Math 303 Sample Exam Questions Round 3

Here are some sample questions for the final. This list only covers material since the second midterm. Refer to the two previous sets of sample questions on prior material.

This list is not comprehensive. It is meant to give you a feel for the kind of questions that could be on the exam. You are responsible for knowing all the theorems and propositions we did in class and that were in your reading (including the ones we did not do in class). This means you must be able to state and prove them.

Any of the homework exercises or an exercise similar to those could show up on the exam. I may ask you about any of the constructions presented in class too.

- 1. What is the math historical significance of Euclid's parallel postulate?
- 2. What's Playfair's postulate? What does it have to do with the parallel postulate?
- 3. What's a non-Euclidean geometry? What non-Euclidean geometries do you know about? Who were the first mathematicians to construct non-Euclidean geometries? When and where did they live?
- 4. Who was G.F.B. Riemann? When and where did he live? What's Riemannian geometry? What does it have to do with a sphere? What axiom of Euclidean geometry does not hold in Riemannian geometry?
- 5. What's the difference between the unboundedness of a line and the infinitude of a line? Are lines in Euclidean geometry unbounded? Are they infinite? Are lines in hyperbolic geometry unbounded? Are they infinite? Are lines in spherical geometry unbounded? Are they infinite?
- 6. What can you say about the sum of the internal angles of the triangle in Euclidean, hyperbolic, and spherical geometries? Is the sum of the angles of the triangle in non-Euclidean geometries constant?
- 7. What does it mean that non-Euclidean geometry is as logically consistent as Euclidean geometry? Who was first to prove this? When and where did he live?
- 8. Define prime number, composite number, perfect number, proper divisor.
- 9. How does the Euclidean algorithm find the greatest common divisor of two numbers? Use the Euclidean algorithm to find the gcd of two positive integers.
- 10. Euclid stated and proved the Fundamental Theorem of Arithmetic. We didn't prove it and neither is the proof in the book, but you should be able to state it. So what does it say?
- 11. Numbers of the form $2^n(2^{n+1}-1)$ are sometimes perfect. When did Euclid say they were perfect? We didn't prove this, but perhaps you can figure out how to do it. It is not so hard. If you have no other idea, try of a few of those that are actually perfect, list their divisors, and note that there is a nice pattern for what those divisors are.
- 12. What are the Platonic solids? What is special about them? Why are only five such solids possible?
- 13. What is the Goldbach conjecture? Why is it a conjecture?
- 14. Who was Archimedes? When and where did he live? What did he do that made him a significant figure in the history of math?

- 15. What's reductio ad absurdum? How is it used?
- 16. What did Archimedes prove about the area of a circle? How did he prove it? What was the math historical significance of this result?
- 17. How did Archimedes estimate the value of π ?
- 18. Archimedes investigated the volumes and surface areas of certain 3-dimensional solids. What solids could he find the volumes and surface areas of?
- 19. What is the general cubic equation? What is the depressed cubic equation? Who were first to find a method for solving the depressed cubic? Who was first to solve the general cubic? When and where did these people live? Why was the solution of the cubic equation a significant result in the history of mathematics?
- 20. What significant mathematical achievement is associated with Gerolamo Cardano's name other than the solution of the general cubic equation? (Hint: If Cardano lived in the USA in the 21st century, which large southwestern city would likely be his favorite hangout?)