MATH 141, Fall 2025, Nathan Reading
Review: Test 1

This is an overview of the most important skills and understanding I expect you to have developed.
I don't promise that every exam problem will match with something on this sheet.

• Exam questions might test your understanding of some of the following important terms and concepts:

limit ε–δ definition of limit properties of limits continuity instantaneous velocity slope of the tangent line

Calculus topics, like limits and derivatives, will be tested directly, and pre-calculus review topics, like functions and parametric curves will not be tested *directly*. But pre-calc topics will be used throughout the course (like knowing the alphabet is necessary for a literature course).

• Know and correctly use the following differentiation rules. (Some are written here in several different notations.)

Derivative of a Constant	$\frac{\mathrm{d}}{\mathrm{d}x}k = 0$		for constant k
Constant Multiple Rule	$(kf)' = kf'$	$\dfrac{\mathrm{d}}{\mathrm{d}x}\,kf = k\,\dfrac{\mathrm{d}f}{\mathrm{d}x}$	for constant k
Sum Rule	$(f+g)' = f' + g'$	$\dfrac{\mathrm{d}}{\mathrm{d}x}\,(f+g) = \dfrac{\mathrm{d}f}{\mathrm{d}x} + \dfrac{\mathrm{d}g}{\mathrm{d}x}$	
Product Rule	$(fg)' = fg' + f'g$	$\dfrac{\mathrm{d}}{\mathrm{d}x}\,fg = f\,\dfrac{\mathrm{d}g}{\mathrm{d}x} + \dfrac{\mathrm{d}f}{\mathrm{d}x}\,g$	
Quotient Rule	$\left(\dfrac{f}{g}\right)' = \dfrac{gf' - fg'}{g^2}$	$\dfrac{\mathrm{d}}{\mathrm{d}x}\,\dfrac{f}{g} = \dfrac{g\frac{\mathrm{d}f}{\mathrm{d}x} - f\frac{\mathrm{d}g}{\mathrm{d}x}}{g^2}$	
Chain Rule	$(f\circ g)' = f'(g)\cdot g'$	$\dfrac{\mathrm{d}}{\mathrm{d}x}\,f(g(x)) = \dfrac{\mathrm{d}f(g(x))}{\mathrm{d}g(x)}\cdot\dfrac{\mathrm{d}g(x)}{\mathrm{d}x}$	

For the simplest of these rules, I could reasonably ask you to explain why the rule is true, using the definition of the derivative.

• Know and correctly compute the the derivatives of functions given below. *You should also either know the derivatives of the other* 4 *trigonometric functions or be able to find them using the Quotient Rule.*

(Derivative of a Constant)	$\dfrac{\mathrm{d}}{\mathrm{d}x}\,k = 0$	for constant k
(Power Rule)	$\dfrac{\mathrm{d}}{\mathrm{d}x}\,x^p = px^{p-1}$	for any constant p

$\dfrac{\mathrm{d}}{\mathrm{d}x}\sin x = \cos x$
$\dfrac{\mathrm{d}}{\mathrm{d}x}\cos x = -\sin x$

The exam might reasonably test your ability to carry out some of the following procedures.

• Given three functions satisfying the conditions for the Squeeze Theorem, correctly use the Squeeze Theorem to find a limit.
• Correctly use the Intermediate Value Theorem to find intervals which contain zeros of a given function.
• Given the *graph* of a function $f(x)$, find $\lim_{x\to x_0} f(x)$ for some given some x_0 and/or find $\lim_{x\to\infty} f(x)$ and/or $\lim_{x\to-\infty} f(x)$. This type of problem will be a major part of the test.
• Given the *formula* for a function $f(x)$, find $\lim_{x\to x_0} f(x)$ for some given some x_0 and/or find $\lim_{x\to\infty} f(x)$ and/or $\lim_{x\to-\infty} f(x)$. This type of problem will be a major part of the test.
• Correctly apply properties of limits.
• Find the derivative of a function using the definition. No credit will be given for finding derivatives some other way, and you must remember the definition of the derivative. (There are at least two good reasons to remember it: slope of the tangent line or instantaneous velocity.) This type of problem will be a major part of the test.
• Use differentiation rules to find the derivative of any function that we could write down using addition, subtraction, multiplication, division, composition, and the functions whose derivatives we know. (I may also ask a question where you are told have to use the product rule or quotient rule to get credit.) This type of problem will be a major part of the test.
• Compute higher derivatives (e.g. second derivatives, third derivatives, etc.)

I will ask a few challenge questions at the end of the exam, worth very few points, and these problems are exempt from anything I have told you or will tell you about what I will or will not ask on the test.

Closed book, closed notes, no calculators.