

Things to Know for Math 140B Midterm Exam #1

Wednesday, October 8th

Review Algebra and Trigonometry

- Be able to draw a sign chart for a function and identify where the breaks must occur
- Know the point-slope equation of a line, and how to convert it to slope-intercept form
- Know how to find the x - and y -intercepts of a function
- Know how to evaluate $f(x+h)$ and how to simplify a difference quotient
- Know three sets of trigonometric identities: Reciprocal, Quotient, and Pythagorean

2.1 Limits and Continuity (Graphically)

- Know how to identify the existence and value of a limit displayed on a graph
- Understand the difference between a limit $\lim_{x \rightarrow a} f(x)$, left limit $\lim_{x \rightarrow a^-} f(x)$, and right limit $\lim_{x \rightarrow a^+} f(x)$
- Understand how to identify where a function is continuous or discontinuous, based on a graph

2.2 Limits and Continuity (Algebraically)

- Understand how continuity and evaluating limits are related - when can we just plug in the number?
- Know common indeterminate forms: $\frac{0}{0}$, $\frac{\pm\infty}{\pm\infty}$, $\infty - \infty$, $0 \times \infty$
- Understand common methods for simplifying indeterminate forms
 - * factoring
 - * getting a common denominator
 - * multiplying by the conjugate
 - * rearranging into more manageable parts
- Know the differences between handling $\lim_{x \rightarrow a} f(x) = \frac{0}{c}$, $\frac{c}{0}$, or $\frac{0}{0}$ (for $c \neq 0$)
- Memorize the identity $\lim_{\theta \rightarrow 0} \frac{\sin \theta}{\theta} = \lim_{\theta \rightarrow 0} \frac{\theta}{\sin \theta} = 1$
- Know how to apply the limit definition of continuity: $\lim_{x \rightarrow a^-} f(x) = \lim_{x \rightarrow a^+} f(x) = f(a)$

Extra Types of Continuity and Intermediate Value Theorem

- Understand how to visually classify discontinuities as removable, jump, or infinite (asymptotic)
- Understand how to algebraically classify the above discontinuities
- Memorize the Intermediate Value Theorem (IVT)
- Know how to apply the IVT (be able to justify your steps, identify a , b , $f(x)$, and N , etc.)

2.3 Average Rates of Change

- Understand how to visually and algebraically calculate an average rate of change
- Understand how difference quotients relate to average rates of change
- Know how to identify the units for a rate of change

2.4/2.6 Limit Definition of the Derivative/Instantaneous Rates of Change

- Know how to calculate a derivative using the limit definition
- Know and understand the various interpretations of the derivative: the slope of the tangent line, the instantaneous rate of change at a specific point/time
- Understand different notations for the derivative: $f'(x)$, y' , $\frac{dy}{dx}$
- Know how to find the equation of a tangent line to a function at a point
- Understand the difference between an instantaneous rate of change and an average rate of change, both algebraically and visually
- Know how to identify where a function is differentiable, algebraically and visually
- Understand the relationship between position, velocity, and acceleration

2.5 Differentiation Techniques

- Know how and when to apply the Power Rule
- Know how to take the derivative of a constant function
- Know how to take the derivative of a constant TIMES a function
- Know how to take the derivative of two functions being added or subtracted
- Know the derivatives of $\sin x$ and $\cos x$

2.7 The Product and Quotient Rules

- Know how and when to apply the Product Rule
- Know how and when to apply the Quotient Rule
- Memorize the derivatives of all six standard trigonometric functions

2.8 The Chain Rule

- Understand how to identify function composition and which are the “inside” and “outside” functions
- Know how and when to apply the Chain Rule
- Understand how to take derivatives involving multiple differentiation techniques at once

2.9 Higher-Order Derivatives

- Know how to take multiple derivatives of a function
- Understand how units are affected by taking multiple derivatives
- Understand the various notations for the n th derivative: $f^{(n)}(x)$, $\frac{d^n y}{dx^n}$

3.1/3.2 Basic Curve Sketching

- Know how to draw a basic sketch of the derivative $f'(x)$, given the original graph of $f(x)$
- Know how to identify relative/local maximums and minimums (extrema) based on a graph
- Understand how to find critical points and local extrema algebraically
- Understand how to identify intervals of increase and decrease of a function, both visually and algebraically
- Know how to identify points of inflection and concavity based on a graph
- Understand how to find points of inflection and intervals of concavity algebraically
- Be able to accurately graph basic functions by identifying intercepts, critical points, local extrema, points of inflection, intervals of increase/decrease, and intervals of concavity

Suggested Review Problems

- Chapter 2 Summary and Review (page 155) - #3 - 44, except 41
- Chapter 2 Test (page 157) - #3 - 45
- Section 3.2 - #1-113
- Sample Exams for regular Math 140 found here: <http://www.math.psu.edu/ug/courses/math140/sampleexams>
 - Sample Exam A: #1-5, 8-16
 - Sample Exam B: #1-6, 8-11, 13, 15-20 (try 7 and 8 for an extra challenge!)
 - Sample Exam C: #1-9, 11, 13-18
 - Sample Exam D: #1-5, 7-10,14-15 (try 6 and 11 for an extra challenge!)
- Please look over ALL graded homework, and supplemental homeworks/handouts, ESPECIALLY the ones on continuity/IVT and graphing the derivative!