How do historians know what people in the past did? They evaluate written sources. In this class, we must also evaluate our sources. In order to examine Egyptian mathematics, it is particularly important to understand the nature of sources. The most important fact to understand about the sources for Egyptian mathematics, is how limited they are. We have the remains of 7 papyri (and only the Rhind Papyrus is complete), 1 leather scroll, 2 wooden exercise tablets and 4 fragmentary sources. Moreover, except for 2 of the fragmentary sources, all of these objects date from the Middle Kingdom (2040–1785 BC). Not only does this mean that there is the amount of information about Egyptian Mathematics is very limited, it is also from a short historical period. Because of the lack of information, I do not believe that it is possible to draw reliable conclusions about the nature of Egyptian mathematics. Nonetheless, many writers have done so.

Most of what we know about Egyptian mathematics comes from only two sources: the Rhind Papyrus and the Moscow Papyrus. Between the two we have 110 problems on a variety of subjects, as well as some mathematical tables. The contents of the remainder of the extant sources (which are often poorly preserved) is generally similar to the contents of these two papyri. We will consider the contents of the Rhind Papyrus in detail. We will ask a question that many historians have not asked: who was the intended audience of this papyrus? The answer to this question has important implications for the kinds of questions we can reasonable ask about Egyptian
mathematics.

The Rhind Papyrus was written around 1650 BC by a scribe named Amhes (also rendered as A’h-mosè). In fact, Amhes is the earliest mathematician whose name is known. The papyrus contains some 87 mathematical problems as well a table of fractions. For each of the problems, Amhes stated the problem and then gave the solution. The problems are grouped by topic (fractions, algebra, geometry, etc.) and generally are ordered from easiest to most difficult. The most reasonable conclusion is that the papyrus was intended for the instruction of students. What level of student did Amhes have in mind? He assumed that his reader was familiar with arithmetic and provides no explanation of arithmetic operations although he often provides a fairly detailed description of a problem that only requires arithmetic. For example, problem 6 requires that 10 loaves of bread be divide among 9 labors; so the problem is to divide 10 by 9 (which is a fairly hard problem using Egyptian techniques). He provides a solution that lists every step. From this we can reasonable conclude that Ahmes did not expect his audience to be proficient with manipulating fractions. So the intended audience of the Rhind Papyrus knew arithmetic but was not proficient with fractions. We can conclude that the Rhind Papyrus was written for what we might call secondary students: scribes-in-training who had completed their elementary mathematical education and were ready for instruction in more advanced subjects. In terms of our modern education system, the Rhind Papyrus would be appropriate for middle-school students.
Pretend for a moment that you are an archaeologist from a thousand years in the future. You have unearthed a middle-school level algebra textbook. What would you conclude about our mathematical knowledge? You would conclude that our algebra was extremely proficient at handling linear equations (solving $y = ax$, graphing $y = mx + b$, etc) and capable of solving some special quadratic equations ($ax^2 + bx + c = 0$ when we can factor the equation). You would probably conclude that our system was not capable of handling high degree equations ($x^3$ etc). The error that you would make in this situation, is not to misread the data but to misinterpret it. The fact that there are middle-school textbooks (or seven of them), does not preclude the existence of more advanced books of mathematics.

Many historians of mathematics have drawn the conclusion that Egyptian mathematics was not very sophisticated and was stagnant. But let us consider the sources available. We have 7 “textbooks” and some mathematical tables. We do not have any sources that could be categorized as “advanced mathematics.” We should not expect the sources we have to contain any sophisticated problems, they would overwhelm the students. We should not expect that the curriculum that scribes learned nor texts used to learn it would change much over a 400 year period. For instance, Euclid’s *Elements* was used an introductory geometry text for 1500 years. I believe that it is impossible to draw any conclusions on the sophistication of Egyptian mathematics based on the sources available.

Two problems that we do have, hint at the level of sophistication of Egyptian mathematics. The first is problem 79 of the Rhind Papyrus (see Eves §2-10). The
problem is obscure, but essentially asks for the sum

\[ 7 + 49 + 343 + 2401 + 16807. \]

That is,

\[ 7 + 7^2 + 7^3 + 7^4 + 7^5. \]

The interesting thing here is that this problem shows that the Egyptians may have known a version of the formula:

\[ 1 + x + x^2 + \cdots + x^n = \frac{(x^{n+1} - 1)}{(x - 1)}. \]

Problem 14 of the Moscow Papyrus gives the correct procedure for finding the volume of a frustum of a square pyramid (that is, the solid obtained by cutting a little pyramid off the top of a big pyramid). In our notation,

\[ V = \frac{h}{3}(a^2 + ab + b^2), \]

where \( h \) is the height, and \( a \) and \( b \) are the lengths of the upper and lower squares. No justification of these two results is provided, but this is to be expected in a textbook; you can use a formula even if you can’t derive it. However, these problems imply that Egyptian mathematics may have been more sophisticated than historians have generally thought.