Name: ____________________ Section: ____________________

1 Functions

1. Definitions and Interpretations
   (a) Definition of function, and the vertical line test,
   (b) Domain and range of a function
   (c) Increasing and decreasing functions.

2. Common functions
   (a) Types: lines, polynomials, square roots, rational functions, exponentials, and logarithms.
   (b) Know graphs, domains, and ranges.
   (c) Know the point-slope and slope-intercept formulas for a line.
   (d) The laws of exponentials and logarithms: know them and be able to use them!

3. Combining functions
   (a) Types of combination: adding, subtracting, multiplying, dividing, and composing.
   (b) Be able to simplify, and to find the domain for each

4. Inverse functions
   (a) Defining 1:1 functions, and the horizontal line test
   (b) The definition of the inverse
   (c) Evaluating the inverse of a function given point-by point
   (d) Finding the equation for some inverses.
   (e) Finding the graph of an inverse

2 Limits

1. The tangent line (through 1 point) is the limit of the nearby secant lines (through 2 points).

2. Defining Limits
   (a) $\lim_{x \to a} f(x) = L$ means "we can force $f(x)$ close to L by making x close enough to a".
   (b) Left and right hand limits.
   (c) The precise definition: you can decide on a **d**istance (written as δ) such that if x is this close to a, then $f(x)$ is within the given acceptable **e**rror (written as ϵ) of L.

3. Continuity

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(a) "f is continuous at a" means $\lim_{x\to a} f(x) = f(a)$.

(b) Possible reasons f could be **discontinuous** at a.

(c) Where are the common functions continuous?

(d) Compositions and continuous functions: If g is continuous at a and f is continuous at $g(a)$, then $\lim_{x\to a} f(g(x)) = f(\lim_{x\to a} g(x))$.

(e) Determining where a graph is and is not continuous.

4. Computing Limits

   (a) Reading limits from the graph of a function.

   (b) Limit Laws - what you can and can't do.

   (c) Plugging in a - ONLY when the function is continuous at a.

   (d) Rewriting - If you can't just plug in a, you can often rewrite the equation until you can.

   (e) Infinite Limits - Think to yourself: as x gets close to a (from the appropriate direction), where does $f(x)$ go? Break this into steps!

   (f) Limits at Infinity - When x gets big, where does $f(x)$ go? (You may need to factor the fastest terms off the top and bottom of a fraction, or you may need to think very carefully).

3 Derivatives

1. What is a derivative?

   (a) The slope of the tangent to the graph at a point.
   (Be able to use the derivative to find the equation of a tangent line.)

   (b) The limit of the slope of the nearby secant lines.
   (Be able to use the limit definition of the derivative to compute simple derivatives.)

2. The derivative is also its own function.

   (a) Sketching the graph of f' from the graph of f.

   (b) Be able to find/recognize the points where the derivative is **not** defined. Use this to write down the domain of the derivative (a.k.a. the points where f is differentiable)

   (c) Be able to compute higher derivatives.

3. Rules for finding derivatives quickly.

   (a) Take polynomial derivatives (rules for sums, constant powers, and constant coefficients),

   (b) Know and use the formula for $\frac{d}{dx}e^x$,

   (c) Know and use all 6 trigonometric derivatives, Name: ______________________ Section: ______________________

(d) Know and use the product and quotient rules.

(e) Use these rules to find the tangent line to a curve.

(f) **Be comfortable with the problems on homework #12-14**

Working with graphs

We've used graphs of function in a variety of ways. It can be tricky to keep these straight, so they are listed here by topic for easier comparison.

1. **Functions:** The vertical line test, and reading the graph of a function.

2. **Functions:** The horizontal line test, and finding the graph of the inverse of a function.

3. **Limits:** Using a function's graph to compute the limit at a point.

4. **Limits:** Using a function's graph to find where the function is continuous.

5. **Limits:** Using limits to find horizontal and vertical asymptotes.

6. **Limits:** Suppose it is clear from the graph that $\lim_{x \to a} f(x) = L$.
   If you are given an acceptable error ϵ, be able to find a distance δ from a such that $0 < |x - a| < \delta \Rightarrow |f(x) - L| < \epsilon$.

7. **Derivatives:** Using a function's graph to sketch the graph of its derivative.

8. **Derivatives:** Using a function's graph to find where it is differentiable.

Showing Required Work

You must always show the main steps used in solving a problem. If you skip a step that I couldn't do in my head, I will assume you are copying somebody else's answer.

However, certain problems are *about* the method used to solve them. In these cases, you must show all the steps discussed in class to earn full credit.

1. Laws of Logarithms
2. Limits at infinity
3. Using the precise definition of the limit (either graphically or algebraically)
4. Infinite limits
5. Use the limit definition of the derivative to compute the slope at a point