A. The best ways to prepare for the test are to:

- read your notes from the lectures and labs – you are responsible for all the material covered in the class and the lab;
- read all the sections listed below, being careful to do as many of the examples as possible, particularly those listed; **omit** all the Technology Connection subsections for this midterm;
- do the daily assigned exercises and the lab worksheets since exam questions can be based on these;
- redo the quizzes;
- there are more review problems and a Chapter Test at the end of Chapters 4 and 5;

Some of the daily assigned exercises are too long for an in-class exam, but they do require understanding of the important ideas we have covered and, so, give a good test of understanding.

B. Here is a list of the sections from our text and any other materials relevant to the first test.

**§3.5 and 3.7:** Applied max-min problems. The strategy described on pp. 228 - 229 is a useful summary; all the examples in the section are useful. You will need to know how to find absolute maxima and minima, so you should review the methods from §3.4. The only subsection of §3.7 we studied was Related Rates. The examples are good and be able to do 33, 37, 39, 41 on pp. 254 - 255.

**§4.1 - 4.2:** Know the basic properties of exponential and log functions since we use these in the next sections. Omit the subsection Log-Log Plots, pp. 290 - 292.

**§4.3:** All of the section and all examples, except the subsection Rule of 69. Theorem 8 is very important. Know the form of the logistic equation, and that it satisfies the differential equation

\[
\frac{dP}{dt} = kP \left( 1 - \frac{P}{L} \right).
\]

See your notes for the facts about logistic growth. Also, see the first few pages of Logistic Equation and Notes on Maximizing Food Intake posted on the website at the link Other material. You are **not** responsible for the content of this handout beyond p. 3 but the first few pages explain the meaning of the differential equation.

**§4.4:** All of the section and examples. Remember: Newton’s Law of Cooling applies to warming, too!

**§4.5:** Just know Theorems 12, 13, 14.

**Chapter 4 Summary and Review pp. 330 - 331:** List of terms, Review Exercises, Chapter Test

**§5.1:** Know Theorems 1 - 3 and how to use them; all the examples in the section are useful; acceleration/velocity/distance functions and population growth are the first applications of antiderivatives.

**§5.2:** Be able use to use summation notation and know the definition of the Riemann sum \([p. 350]\). This definition uses the right endpoint of each subinterval to compute the value of the function. Example 6 is particularly important – it illustrates how one computes a definite integral by taking
the limit of Riemann sums. Know the distinction between area and the definite integrals. We did not use a lot the term signed area but you must understand the examples in that subsection.

§5.3: You can skip the subsection The Derivative of Area Functions and Theorem 4. Begin reading this section at the top of p. 364. For us, the Fundamental Theorem of Calculus is Theorem 5 [p. 364] – know the statement of this theorem and how to use it to find definite integrals. All the examples are important. Know the definition of the average of a continuous function on a closed interval [p. 367].

§5.4: We use Properties 1 - 3 all the time to compute definite integrals. Know how to use Theorem 6 to compute the area of a region between two curves. You must also be able to do a more general question where you first have to determine where graphs intersect before you know what the region is. Here are two good examples:

1) Find the area of the region between the graphs of \( f(x) = x^2 \) and \( g(x) = x^3 \), between \( x = -1 \) and \( x = 2 \).

2) Find the area of the region between the graphs of \( f(x) = \cos x \) and \( g(x) = \sin x \), between \( x = 0 \) and \( x = \pi \).

§5.5: Using the Substitution Method requires practice, so do lots of the examples and exercises. Remember, you are looking for an integrand of the form \( f'(g(x)) \cdot g'(x) \) so that you can use the substitution \( u = g(x) \). This strategy is explained well at the beginning of the section.

§5.6: Integration by Parts [formula is Theorem 7 on p. 387] is the reverse of the product rule. There are a few basic forms of integrand that are most common:

- \( \int xe^x \, dx \), \( \int x \sin x \, dx \), let \( g = x \) and let \( df \) be the rest of the integrand
- \( \int x^2 e^x \, dx \), let \( g = x^2 \) and be ready to do parts twice
- \( \int \ln x \, dx \), \( \int x \cdot \ln x \, dx \), let \( g = \ln x \) and let \( df \) be what it has to be
- \( \int x\sqrt{x+1} \, dx \), let \( g = x \) and let \( df \) be what it has to be. However, it is easier to use substitution – let \( u = x + 1 \) – for this integral.

All of these types are illustrated in the examples in the section. Also, read Tips on Using Integration by Parts on the bottom of p. 388. Omit the subsection Tabular Integration by Parts.

§5.9: Know the definition of an improper integral [on pp. 415-416] and what it means for an improper integral to converge or diverge. Example 2 is a good illustration and Example 3 is a reasonable application.

Chapter 5 Summary and Review pp. 422-425: list of terms, Review Exercises [1 - 25; do 28 and 31 by Substitution and/or Integration by Parts; 33 - 36, 38 - 50], Chapter Test [1 - 15, 16 by realizing that \( 2 = e^{\ln 2} \), 18 - 22, 25 , 35]

World problems: We did a lot of exponential models, for population growth, population/radioactive decay and cooling/warming. Try to redo all of them and also do these two:

- In a lab, Staphylococcus aureus bacteria will grow exponentially with doubling time 0.47 hours. (a) A sample of 200 bacteria is placed in a petri dish. Find the population after 2 days.
(b) A biologist wishes to have a sample of 10,000 Staphylococcus aureus for an experiment at 10:30 a.m. How many bacteria should be placed in a petri dish at 8:00 a.m. in order for the sample to contain the right number for the experiment?

- Exponential decay: The decay rate of carbon-14 is about 0.00011205. How old is a skeleton that has lost 60% of its carbon-14?