

Math 161, Fall 2001
Test 1 Review Sheet

Test 1 covers sections 1.1–1.4, 2.1–2.5, 2.7–2.9, and Appendices A–D. This includes the following:

1. Graphs, Equations and Functions

(a) Basics

- i. Coordinate Geometry (how graphs and equations mix)
- ii. Domain and range of functions
- iii. Combination of functions (especially composition)
- iv. Shifts and stretches of graphs

(b) Modeling with functions

(c) Floor and Ceiling Functions: $\lfloor x \rfloor$, $\lceil x \rceil$

(d) Polynomials

- i. all polynomials are continuous at every point on real line (why?)
- ii. if $p(a) = 0$ then $(x - a)$ will factor out

(e) Rational functions (quotients of polynomials)

- i. continuous on their domains (Why?)
- ii. techniques for evaluating limits of
 - factoring (see note on polynomials) and simplifying

(f) Trigonometric functions

- i. definitions in terms of unit circle
- ii. relationship to right triangles (soh-cah-toa)
- iii. Pythagorean Theorem (including applications and proof)
- iv. evaluation at special angles (multiples of $\pi/6$ and $\pi/4$)
- v. trig identities based on Pythagorean Theorem ($\sin^2 x + \cos^2 x = 1$ and its cousins)

2. Limits

(a) Interpreting $\lim_{x \rightarrow a} f(x) = L$, $\lim_{x \rightarrow a^-} f(x) = L$, $\lim_{x \rightarrow a^+} f(x) = \infty$, etc. in words or from graphs.

(b) Definition

- i. be able to find a δ for ϵ with simple functions
- ii. how definition makes “close to” a precise notion

(c) Finding a limit (one-sided, two-sided)

- i. Approximating numerically (assuming it exists)
- ii. From graphs
- iii. Via limit laws (and common algebraic techniques)
- iv. Via continuity
- v. Via the Squeeze Theorem

3. Continuity

- (a) Definition of continuity; definition of continuity from the left/right, on an interval
- (b) Various functions that are continuous (see Thms. 4, 5, 7 and 9, pp. 125, 127, 128)
- (c) Intermediate Value Theorem
 - i. Be able to state it, draw pictures to represent it,
 - ii. How to use it to locate roots of functions (bisection method)
- (d) Differentiability implies continuity (Thm. p. 169)

4. Derivatives

- (a) Relationship between slope of secant line and slope of tangent line
- (b) Relationship between average rate of change and instantaneous rates of change
- (c) Formal definitions of
 - i. Derivative (see boxes 2, 3 on p. 156) [Be able to both state it and explain it.]
 - ii. Differentiability at a number a and on an interval (a, b)
- (d) Using definition to evaluate a derivative
- (e) Using graph of f to sketch graph of f'
- (f) Applications of derivative
 - i. Interpreting
 - A. As the limit of average rates of change
 - B. As (instantaneous) rate of change and finding units
 - ii. If $s(t)$ gives position, then $s'(t)$ is velocity
 - iii. Finding equations of tangent lines