MONT 106Q – Mathematical Thinking
Information for Midterm Exam
October 26, 2016

General Information

The first midterm exam will be given in class on Friday, November 4. It will cover the mathematical material we have studied since the start of the semester as well as the CHQ common readings *the curious incident of the dog in the night-time* and the *Histories* of Herodotus. For the mathematical questions, you may use a calculator (a graphing calculator is fine; graphing functions will not be used, though). No use of cell phones, I-pods, I-pads, or any other electronic devices beyond a calculator will be allowed during the exam. *If your only calculator is on your phone and you want to use one, then you will need to borrow a calculator for this exam.*

Format

Approximately 60% of the exam will consist of two or three short mathematical problems similar in format and content to the ones you have seen on the problem sets so far, together with a few multiple choice questions and short answer questions on the mathematical topics. The remaining 40% will be a short essay concentrating on aspects of the two CHQ common readings above. The mathematical topics are, in particular:

1. General ideas about number systems – positional systems (like ours) vs. non-positional systems (like Roman numerals, for instance), the *base* of a positional system, etc. Know how to interpret base-10 and base-2 numbers and give the base-10 form of a number expressed in base-2 and vice versa. Understand the distinctions between numbers, numerals, and number-words in a language.

2. Egyptian mathematics

   a. Know the approximate historical period represented by our primary Egyptian mathematical sources (the Rhind and Moscow mathematical papyri).
   b. Know the basic idea of their number system and the number symbols for 1's, 10's, 100's, 1000's (see p. 85 in *The Crest of the Peacock*)
   c. "Egyptian" multiplication and division by repeated doubling (you will not need to use the Egyptian symbols for this – compute with modern Hindu-Arabic numerals, but using the Egyptian methods).
   d. Egyptian computations with unit fractions via tables of representations like the one from the Rhind papyrus on page 95 of *The Crest of the Peacock* or the handout we discussed in class); also know that there are many different representations for fractions as sums of unit fractions.
   e. Be prepared for problems like the ones on Problem Set 2.

3. The Classic Mayan number and calendar systems (see Problem Set/Discussion 1) and the Lunar Eclipse Table from the Dresden Codex. Note: For questions about

computations within the *tzol'kin* calendar, I would give you the list of "month" names. There is no need to memorize them.

    a. Know how to work with the "mixed" base-20 system the Classic Maya used.

    b. Understand the *tzol'kin* calendar with 13 "months" of 20 days each and how days are identified in that system.

    c. Understand what the information on the page from the Dresden Codex we deciphered is and how it shows the mathematical thinking of the Classic Maya.

Some practice questions

I.

A) Express in base 10: $(101101)_2$.

B) Express in base 2: $(2691)_{10}$.

II. The following two questions are typical of the Egyptian geometry problems from the Moscow mathematical papyrus. Solve them using modern methods.

A) The area of a rectangle is 48 and the width is $3/4$ the length. What are the dimensions?

B) One leg of a right triangle is $5/2$ times the length of the other. The area is 20. What are the dimensions?

III. Compute "the Egyptian way:"

A) 56×125

B) 73×96

C) $134 \div 24$

IV.

A) Write the base-10 number 173 using Mayan numerals.

B) What day comes after 5 Imix in the Mayan *tzol'kin* calendar? Same question for 13 Ahau. (Look at the calendar graphic on the course homepage to figure these out; I would give you the list of "month" names in order if I asked something like this.

Essay

The prompt for the essay question will be *one of the following.* (**NOTE:** I will choose the question for the exam, so you will probably want to work out responses to both of these prompts to be well-prepared.) Aim for about 1 or 2 hand-written pages for your answer. In grading essay questions on an in-class exam, I will be looking just at the content of what you say. I might mark technical errors (misspellings, etc.) but those will not be taken into account in the grading.

1) Explain in detail two examples of mathematical problems that Christopher Boone discusses in *the curious incident of the dog in the night-time.* What do those problems

mean for him? More generally, what is the role of mathematics in his life? Is it fair to say that he relates to the world in mathematical terms? Why or why not?

2) Describe in detail two passages in the parts of the *Histories* we read where Herodotus mentions something that could be described as mathematical thinking in some form, or uses mathematical reasoning to make a point. In each case, say what the point of your passage is for Herodotus and analyze how the mathematical thinking is used.