Lesson 12: Graphs of Exponential Functions

(Cover 3.3)	**Read:** Sections **3.4 and 3.5** **Do: WebWork, Team Homework**
MIDTERM 1 is Monday, October 11th from 6 pm - 7:30 pm, location TBA (Note that this is NOT Michigan time - arrive by 5:50 pm. Exam begins at 6 pm.) The Exam will cover Sections 1.1-1.5, 2.1-2.6, and 3.1-3.5.	

§3.3 Objectives

- For the exponential function $Q = ab^t$, students should understand how changes to the parameters a and b affect the shape of the graph.
- Students should be introduced to horizontal asymptotes. For exponential functions, they should recognize that $y = 0$ is a horizontal asymptote for a function of the form $f(x) = ab^x$ (as long as $0 < b < 1$ or $b > 1$ of course).
- Given an output value for Q, students should be able to use their graphing calculators to find an approximate solution for t for $Q = ab^t$. (Reminder: No logarithms yet!)

Suggested Lesson Plan

0-25 Use this time for a short quiz and/or to hand back graded papers. Then do a *very* short recap of the previous lesson. **Section 3.2 #25 on page 121** could be a good review problem.

25-40 Start developing the general characteristics of the graphs of $f(x) = ab^x$ by having students quickly graph several exponential functions, using their calculators, on the same screen. For example, you could ask them to graph $f(x) = 20(1.4)^x$, $g(x) = 28(1.2)^x$, $h(x) = 10(0.8)^x$, and $j(x) = 15(0.6)^x$ in the window $-5 \le x \le 5$ and $0 \le y \le 70$. They should note that the a gives the y-intercept and that b determines whether the graph is increasing or decreasing. Talk about the concavity of the graphs. This is an opportunity to build on students' understanding of the connection between the algebraic formula for an exponential function and the appearance of the graph. Ask a few questions to promote a class discussion. For example, why does the graph tend to 0 as x gets very large (tends to ∞) when $0 < b < 1$? Why does the graph go to ∞ when x goes to ∞ when $b > 1$? You can use this opportunity to discuss the domain and range of these functions as well.

40-50 Ask the students to work on **Section 3.3 #24 on page 128**. Make sure that they consider the possibilities when $a < 0$. However, do not dwell on the specifics. (We will discuss reflections in Chapter 5, and students will be able to more easily understand the $a < 0$ case then.)

50-65 Introduce the idea of horizontal asymptotes. [Note: vertical asymptotes are introduced with the graph of the log function. There is no need to discuss them here.] Use the notation, $Q \to 0$ as $x \to \infty$, as introduced in this section. Also introduce proper limit notation. Note that we DO NOT use formal definitions of the limit in this class, so there is no need to introduce them to the students. To make sure the class understands the notion of horizontal asymptotes, have the students try **Section 3.3 #28 and #30 on page 128**. Ask for volunteers to draw their graphs on the board, and make sure to point out that there are a variety of answers that would be acceptable.

65-70 Remind students how they can solve exponential functions using their calculators. DO NOT DO THIS ALGEBRICALLY AT THIS POINT. Students will learn how to solve this analytically when we cover logarithms in Chapter 4. For now, the students should know how to use the INTERSECT capability of the calculator to find the solution of an exponential equation. Ask the students to work on **Section 3.3 #12 on page 127**. Circulate the room to make sure students dont have questions with the calculator.

70-80 For the last 10 minutes of class, work on some application problems that summarize the main concepts in this lesson. **Section 3.3 #16 on page 127** is a nice example to do here since it also gives students more practice in finding appropriate viewing windows, which tends to be difficult for students. You could also try **Section 3.3 #15 on page 128**. Summarize the key points of the problem, and then of the lesson.

At the end of class, summarize the day's lesson and remind students about the upcoming exam. (It will cover Sections 1.1-1.5, 2.1-2.6, and 3.1-3.5.)