Name: 
ID# (last 4 digits): 
Section: 

- Please explain your answers clearly and show all work in the space provided. I reserve the right to give no credit for a response with no work even if the final answer is correct.

- You are not allowed the use of any calculator, unapproved formula sheet, or electronic device.

- All electronic devices must be turned off.

- Unless noted otherwise, all final answers should be exact.

- You have 70 minutes to complete the exam.

- This exam has 8 questions, printed in 2 booklets, for a total of 100 points.

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1. Find an equation of the line tangent to the graph of $y = 2x^2 - 3x + 1$ at $x = 1$.

2. Show that the equation
   
   $$x^{2/3} = 2x^2 + 2x - 2$$

   has at least one solution in the interval $[0, 1]$. Explain your answer.
3. Find all real solutions to the following equation.

\[2 \ln(x) = \ln \left( \frac{x^5}{5 - x} \right) - \ln \left( \frac{x^3}{2 + x} \right)\]

4. Find the values of the constants \(a\) and \(b\) so that the following function is continuous for all \(x\). If this is not possible, explain why.

\[f(x) = \begin{cases} 
ax + b & , \ x < 1 \\
-2 & , \ x = 1 \\
3\sqrt{x} + b & , \ x > 1 
\end{cases}\]

You must give a full, clear justification for your answer. You must use proper methods taught in this course.
5. On the set of axes provided below, sketch the graph of a function $f(x)$ that satisfies all of the following properties.

- the domain of $f$ is all real numbers
- $\lim_{x \to -4^+} f(x) = f(-4)$
- $f$ is not continuous at $x = -4$
- $\lim_{x \to 1} f(x)$ exists
- $f$ is not continuous at $x = 1$
- $f$ is continuous at $x = 5$
- $f$ is not differentiable at $x = 5$
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6. For each part, calculate \( f'(x) \).

After calculating the derivative, do not simplify your answer.

(a) \( f(x) = \frac{7x^3}{3x^{1/2}x^5} \)

(b) \( f(x) = -\cos(x) \ln(x) \)

(c) \( f(x) = \frac{\csc(x) + 4x^3}{e^x - e^5} \)
7. The parts of this question are independent of each other.

(a) Given the function \( g(x) \), state the definition of \( g'(x) \).

(b) Let \( f(x) = \sqrt{6x + 1} \). Calculate \( f'(1) \) directly from the definition. Show all work.

*If you simply quote a rule, you will receive no credit. You must use the definition of derivative.*
8. For each limit, calculate the value or show that it does not exist. Show all work.

(a) \( \lim_{x \to 7} \left( \frac{\frac{1}{7} - \frac{1}{x}}{x - 7} \right) \)

(b) \( \lim_{x \to 0} \left( \frac{\sin(7x)}{\tan(2x)} \right) \)

(c) \( \lim_{x \to -1} \left( \frac{|x + 1|}{x + 1} \right) \)