Midterm 1
Version A

Last Name: __________________________________________

First Name: __________________________________________

Student ID: __________________________________________

Signature: _____________________________________________

Section: 1A  (TA: Thomas Gilton, LA: Kim)
1B  (TA: Joe Breen, LA: Adela)
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1E  (TA: Sam Dittmer, LA: Clover)

Instructions: Do not open this exam until instructed to do so. You will have 50 minutes to complete the exam. Please print your name and student ID number above, and circle the number of your discussion section. You may not use calculators, books, notes, or any other material to help you. Please make sure your phone is silenced and stowed where you cannot see it. You may use any available space on the exam for scratch work. If you need more scratch paper, please ask one of the proctors. You must show your work to receive credit. Please circle or box your final answers.

Please do not write below this line.

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1. Compute the following limits. If a limit does not exist, be as specific as possible. (E.g. for an infinite limit, find the one-sided limits.) As always, you must justify each answer.

(a) (4 points) \( \lim_{x \to -2} \frac{-12}{x^2 - 4} - \frac{3}{x + 2} \)

(b) (4 points) \( \lim_{t \to \frac{\pi}{2}} \frac{t}{\sin(t) - 1} \)
(c) (4 points) \( \lim_{x \to 0} \frac{\sin(6x)}{2x} \)
2. (a) (3 points) Complete the following definition:

Suppose $f(x)$ is defined on an open interval containing $x = a$.
Then $f$ is continuous at $x = a$ if

(b) (9 points) Define a function $f: \mathbb{R} \to \mathbb{R}$ as follows, where $c$ is a constant:

$$f(x) = \begin{cases} \frac{\sqrt{x^2+5x-6}}{x^2-9x+20} & \text{if } x < 4 \\ \frac{x^2-cx-9}{2x+4} & \text{if } x \geq 4 \end{cases}$$

What value of $c$ is needed to make $f$ a continuous function?
3. The two parts of this problem are not related to each other.

(a) (6 points) Let \( g(x) = 3x^3 + \frac{16}{\sqrt{x}} - 5. \)

Find an equation for the tangent line to the graph of \( g(x) \) at \( x = 4. \)

(b) (6 points) Let \( h(x) = x^3 - 3x^2 - 6x + 4. \)

At what \( x \)-value(s) does the graph of \( h(x) \) have a tangent line parallel to \( y = 3x - 5? \)
4. (9 points) Let $f(x) = \sqrt{x^3}$. Use the limit definition of the derivative* to compute $f'(1)$.

*You may use either of the two formulas we learned for the limit definition of the derivative. Be sure to show all of your steps. Do not just use differentiation rules! Although you can use those to double-check your answer, of course.