St. Joseph's University
Date: November 24, 2025 Professor: Asher Roberts

Calculus I Test 3

Directions: Solve each of the following problems using separate paper, while clearly indicating each problem number when solving. Irrelevant work will detract from your score, while answers without work shown will be awarded no credit. Answers with partially correct work will receive partial credit. Each problem is worth 10 points. You must work alone, but you may use a graphing calculator as a supplement to your own work if you indicate the steps used. You may not use a phone, computer, computational intelligence, AI, or other tools to assist you in solving the problems.

1. Find $f'(x)$ if $f(x) = (5x+4)^{-3}(8-3x)^6$.
2. Find $\dfrac{d}{dx}\left(\log_3(\ln x)\right)$.
3. Find $\dfrac{d}{dx}\left(\sin 5^{3x}\right)$.
4. If $x^2 + y^2 = (2x^2 + 2y^2 - x)^2$, what is $\dfrac{dy}{dx}$ at the point $(0, \frac{1}{2})$?
5. Find $\dfrac{d^2y}{dx^2}$ for $x^5 + y^5 = 10$. Simplify where possible.
6. What is an equation for a tangent to the graph of $y = \arccos\dfrac{x}{4}$ at $x = 0$?
7. Use the table below to find $(f^{-1})'(5)$.

x	$f(x)$	$f'(x)$	$f^{-1}(x)$
5	-3	10	8
8	5	-3	-10

8. Someone sits on a chair cushion in the shape of a square prism so that the side of the square base is increasing at a rate of 2 cm per second and the height is *decreasing* at a rate of 3 cm per second. What is the rate of change of the volume of the cushion when the side of the square base is 50 cm and the height is 4 cm?
9. Let $f(x) = 3x^4 + 4x^3 - 72x^2$. Where does f have critical points?
10. Find the absolute maximum and absolute minimum values of $f(x) = 1 + \cos^2 x$ on the interval $[\pi/4, \pi]$.