Math 1231 Fall 2026
Single-Variable Calculus I Section 12
Mastery Quiz Worksheet 12
Due Friday, November 13

This week's mastery quiz has three topics. It is the last time we will see topic M3 or S9, and the first time we see topic M4. The quiz on Friday will have five questions on three topics, and should take about 25 minutes.

Remember that you are trying to demonstrate that you understand the concepts involved. For all these problems, you should justify your answers and show your work. Do not just write "yes" or "no" or give a single number.

On Friday, we will end class with a short quiz, containing questions drawn from this worksheet, plus one "easy" question on topic M1. You may not use or consult any materials or notes during Friday's quiz; make sure you work through these problems carefully, and understand them well enough that you can replicate that work in class.

Topics on This Quiz

- Major Topic 3: Optimization and Extrema
- Major Topic 4: Integration
- Secondary Topic 9: Riemann Sums

Major Topic 3: Opitmization and Extrema

(a) The function $f(x) = \dfrac{x}{x^2+1}$ has absolute extrema either on the interval $[0, 3]$ or on the interval $(2, 4)$. Pick one of those intervals, explain why f has extrema on that interval, and find the absolute extrema.

(b) Classify all the critical points and relative extrema of $h(x) = x^3/(x+1)$. (For each critical point, tell me whether it is a relative maximum, a relative minimum, or neither.)

Major Topic 4: Integration

(a) Let $F(x) = \displaystyle\int_2^{\sqrt{x^2+1}} t\sin(t)\,dt$. What is $F'(x)$?

(b) Find $\displaystyle\int \cos(x) + 2x\,dx$.

(c) Compute $\displaystyle\int_{-2}^{4} x^3 - 3x\,dx =$

Secondary Topic 9: Riemann Sums

Using **only the definition of Riemann sum** and your knowledge of limits, compute the exact area under the curve $x^3 + 2x$ between $x = -1$ and $x = 2$.