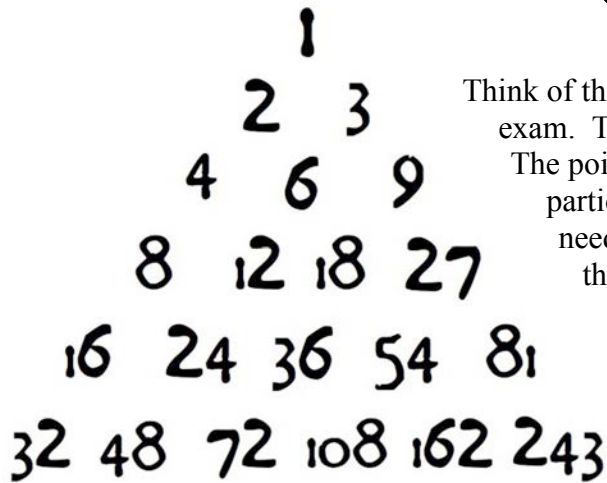


# Quadrivium: Takehome Exam I

Due: Feb. 26, 2019



Think of this as more of an assignment or an artsy essay than an exam. There is a huge range of possibilities in this project-exam. The point is to get into the medieval mathematical mindset and participate in it. Analysis and presentation are the point. You need to delve into the numbers, find the patterns, describe them, explain them, and show them.

Analyze the diagram to the left. It is an extended Platonic Lambda. [Feel free to extend it further if you want to.] As you see, it has more numbers inside and inbetween and connecting the base-2 side with the base-3 side and it goes down further than the typical Platonic Lambda.

Boethius describes this and similar diagrams on pp. 124-125 in *De institutione arithmetica*, but his description is very hard to follow. Lots of *duplexi* and *sesquiquarti* and poorly formatted numerical diagrams. It's hard to figure out.

Your job is to analyze this diagram using the mathematical tools we've been reading about and practicing in previous homework assignments. Below is a partial list of these analytical tools with informal citations to the texts where these tools are described. There are certainly more mathematical tools than these and my citations are incomplete, but this list gives you an idea of the sorts of things to look for and where to find descriptions of them.

- 1) Arithmetical, Geometrical, and Harmonic means and series. [See Boethius pp. 172-175, *Timaeus*/Bury pp. 58-59, *Timaeus*/Cornford pp. 68-75.]
- 2) Elemental relationships. [See *Timaeus*/Bury pp. 58-59.]
- 3) General Platonic Lambda relationships. [See *Timaeus*/Bury pp. 66-71, *Timaeus*/Cornford pp. 66-75, *Capella* p. 275.]
- 4) The consonant musical ratios and superparticular ratios (*Sesquialtera*, *sesquitercia*, etc.) –  $2/1$ ,  $3/2$ , and  $4/3$ . [See Boethius pp. 103-105, *Timaeus*/Bury and *Timaeus*/Cornford.]
- 5) Planetary spacing, orbital velocity, and pitch. [See combination of Plato's *Republic* and *Timaeus*.]
- 6) The multiplex ratios of  $2/1$ ,  $3/1$ ,  $4/1$ , etc. [See Boethius, pp. 123-128, *Timaeus* in general.]
- 7) The non-consonant ratios of  $9/8$  and  $256/243$ . [See *Capella* p. 284. *Timaeus*/Cornford pp. 66-73.]
- 8) Diminutive (Diminished, Deficient), Superfluous (Abundant), and Perfect numbers. [See Boethius, pp. 96-100.]
- 9) Exponential patterns. (mostly using modern algebraic notation and analysis). What is the prime factorization of each number in the diagram?

- 10) Prime and composite numbers. [See Boethius pp. 89-92, Capella p. 286.]
- 11) Numerological observations. [See Capella pp. 278-285.]
- 12) Odds and Evens. [See Boethius pp.76-83 and 136, Capella p. 287.]
- 13) Linear, Triangular, Pentagonal, and Hexagonal numbers. [See Boethius pp. 129-142.]
- 14) Platonic Solid analysis. [See *Timaeus*/Bury pp. 130-139, Boethius pp. 179-180.]

You don't have to find all of the things on this list. You don't even have to find half of the things on the list, but I want you to dig deep into the numbers. Find the patterns that interest you the most. Figure out a way to show the patterns. Comment on the patterns. Look for meaning in the math. Pretend that you are a mathematician from the past.

You have a total of 2 pages [1 front and 1 back] to present your findings. No more, no less. A single sheet of paper. You won't have room to present everything you might find, so be judicious. Present only the choice material. The patterns and concepts that resonate the most within you. Feel free to go all-out decorating these pages. Feel free to use any graphic medium you like... pencil, ink, charcoal, paint, collage, markers, Photoshop, diagrams, graphs, etc.

I'm handing this out a full week early so that you can ponder the set of numbers. Doodle them in your notes while in another class. Fiddle around with them. Try out some theories. See how they relate to one another.

### Suggestions for Diagrams and Drawings

Color-code mathematical ideas. Use different box shapes to distinguish different mathematical ideas. Rearrange the numbers and find patterns in the rearrangement. Draw lines to connect particular numbers. Put the numbers in a table, in a circle, in a pentagon, in a dragon. Look for symmetries, for shapes, for zig-zags, for magic. Your project could be mostly diagrams/drawings with a little math and prose to explain what you found. Play with the numbers and find meaning. It doesn't have to be modern meaning. Just something that passes as meaning. Your projects could be decorated with more complicated and symbolic ideas all around the margins... planets and sirens and seasons and polyhedrons and muses and personifications, etc. Think of this exam as an illustrated book project or a comic book on medieval math.

If you draw it up, you also need to say something about it. Analyze everything you do. I need to understand what you are doing...what you are thinking. Think of this as the equivalent of a 3 or 4 page paper. Put that much work into it. Have fun with it. Feel free to be pretty crazy. Find stuff. It will be graded on content, clarity, and finish. Make this look good.

This is what I mean by working the diagram. [See image at right.] This is a bit chaotic but indicative of exploration. Your final presentation should be more organized.

