

MATH 381, History of Mathematics  
Review sheet for final Exam Fall 2011

**Broad description of content:** There will be a section with questions from the reading assignments and video on Archimedes. Apart from this, the emphasis of the exam will be on primarily on computations and proofs, often to be carried out using the (suspected) historical methods, and, to a lesser extent, possibly explanations of why certain methods were used, why and how certain historical phenomena happened, why mathematics developed the way it did, etc. (as best as we can tell).

**Materials:** During the exam you may use a calculator and (both sides of) *two* 3" × 5" notecard with notes written in your own handwriting. The rationale is that you could use one notecard for notes on the readings and video, with the other card containing any additional information. However, you can put anything you want on either of the notecards. Scratch paper will be available for those who want to use it. You are also free to bring a ruler or compass, but these won't strictly be necessary.

**Test layout:** The exam will be five or six pages, consisting of approximately 25 problems (including questions about the readings and video) plus approximately 3 extra credit problems. Most of the problems will be similar to the types of problems you've seen on quizzes, homework, previous exams, and review materials.

**Sections covered:** 1.2, 1.4-1.10, 2.1-2.10, 3.1-3.10, 4.1-4.8, 6.1-6.2, (and primarily just the reading from Sections 6.3, 6.7, and 6.8)

**Most important skills and concepts for this exam** (in no particular order)

1. Approximate  $\pi$  using various methods (classical, Gregory's series, Machin's formula, the Buffon needle experiment/probability)
2. Convert Hindu-Arabic numerals to numerals in Egyptian hieroglyphic, Babylonian cuneiform, Attic Greek, Ionic Greek, Roman, Chinese-Japanese, or Mayan system, & vice-versa
3. Solve the Greeks' three types of application of area problems that correspond to quadratic equations (and interpreting these problems and solutions in modern notation)
4. Use the Egyptian duplation method as well as duplation and mediation
5. Solve equations using the method of false position
6. Use the Babylonian geometric method for approximating square roots
7. Solve Babylonian inverse rectangle problems of types 1 (given area and semiperimeter) and 2 (given one dimension and total area with adjoining square).
8. Prove that a number is irrational (eg. roots, logs, pi, combinations of numbers)
9. Convert numerals from a positional system in one base to a positional system in another base, including radix fractions (approximating when necessary)
10. Proofs in Greek geometric algebra, and their interpretations in symbolic algebra
11. The three great Greek construction problems (and duplication, multisection, and quadrature problems in general); Insolvability of these problems using straightedge and compass (and connection to roots of polynomial equations); Solutions of the these problems using concepts of higher geometry

**Other important concepts/topics**

Law of the Lever; The Method of Archimedes; Converting equations from Diophantus' notation to modern notation and vice versa; Three stages in the development of algebraic notation; The introduction of modern notation; Constructing a segment whose length is any square root; Decomposing a fraction into a sum of unit fractions; Perfect numbers (definitions, Euclid's formula, Euler's Theorem); Figurate numbers—triangular, square, pentagonal, etc. (definitions, formulas, properties and proofs thereof); Pythagorean triples (definition, examples, properties and proofs, generating using the formulas of the Pythagoreans and Plato); The Pythagorean theory of ratios (and corresponding philosophy); Incommensurable lengths and irrational numbers (definitions, connection between, proofs involving); Determining whether a number is regular in a certain base; Archimedes' divisions of a sphere\*; Using Heron's formula\*; Constructing a sieve of Eratosthenes\*; spiral of Archimedes\*.

\* if covered

**Problems preceding the final exam**

For problems on material not covered on the first two exams, refer to Supplemental Homework 9 and any subsequent homework assignments. For problems dealing with the earlier material, see the sheets of review problems for the previous exams. There is no claim that the problems on these sheets together represent all possible types of exam problems. You should also review the problems on homework assignments, problem assignments, quizzes, and previous exams. Make sure you know how to do problems of these types.