

Fall 2025

MATH ~~007~~A: Calculus for Life Sciences I

Midterm 2 Review

Problem 1. Find the derivatives of the following functions. **Do not simplify your answers.**

(a) [1 pt] $f(x) = \frac{x^2 + \frac{1}{x^2}}{1 - 5x}$

(b) [1 pt] $g(x) = \sqrt{4x^2 + 5x - 7}$

Problem 2. Find the derivatives of the following functions. **Do not simplify your answers.**

(a) [1 pt] $f(x) = 2^x \cdot e^{5x}$

(b) [1 pt] $h(x) = \ln\left(\frac{x-5}{x^2+8}\right)$

(c) [1 pt] $m(x) = e^{\ln(x^3-x)}$

Problem 3. Consider the function $f(x) = \sec(x) = \frac{1}{\cos(x)}$.

(a) [1 pt] Show that $f'(x) = \sec(x) \tan(x)$.

(b) [1 pt] Find $f''(x)$.

Problem 4. Consider the curve given by the equation $y \cos(x) = x^2 + y^2$.

(a) [1 pt] Use implicit differentiation to compute $\frac{dy}{dx}$.

(b) [1 pt] Verify that the point $(0, 1)$ lies on the curve.

(c) [1 pt] Determine the equation of the tangent line to the curve at the point $(0, 1)$.

Problem 5. [2 pts] The local aquarium has a cool new fish tank. This tank is not a rectangular prism like most fish tanks are. Instead, it's an inverted right circular cone i.e. an upside down cone. Water is being pumped into the tank a rate of 5 cubic feet per minute. The height of the tank is 6 feet, and the radius of the circular opening at the top is 3 feet. What is the rate at which the water level in the tank is rising when the depth of the water in the tank is 2 feet?

Note: the volume of a right circular cone with radius r and height h is equal to $\frac{1}{3}\pi r^2 h$.

Problem 6. [2 pts] The volume of a cube is increasing at a rate of $5 \text{ in}^3/\text{sec}$. How fast is the surface area increasing when the length of an edge is 10 in?

Hint. The surface area of a cube with edge length x is $6x^2$.