MATH 210: ORAL FINAL

QUESTIONS

For the oral final you will present your solutions to two of these questions. You will choose one question and I will choose the other.

(1) Evaluate
$$\int_0^4 \frac{x}{3\sqrt{9+x^2}} + \frac{2}{4+x}\, dx.$$

(2) Consider the function $f(x) = \ln(x^2 + 2x + 4)$. Find the x-coordinates of all local maximums and minimums and inflection points of $f(x)$. Where is $f(x)$ increasing? Decreasing? Concave up? Concave down?

(3) The equation $x^y = \frac{4x}{y}$ describes a curve. Write an equation for the tangent line for this curve at the point $(1, 4)$.

(4) A rectangle is inscribed within the top half of a circle of radius 1 so that one side of the rectangle is along the diameter of the semicircle and the top corners of the rectangle touch the edge of the circle, as in the picture below. What is the maximum possible area for such a rectangle, and what are the side lengths which give that maximum area?
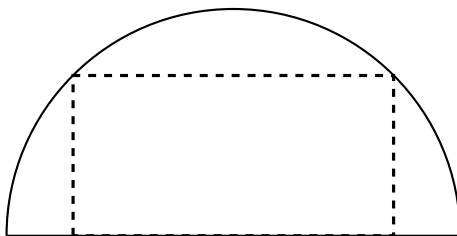
(5) Consider the function
$$f(x) = \begin{cases} \frac{\tan x}{x} - 1 & \text{if } x \neq 0 \\ 0 & \text{if } x = 0 \end{cases}$$

Is $f(x)$ differentiable at $x = 0$? If not, show why. If so, what is $f'(0)$?

Grading Rubric

Each question will be graded out of 50 points, for 100 points total. Grades for each problem will be assigned according to the following rubric.

- A^+ **(50 points)** Student understood the problem completely and gave a full solution with no need for outside help. Perhaps a minor misstep was made along the way, but they were quick to correct it when prompted. When asked to justify their process they gave a cogent explanation.
- A **(45 points)** Student was able to get through a complete solution, but required minor outside help or was unable to fully explain their process.
- B **(40 points)** Student knew the bulk of what they needed to do, but required substantive outside help to get all the way through the problem. Student knew the key concepts, but may have struggled to explain how they apply to this problem.
- C **(35 points)** Student needed outside help to know what to do, but with that help was able to get through the problem. Student's explanation for their thought process had significant issues.
- D **(30 points)** Student needed outside help to know what to do, but even with that help was unable to complete the problem. Student could not adequately explain their thought process.
- F **(20 points)** Student did not know how to approach the problem even with outside help, but recognized some of the concepts involved.
- 0 **(0 points)** Student did not show up, or said nothing related to the problem.

Detailed rules and format for oral final

You will schedule a 30 minute timeslot for the oral final, which will be done at my office. Time slots are offered on the 11th, 12th, 13th, 18th, 19th, and 20th. You will sign up via a google sheet, which I will email to you. I'm doing an oral final for all my classes, and there's enough slots for everyone. But please do not put off signing up for a slot; I don't want you to try to sign up last minute only to learn all the slots left are taken.

You will present solutions to two of the questions. The first will be chosen by you, and the second by me. You will be graded according to the rubric in this document. After presenting your solutions I'll let you know your grade on the final and your overall grade in the class.

The rubric mentions outside help. Here's a few things that would count as that: consulting your notes; using a graphing calculator or computer algebra system (using a calculator for routine arithmetic is fine); asking me for help.

Advice for preparing

- Do all questions fully in advance! Practice writing down your solutions and explaining them.
- You are allowed to talk to classmates when preparing, but make sure you understand everything yourself. If I ask you "why did you do X?" then "my classmate said it's the right thing" isn't a good answer.
- Check your solutions. Computer tools, especially graphing calculators, are great for checking your work.
- You can stop by office hours to ask about the class material, but I will not answer questions about nor give hints for the questions for the final.