1.7: Parametric Curves

- Sketch Curves
- Find Cartesian Equations
- Find Initial points and terminal points
- Find parametric equations for a given curve

2.1: Tangents and Velocities

- Identify, graph, and find approximate equations for tangent lines
- Approximate instantaneous rates of change

2.2: Limits

- Estimate graphically and numerically
- Be able to explain what $\lim_{x\to a} f(x) = L$ means
- Be able to show that a limit DNE numerically
- Graphical and numerical estimates for one-sided limits
- Know that $\lim_{x\to a} f(x) = L \Leftrightarrow \lim_{x\to a^+} f(x) = L = \lim_{x\to a^-} f(x)$
- Know that two sided limits are undefined when $f(x)$ is not defined on an interval around the limit point.

Appendix D: Formal Definition of Limits

- Be able to state the formal definition:

$$\lim_{x\to a} f(x) = L \Leftrightarrow \forall\epsilon > 0 \exists\delta > 0 \text{ such that } 0 < |x-a| < \delta \Rightarrow |f(x) - L| < \epsilon$$

, where $f(x)$ is defined on (c, d) except possibly at a with $c < a < d$.

- Be able to give a specific δ for a given ϵ.
- Be able to use the $\epsilon - \delta$ definition to prove that the following types of functions have specified limits:
  - linear functions
  - constant functions
  - power functions

2.3: Limit Laws

- Remember to check that the limit of each subexpression exists before applying any arithmetic limit laws
- Know laws for sums, multiples, products, quotients, powers, and roots of functions
- Know that $\lim_{x\to a} p(x) = p(a)$ for any polynomial $p(x)$
- $\lim_{x\to a} f(x) = \lim_{x\to a} g(x)$ if $f(x) = g(x)$ for x near a
- Find limits of rational functions by factoring and canceling
- Finding limits by rationalizing the numerator
- Using 1-sided limits to prove that 2-sided limits do not exist
- The Comparison Theorem
- The Squeeze Theorem

2.4: Continuity

- Know the definition of continuity: $f(x)$ is continuous at $a \Leftrightarrow \lim_{x\to a} f(x) = f(a)$
- Show functions are or are not continuous using the definition and the limit laws.
- Identify discontinuities on a graph (breaks, jumps, or gaps).
- Determine continuity using 1-sided limits for piecewise functions/absolute value functions
- Know the distinction between removable discontinuities and infinite/jump discontinuities
- Know the definition of left continuity and right continuity
- Continuity laws (continuity of $fg, f \pm g, f/g, cf$, etc.)
- Know how to find the intervals on which a function is continuous using continuity algebra
- Know the list of common continuous functions:
  - logs
  - exponentials
  - polynomials
  - rational functions
  - roots

  - trigonometric functions
  - inverse trigonometric functions

- Using continuity to find a limit
- Know the rule for continuity of a composition $f \circ g$: if $f(x)$ is continuous at b and $\lim_{x \to a} g(x) = b$, then $f \circ g(x)$ is continuous at a.
- The Intermediate Value Theorem
- Bisection

2.5: Infinite limits and limits and infinity

- Graphical and numerical estimation
- "Infinite Arithmetic"
- Limit laws for limits at infinity
- Comparison Theorem for infinite valued limits
- Definition of horizontal and vertical asymptotes using limits involving infinity
- Limits at infinity of rational functions
- Limits at infinity of root functions (rationalizing the numerator)