Math 1231: Single-Variable Calculus I
George Washington University Fall 2026
Recitation 5

Jay Daigle

Friday September 25, 2026

We can use the limit definition of the derivative to compute derivatives, but it's not very efficient. In class we learned some rules for computing them more easily:

- (Constants) $\frac{d}{dx}c = 0$
- (Identity) $\frac{d}{dx}x = 1$
- (Scalar products) $\frac{d}{dx}cf(x) = cf'(x)$
- (Sum Rule) $\frac{d}{dx}(f(x) \pm g(x)) = f'(x) \pm g'(x)$
- (Power Rule) $\frac{d}{dx}x^n = nx^{n-1}$
- (Product Rule) $\frac{d}{dx}f(x)g(x) = f'(x)g(x) + f(x)g'(x)$
- (Quotient Rule) $\dfrac{d}{dx}\dfrac{f(x)}{g(x)} = \dfrac{f'(x)g(x) - f(x)g'(x)}{g(x)^2}$.

Problem 1. Let's find the derivative of $3x^2 + 5x$.

(a) First just plug 1 into this function. Think about what operations you do in which order. Which operation do you do last?

(b) What rule should we invoke first? Use that rule to write this as a combination of two smaller derivative problems.

(c) What rule do we use next? We need to use it in two places.

(d) Finish off computing this derivative. What rules did you use?

Problem 2. (a) Use the product rule to differentiate $(x^2+1)(3x^3-5)$.

(b) Multiply out $(x^2+1)(3x^3-5)$ to get one big polynomial. Use our derivative rules to compute that derivative.

(c) Which process was easier?

Problem 3. Compute $\dfrac{d}{dx}\dfrac{x^5-7x}{4x^2+3}$.

Problem 4. Consider the function $\sec^2(x^2+1)$

(a) Find functions f and g so that $(f\circ g)(x)=\sec^2(x^2+1)$.

(b) Talk to the people next to you. Did they pick the same f and g that you did? Can you find a different pair of functions f and g that also work?

(c) Find functions f, g, h so that $(f\circ g\circ h)(x)=\sec^2(x^2+1)$.

(d) Compute f', g', and h'.

(e) What is $\frac{d}{dx}\sec^2(x^2+1)$?

Problem 5. Find

$$\frac{d}{dx}\frac{\sin(x^2)+\sin^2(x)}{x^2+1}$$

Problem 6. (a) Compute

$$\frac{d}{dx}\sqrt{\frac{\sqrt{x}+1}{(\cos x+1)^2}}$$

(b) Find

$$\frac{d}{dx}\tan^4(\sqrt[3]{x^5+x^3+2}+1).$$

Problem 7 (Bonus)**.** Calculate

$$\frac{d}{dx}\left(\frac{\sin^2\left(\frac{x^2+1}{\sqrt{x-1}}\right)+\sqrt{x^3-2}}{\cos(\sqrt{x^2+1}+1)-\tan(x^4+3)}\right)^{5/3}$$