do, please let us know.

---

1. The original triangle in step 0 has area 1. Fill in this table with the area at each step. We recommend that you use *improper* fractions.

Step:	0	1	2	3	4	5
Area:	1					

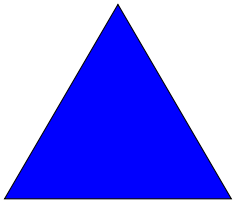
---

2. Can you write a rule (formula) to tell what the area is at any step? We call this "step n" and use the letter n to show how the numbers in the formula relate to the step number. Hint: using so-called *improper* fractions makes it much easier to find a rule.

Here is another triangle being formed into a Sierpinski Triangle. The sides in step 0 are each of length 1.

Step 0:

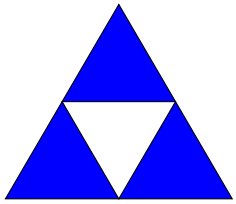
Start with a triangle whose perimeter is 3.



Perimeter = 3

Step 1:

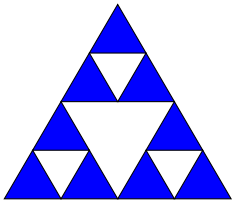
Cut out a little triangle. (notice that there is now more outer edge because of the cut-out).



Perimeter = ?

Step 2:

Now cut smaller triangles from each remaining triangle.



Perimeter = ?

---

3. The triangle in step 0 has perimeter 3. Fill in this table with the perimeter at each step. We again recommend that you use *improper* fractions.

Step:	0	1	2	3	4	5
Perimeter:	3					

---

4. Can you write a rule (formula) to tell what the perimeter is at the nth step? Hint: using so-called *improper* fractions makes it much easier to find a rule.

CAMP 2022 Application

Fission Trees

To make the **Fission Tree** (based on the activity of Gordon Hamilton at Math Pickle) of a positive integer that is bigger than 1, follow these steps: Split your number into two smaller factors that are as close together as possible (see diagram A). Note that the larger factor goes on the right (see diagram B). Keep splitting the factors as far as possible (see diagram C).

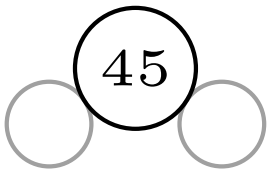


Diagram A

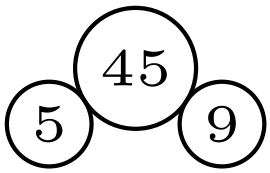


Diagram B

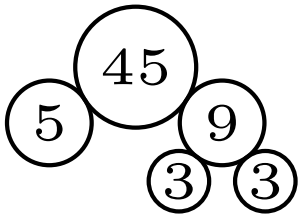
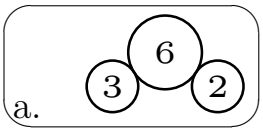
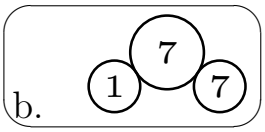


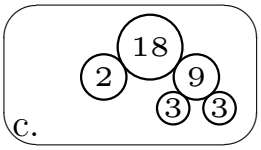
Diagram C

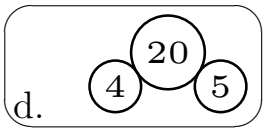
Instructions: Solve the following problems, writing your answers clearly. We're very interested in *how* you solved them, so please write out your steps. Feel free to be creative, except don't search the internet. You may use a calculator and/or write a computer program. If you do, please let us know.

1. Each of these fission trees is badly formed because it breaks a rule. Connect each bad fission tree with the rule that it breaks.









(1) The two factors must each be *smaller* than the number.

(2) The two factors are as *close* together as possible.

(3) If the two factors are not equal, then the *larger* one goes on the *right*.

(4) Keep on splitting the factors as *far* as possible.

2. Write the Fission Trees for these numbers. Follow the rules, of course!

2 5 9

3. Here are some more Fission Trees to write.

8 10 12

---

4. The Fission Tree for 3 is just one circle. Can you describe all the positive integers whose Fission Tree is just one circle? Explain why.

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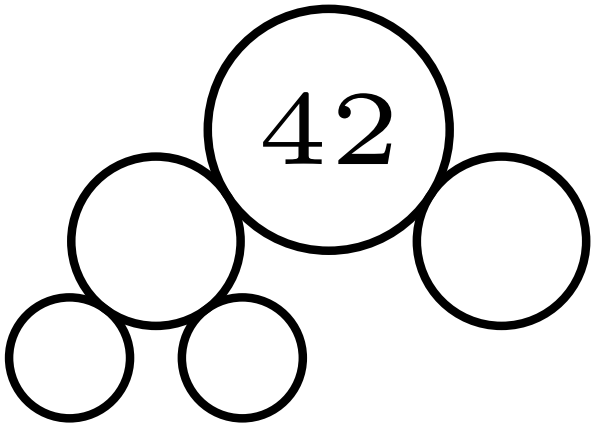
5. Complete the **Fission Tree** for 42:



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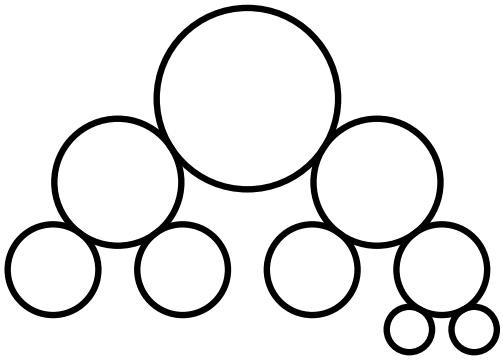
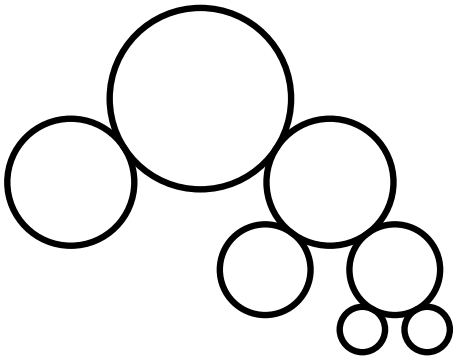
6. Can you list out *all* the positive integers less than 42 that have the same shape Fission Tree as 42? How do you know you found them all?

7. More Fission Tree Challenges! Find numbers for each of the Fission Tree shapes. Can you find the smallest number for each? See if you can find several numbers, each with the given shape.

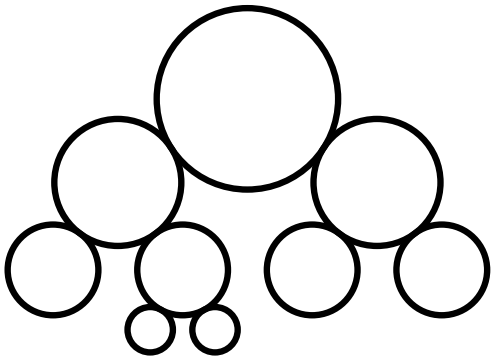
a.



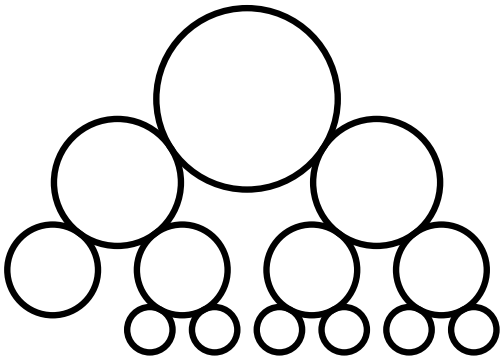
b.



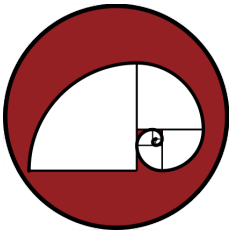
c.



d.



8. Can a Fission Tree contain an even number of circles?
Draw one or explain why not.



CAMP 2022 Application

Computer Science and Programming Experience

One of the great things about CAMP is the opportunity to write computer programs to further explore mathematics. We understand that you may not have any previous programming experience, or you might be quite accomplished! Describe your Computer Science (CS) and Programming knowledge and background in the following questions. If you don't have any relevant experience, no worries! Just write "N/A" and leave the rest blank. Or take a risk and fill in your best guesses. Please complete this section without checking reference material, just use what you know in your head.

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1. What programming languages have you worked with?

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2. Describe your favorite programming achievement.

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3. Variables. Feel free to respond N/A to the following questions if you are not sure, or if they do not apply:

   - What is a variable in CS?

   - How do you declare a variable in your favorite programming language?

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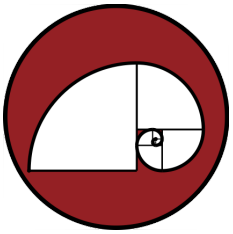
4. Write a short function to print out "Bard CAMP 2022" in your favorite programming language.



CAMP 2022 Application

Checklist

When you have completed this packet,

- ☐ Please organize your pages and scan them as one PDF document. If you don't have a flatbed scanner, we recommend the smartphone app `Tiny Scanner`, for both Android and iPhone. The results are quite good.

- ☐ Email the PDF to `<hello@bardmathcircle.org>`.
  Use the subject line "`2022 CAMP Math Activity Packet: <Student Name>`"

- ☐ If things are going slowly and you won't finish in a timely manner, please send a friendly email to `<hello@bardmathcircle.org>`.