

## Homework 05

Math 140-002: Calculus I (Spring 2026)

Week 5

**Relevant topics:** chain rule; implicit differentiation; derivatives of exponential and logarithmic functions; derivatives of inverse trigonometric functions

**Due:** Wednesday, Feb 18, 2026.

**Instructions:** Show your work clearly. Problems 1–6 emphasize computational fluency; Problems 7–12 emphasize concepts and communication.

1. Evaluate  $\frac{d}{dx} ((3x^2 + 1)^4)$ .

2. Evaluate  $\frac{d}{dx} (e^{2x-1})$ .

3. Evaluate  $\frac{d}{dx} (\ln(x^2 + 4x + 5))$ .

4. Evaluate  $\frac{d}{dx} (2^x)$ .

5. Evaluate  $\frac{d}{dx} (\arctan(3x))$ .

6. Use implicit differentiation to find  $\frac{dy}{dx}$ :

$$x^2 + xy + y^2 = 1.$$

7. For the curve

$$x^2 + xy + y^2 = 3,$$

find  $\frac{dy}{dx}$  and the equation of the tangent line at the point  $(1, 1)$ .

8. Differentiate:

$$f(x) = \frac{(x^2 + 1)e^x}{\sqrt{x + 1}}.$$

9. Differentiate:

$$y = \arcsin\left(\frac{x}{\sqrt{1 + x^2}}\right).$$

(Your final answer should be simplified.)

10. Let the curve be defined by

$$x^2 + y^2 = 4.$$

(a) Find  $\frac{dy}{dx}$ .

(b) Find  $\frac{d^2y}{dx^2}$ .

11. Use implicit differentiation to find  $\frac{dy}{dx}$ :

$$xe^y + y = 1.$$

12. Use implicit differentiation to prove that  $\frac{d}{dx}(\ln(x)) = \frac{1}{x}$  for  $x > 0$ . (Hint: Start from  $e^{\ln(x)} = x$ .)