

# Midterm #1 Study Guide

## Math 156 (Calculus I), Fall 2022

1. Basics (domain/range, what graph looks like, etc.) for standard functions [§1.1, 1.2, 1.4, 1.5]
  - (a) algebraic functions: power functions (like  $x^3$ ), root functions (like  $\sqrt{x}$ ), polynomials (like  $x^2 - 3x + 1$ ), rational functions (like  $\frac{x^2-1}{x+5}$ )
  - (b) trigonometric functions (like  $\sin(x)$  and  $\cos(x)$ )
  - (c) exponential functions (like  $e^x$ ) and logarithmic functions (like  $\ln(x)$ )
  - (d) piecewise functions (like absolute value  $|x|$ )
2. Algebraic operations on functions as geometric operations on graphs [§1.3]
  - (a) translation (up/down & left/right), stretching (horiz. & vert.), reflection (over axes)
  - (b) symmetry under these operations, especially even and odd functions
3. How to make new functions from old functions  $f(x), g(x)$  [§1.3]
  - (a) sum ( $f + g$ ), difference ( $f - g$ ), scaling ( $cf$ ), product ( $fg$ ), quotient ( $f/g$ )
  - (b) composition of functions:  $(f \circ g)(x) = f(g(x))$
4. Inverse functions  $f = g^{-1}$  [§1.5]
  - (a) especially exponential and logarithmic functions
  - (b) graph of inverse function is reflection across line  $y = x$
5. Intuitive definition of limit and basic reasons why a limit might not exist [§2.2]
  - (a) intuitive definition of one-sided limits
  - (b) one-sided limits must agree for usual (two-sided) limit to exist
6. How to compute limits using the limit laws [§2.3, 2.5]
  - (a) sum ( $f + g$ ), difference ( $f - g$ ), scaling ( $cf$ ), product ( $fg$ ), quotient ( $f/g$ ) limit laws
  - (b) how to deal with " $\frac{0}{0}$ " by cancelling factors
  - (c) continuous functions (pushing limit thru, and direct substitution a.k.a. "plugging in")
7. Limits at infinity and limits equal to infinity [§2.2, 2.6]
  - (a) limits at  $\pm\infty$  = horizontal asymptotes
  - (b)  $\pm\infty$ -valued limits = vertical asymptotes
8. The definition(s) of derivative [§2.1, 2.7, 2.8]
  - (a) derivative as slope of the tangent to a curve at a point
  - (b) derivative as a limit  $f'(a) = \lim_{x \rightarrow a} \frac{f(x) - f(a)}{x - a}$