Math 1231 Fall 2026
Single-Variable Calculus I Section 11
Mastery Quiz Worksheet 7
Due Friday, October 9

This week's mastery quiz has four topics. It is the last time we will topic S3 or S4, and the first time we have seen topic S5.

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 2: Computing Derivatives
- Secondary Topic 3: Linear Approximation
- Secondary Topic 4: Rates of Change
- Secondary Topic 5: Implicit Differentiation

Major Topic 2: Computing Derivatives

(a) Compute $\dfrac{d}{dx}\dfrac{\sin(\csc(x^2+1))}{x^4+\cos(x)} =$

(b) Compute $\dfrac{d}{dx}\tan^{3/5}\left(\sec\left(x^3-4\right)\right) =$

(c) Compute $\dfrac{d}{dx}\cos^2\left(\tan^2\left(\sec^2(\sqrt{x}+x)\right)\right) =$

Secondary Topic 3: Linear Approximation

(a) Find an equation of the line tangent to $y = \frac{x+1}{x-1}$ at the point $x = 2$.

(b) Estimate $\sqrt[4]{15}$ using a linear approximation of the function $\sqrt[4]{x}$ at the point 16.

Secondary Topic 4: Rates of Change

(a) Suppose the vertical position of a weight on a spring in inches is given as a function of time in seconds by the formula $h(t) = \cos(2t)$.

(i) When is the velocity zero?

(ii) When is the acceleration zero?

(b) Let $F(x) = \frac{1}{x} + 1$ be the amount of pressure exerted on a beam in pounds per square inch at a point x inches to the right of its left end.

(i) What are the units of $F'(x)$? What does $F'(x)$ represent physically? What would it mean if $F'(x)$ is big?

(ii) Compute $F'(5)$. What does this tell you physically? What physical observation could you make to check your calculation?

Secondary Topic 5: Implicit Differentiation

(a) Find a formula for $\frac{d^2y}{dx^2}$ in terms of x and y if $\sin(xy) = x + y$.

(b) Find an equation for the tangent line to the curve $x^2y^2 = 5 + x + y$ at the point $(1, 3)$.