How to Prepare

In 3 words: Practice, practice, practice! There's no substitute.

See Test 2 review for details on how to do this.

Included topics & syllabus

The test will be based on material from the following sections of the textbook:

* Chapter 3: Sec. 3.6-3.9.

* Chapter 4: All sections, except 4.4 and 4.8.

* Chapter 5: Sec. 5.1-5.2.

IMPORTANT NOTE: Although this test won't have any questions directly taken from the earlier materials, it will be impossible to pass this test without proficiency on most concepts covered earlier. E.g., all the rules of differentiation covered in Sec. 3.1-3.5 are heavily used in Chapters 4-5. Also, understanding of key limit concepts is required in Sec. 4.5.

Other key reminders

* Grading will be based on solution process and reasoning – NOT on right answers.

* Remember to bring a graphing calculator, and to use it for verifying your answers and for insights into solution strategies.

Summary of major shortcuts of differentiation

1. Power rule: $(x^n)' = nx^{n-1}$
2. Product rule: $(fg)' = f'g + fg'$
3. Quotient rule: $\left(\frac{f}{g}\right)' = \frac{f'g - fg'}{g^2}$
4. Chain rule: $\frac{df}{dx} = \frac{df}{du} \times \frac{du}{dx}$
5. Exponential function with base e: $(e^x)' = e^x$
   Important derived rule: $(\ln x)' = \frac{1}{x}$
6. Basic trigonometric functions: $(\sin x)' = \cos x, \quad (\cos x)' = -\sin x$
   Important derived rule: $(\tan x)' = \sec^2 x$
7. Implicit differentiation: To differentiate terms written as functions of y, with respect to x, first differentiate with respect to y, then multiply by $\frac{dy}{dx}$. E.g., $(xy^2)' = y^2 + x(2yy') = y^2 + 2xyy'$
8. Logarithmic differentiation: To differentiate functions that have a variable in the exponent, take "ln" of both sides, apply properties of ln, then implicitly differentiate both sides & solve for the derivative. E.g.,

$$y = x^{\sqrt{x}} \;\Rightarrow\; \ln(y) = \sqrt{x}\ln(x) \;\Rightarrow\; \frac{y'}{y} = \frac{\sqrt{x}}{x} + \frac{\ln(x)}{2\sqrt{x}}$$

$$\Rightarrow\; y' = x^{\sqrt{x}}\left[\frac{2 + \ln(x)}{2\sqrt{x}}\right]$$

Other derived rules:

* Trig: $(\sec x)' = \sec x \cdot \tan x$, $(\csc x)' = -\csc x \cdot \cot x$, $(\cot x)' = -\csc^2 x$.

* Inverse trig: $(\sin^{-1} x)' = \frac{1}{\sqrt{1-x^2}}, \quad (\cos^{-1} x)' = -\frac{1}{\sqrt{1-x^2}},$

$$(\tan^{-1} x)' = \frac{1}{1+x^2},$$

Notes on emphasis by section

Sec. 3.6-3.9, 4.1

- These sections primarily cover computational skills and applications.
- Although Sec 3.6-3.7 appear to only focus on narrow topics (inverse trig and log functions), you will need differentiation skills from all the previous sections here. In particular, make sure you can comfortably do problems using the chain rule and implicit differentiation.
- We covered Sec. 3.8, 3.9 and 4.1 lightly. My expectation for this test is that you will be able to do problems and applications of the type that were on homework or that were covered in class or lab.

Sec. 4.6

- Optimization is an important applications topic. Expect one problem from this section. A common error students make is to forget to check/show that their answer is actually the required type of absolute extreme.

Sec. 4.2-4.3

- These sections contain a mix of theoretical concepts and computations.
- Key concepts & definitions include:
  - Local vs. absolute minimum/maximum (extremes) of a function
  - Critical points and how to find all of them
  - What do the 1st and 2nd derivatives tell us about a function
  - 1st derivative and 2nd derivative test for local extremes
  - How to find absolute extremes: (1) plugin method for continuous $f(x)$ on closed interval; (2) If continuous $f(x)$ has one critical point.
- Mean Value Theorem: Explain what it says. To what functions is it applicable?
- Computational skills expected: How to graph $f(x)$ using calculus - by finding domain, intercept, asymptotes, critical points, sign charts of 1st and 2nd derivatives, increasing/decreasing intervals, local extremes, concave up/down.

Sec. 4.5

- Must understand what an indeterminate form is, and how to apply L.H. rule to find limits of indeterminate quotients, products, differences, and exponents. Expect mainly computational problems here.
- Be sure to verify that a given limit problem is indeterminate before applying L.H. rule.

Sec. 5.1-5.2

- Again, there is a strong mix of theoretical concepts and applications/ computations here.
- Key concepts & definitions include:
  - The area problem: How to approximate the area under a curve
  - How to set up Riemann sums with left/right/mid points
  - The sigma notation - how to put expressions into sigma notation; How to convert back into expanded notation.
  - The exact area under a curve
  - The definite integral of $f(x)$ from a to b: can you define it?
  - Interval properties and comparison properties of definite integrals
- Computational skills expected: How to find approximate area under a curve; how to setup Riemann sums in sigma notation; how to compute a definite integral from the graph (esp. in certain cases where you can find the exact area using geometry).

Some new practice problems

I strongly recommend Worksheets 10-13 which can be found in the "Class supplements" section of the website. Note that Worksheet 13 includes some exercises from Sec. 4.8, which is not on the syllabus for Test 3.

And here are a few more exercises to try under simulated testing conditions after you have completed your preparations 75-80% of the way.

Pg. 248-250: Exercises: 12, 18, 20, 23, 26, 29, 30, 32, 43, 59, 60, 63, 72, 75a, 76.

Pg. 323: Concept check: 1, 4, 5, 6, 9.
Pg. 323-324: True-False: 1, 2, 4, 5, 7, 9, 10.
Pg. 324-326: Exercises: 1, 3, 5, 6, 9, 10, 14, 27, 28, 29, 31, 32, 33, 37, 39, 40, 45, 50.

Pg. 425-427: Exercises: 1-4.