Problems that will definitely be on the test

- There will be at least one problem from each of sections 3.7, 3.8, and 4.1.

- From chapter 5, note that there are only three types of word problems: (1) problems involving compound interest, (2) problems where something grows continuously, and (3) problems where a formula is given. You have to memorize the appropriate formula for the first two types. There will be at least one problem of each type. The compound interest problems may count for more.

- From chapter 5, you will be asked to simplify some quantities. This will test your knowledge of the definition and properties of logarithms, as well as your ability to deal with exponents properly.

- From chapter 5, you will be asked to solve some equations. This will test your knowledge of the definition and properties of logarithms, as well as your ability to deal with exponents properly.

Information on each section

- **Section 3.7 — Operations on Functions**
  - Given \( f(x) \) and \( g(x) \), find \((f \circ g)(x), (f \circ g)(3), g(g(2)), g(f(x))\), etc.
    * Look at exercises #9—20.

- **Section 3.8 — Inverse Functions**
  - Know the horizontal line test for one-to-one functions.
    * Look at exercises #1—12.
  - Know that each one-to-one function \( f(x) \) has an inverse, denoted \( f^{-1}(x) \). This notation does not mean the same thing as \( 1/f(x) \). For example, if \( f(x) = x^3 \), then \( f^{-1}(x) = \sqrt[3]{x} \) (not \( 1/x^3 \).)
  - Be able to use the theorem on inverse functions from page 215, which basically says that \( f \) and \( g \) are inverses if and only if \( f(g(x)) = x \) and \( g(f(x)) = x \).
    * Look at exercises #13—16.
  - When a function has an inverse, one can sometimes find its formula. Know the technique of switching \( y \) and \( x \) and solving for \( y \) to obtain this formula.
    * Look at exercises #17—32.
Given the graph of a one-to-one function \( f(x) \), be able to graph \( f^{-1}(x) \) using that \((a, b)\) is on the graph of \( f(x) \) if and only if \((b, a)\) is on the graph of \( f^{-1}(x) \).

* Look at exercises #35—38.

**Section 4.1 — Polynomial Functions of Degree Greater than 2**

- Graph \( f(x) = x^2, f(x) = x^3, f(x) = x^4, f(x) = x^5 \), etc. or any shifted version of these.
  - Look at exercises #1—4, 11—14.
- If \( f(x) \) is a polynomial which factors into linear terms, sketch the graph of \( f(x) \) by finding the \( x \)-values for which \( f(x) \) is positive, negative, or zero.

**Section 5.1 — Exponential Functions**

- Shifting techniques will not be emphasized, but you should certainly be able to graph \( f(x) = a^x \) for \( a > 1 \) and for \( 0 < a < 1 \).
  - Look at exercises #9a, 9h, 9i, 10a, 10h, 10i, 11, 12.
- Be able to solve simple exponential equations by rewriting both sides so as to have the same base. For example,
  \[
  \left( \frac{1}{2} \right)^x = 8^{x-4} \\
  (2^{-1})^x = (2^3)^{x-4} \\
  2^{-x} = 2^{3x-12} \\
  -x = 3x - 12 \\
  12 = 4x \\
  x = 3
  \]
  - Look at exercises #1—8.
- Know and be able to use the compound interest formula
  \[
  A = P \left( 1 + \frac{r}{n} \right)^{nt}
  \]
  - Look at exercises #29, 30, 33, 34.

- Be able to solve for unknowns in word problems that include the relevant formula.
  - Look at exercises #21, 22, 23a, 24a, 25a, 26a, 27, 31, 32.
• Section 5.2 — The Natural Exponential Function

- Since $e \approx 2.7$, you should be able to graph exponential functions with $e$ as the base.
  * Look at exercises #1a, 2a, 4a.
- Be able to solve for unknowns in word problems where something is said to grow at a continuous rate. This might be the amount of money in an account which earns interest, or it might be for some quantity other than money. In either case, you should use the continuously compounded interest formula $A = Pe^{rt}$.
  * Look at exercises #5—10 (also #58 from section 5.3) for continuously compounded interest, and #21, 22, 31, 32 for other quantities which grow continuously.
- Be able to solve for unknowns in word problems that include the relevant formula.
  * Look at exercises #19, 20, 23, 24, 25, 27, 28 (also #55, 56, 59 from 5.3, #52 from 5.4, and #52 from 5.5.)
- As in the previous section, be able to solve simple exponential equations by rewriting both sides so as to have the same base. Here that base just happens to be the number $e$.
  * Look at exercises #11—12.

• Section 5.3 — Logarithmic Functions

- Know that $a^x$ and $\log_a(x)$ are inverse functions. We usually only talk about logarithms when the base $a > 1$, even though it is also defined for $0 < a < 1$.
- Know that in order to get a real answer, you should only take logarithms of positive numbers.
- Shifting techniques will not be emphasized, but you should certainly be able to graph $f(x) = \log_a(x)$ for $a > 1$.
  * Look at exercises #31a, 32a, 33, 34.
- From the definition of logarithms, know that
  1. $\log_a(x) = y$ if and only $a^y = x$
  * Look at exercises #1—4, 9—12.
- Know the following properties of logarithms.
  2. $\log_a(1) = 0$
  3. $\log_a(a) = 1$
  4. $\log_a(a^x) = x$
  5. $a^{\log_a(x)} = x$

Note that the only logarithms on your calculator are likely to be $\log_{10}$ (called the common logarithm and written log), and $\log_e$ (called the natural logarithm and written ln.) Make sure that the definition and properties above are familiar when the base $a$ is replaced by 10 or $e$. In particular for base $e$ we have the following.
\[ \ln(x) = y \text{ if and only } e^y = x \]
\[ \ln(1) = 0 \]
\[ \ln(e) = 1 \]
\[ \ln(e^x) = x \]
\[ e^{\ln(x)} = x \]

* Look at exercises #13—16.
- Be able to solve equations involving logarithms.
  * Look at exercises #17—30.
- Be able to solve word problems similar to those in section 5.2.
  * Look at exercises #55, 56, 58, 59.

**Section 5.4 — Properties of Logarithms**

- Know the following properties of logarithms.

  6. \( \log_a(uw) = \log_a(u) + \log_a(w) \)
  7. \( \log_a \left( \frac{u}{w} \right) = \log_a(u) - \log_a(w) \)
  8. \( \log_a(u^c) = c \log_a(u) \)

- Be able to solve equations involving logarithms.
  * Look at exercises #17—32.
- Be able to solve word problems similar to those in sections 5.2 and 5.3.
  * Look at exercise #52.

**Section 5.5 — Exponential and Logarithmic Equations**

- Be able to solve equations involving logarithms and exponentials.
  * Look at exercises #1—4, 11—30.
- Be able to solve word problems similar to those in sections 5.2, 5.3, and 5.4.
  * Look at exercise #52.