Final Exam Review **MATH 2250**
Spring 2022 University of Georgia

Exam Date/Time: **Thursday, May 5, 7:00 p.m. - 9:00 p.m.**
Location: announced by your professor
The exam will NOT be in your regular classroom.

According to university policy, "A student with three final examinations scheduled within a twenty-four (24) hour period* or two examinations at the same time may petition to reschedule one exam to a different time or day. If one of the conflicting final examinations is a mass exam, it should be rescheduled first."
*The twenty-four (24) hour period begins at the start time of the first exam.

To accommodate those students with three or more exams scheduled during a 24-hour period, there will be a makeup exam for MATH 2250 on May 6, time TBD. Please contact your instructor to arrange to take the makeup exam. Students are only allowed to take the makeup exam when they meet the requirements of the university policy above or have an emergency (with supporting documentation).

Definitions and Theorems to State:
-The (limit) definition of the derivative of $f(x)$
-The definition of continuity at $x = a$

Properties to Cite when Using:
-The relationship of continuity to differentiability
-The Extreme Value Theorem (Closed Interval Method)
-First derivative test for local extrema
-Second derivative test for local extrema
-Second derivative criterion for concavity
-L'Hopital's rule
-Fundamental Theorems of Calculus (Part 1 and Part 2)

Properties you will be responsible for:
-Properties of logarithmic and exponential functions
-Other precalculus-level formulas (in addition to those listed below)

Limits:
-Be able to find the limits and one-sided limits of functions (even if not continuous), both analytically and graphically
-Find limits that approach infinity or have an infinite limit
-Determine horizontal asymptotes and vertical asymptotes of a function; justify your answer using one or more limits
-Be able to use L'Hopital's Rule to find limits (and identify and state the appropriate indeterminate forms that allow you to do so)

-Verify continuity (analytically and graphically)
-Determine intervals on which a function is continuous
-Be able to "repair" a removable discontinuity by (re)defining the function at that x-value
-Determine the value of a parameter that makes a piecewise function continuous where the two pieces meet

Derivatives:
-Be able to find the derivative $f'(x)$ from the limit definition of the derivative
-Be able to use rules to find the derivative; know all rules from back of book through inverse trig function (no hyperbolic or parametric, no $\text{arcsec}(x)$, $\text{arccot}(x)$, or $\text{arccsc}(x)$)
-Implicit differentiation
-Be able to compute derivatives at specific points using limited information (e.g. a table)
-Be able to find an equation of the tangent line at a point
-Be able to understand/interpret the slope of a function
-Logarithmic differentiation

Proof-based Problems:
-Use differentiation of the appropriate inverse function to verify the differentiation rule for $\ln(x)$
-Use differentiation of the appropriate inverse function to verify the differentiation rule for $\arcsin(x)$, $\arccos(x)$, and $\arctan(x)$ (including an appropriate right triangle diagram or a Pythagorean identity)

Applications of Derivatives
-Applications involving a tangent line
-Be able to find and use the linearization
-Be able to find and use the differential
-Position, displacement, velocity, acceleration problems
-Interpret the derivative as a rate of change in a wide range of contexts
-Related rates
-Understand the relationship between (first and second) derivatives and curve behavior; curve sketching from derivative information
-Determine all extrema of a function on a closed interval
-Applied optimization (open and/or closed interval); justify that you have a max or min

Integration
-Antiderivatives: find the most general antiderivative and solve initial value problems
-Understand the definite integral as net area
-Apply properties of the definite integral
-Be able to use the definite integral to compute and interpret
- net area
- total area
- area between two curves

-Estimate a definite integral using well-chosen sums with a small number of rectangles (left, right, midpoint), and interpret your answer

-Use summation notation to express a Riemann sum with N rectangles of equal width and right endpoints, using only the summation symbol, k, N, and numbers
-Compute a definite integral:

- by interpreting it as area
- by Evaluation Theorem (FTC 2)
- by integration via substitution

Terminology to be familiar with (in addition to terminology listed in sections above):
-average rate of change/secant slope, average velocity
-instantaneous rate of change/tangent slope
-tangent lines and linearization of a function at a point
-domain
-critical points (critical numbers), inflection points
-increasing, decreasing, concave up, concave down
-local (relative) extrema
-absolute (global) extrema

Penalties (approximately 20% of problem's points value for each issue):
-Improper use of $+C$ or missing $+C$
-Improper use of limit notation
-Improper use of integral or sigma
-Improper use of "=" (like $y = x^3 = 3x^2$)
-Improper algebraic notation (missing parentheses, incorrect variable name, etc.)

Remarks for students:
-Problems may combine multiple topics/techniques.
-You do not have to simplify your answers.
-Calculator **TI-30XS Multiview only**! No other calculators are allowed, and sharing of calculators is not allowed.
-You do not have to use a calculator; answers containing symbolic expressions such as $\cos(\pi/3)$ and $\ln(e^4)$ are acceptable. Include an exact answer for each problem. -You will leave your backpacks at the front of the room; a backpack that rings or buzzes will be taken out to the hallway and left there.
-No smart watches are allowed during the exam; smart devices (including smart watches and cell phones) may not be on your person and must be stored in a backpack, purse, or other storage item left at the front of the classroom.

Formulas to Remember

- Distance between (x_1, y_1) and (x_2, y_2): $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
- Triangles and Trig
  - perimeter (add up side lengths)
  - area: $A = \frac{1}{2}bh$
  - Be able to use properties of similar triangles.
  - Pythagorean Theorem for right triangles: $a^2 + b^2 = c^2$
  - right triangles and acute angle trig: SOH-CAH-TOA
  -

$\tan(x) = \dfrac{\sin(x)}{\cos(x)}$	$\cot(x) = \dfrac{\cos(x)}{\sin(x)}$
$\csc(x) = \dfrac{1}{\sin(x)}$	$\sec(x) = \dfrac{1}{\cos(x)}$

  - $\sin^2(x) + \cos^2(x) = 1$
  - Your trig differentiation formulas assume that your angle is in <u>radians</u>. (Why?)
- Circles
  - area: $A = \pi r^2$
  - circumference: $C = 2\pi r$
  - Equation of the circle of radius r centered at (h, k): $(x - h)^2 + (y - k)^2 = r^2$
- Rectangles
  - area: $A = lw$
  - perimeter: $P = 2l + 2w$
- Cylinder
  - volume: $V = \pi r^2 h$
  - surface area: $S = 2\pi r^2 + 2\pi rh$ (includes base and lid)
- Rectangular prisms
  - volume: $V = lwh$
  - surface area: $S = 2lw + 2wh + 2lh$ (includes top and base)
- Circular cone
  - volume: $V = \frac{1}{3}\pi r^2 h$
- Sphere
  - volume: $V = \frac{4}{3}\pi r^3$