You have 50 minutes to complete this test. You must show all work to receive full credit. Work any 7 of the following 8 problems. Clearly CROSS OUT the problem you do not wish me to grade. Each problem is worth 14 points, and you get 2 points for free, for a total of 100 points. If you have any questions, please come to the front and ask.

1. Using the definition of the derivative, find $f'(x)$ if $f(x) = 3 - \sqrt{x}$.

2. Evaluate the following limits. If any of them do not exist, EXPLAIN why not ("because it's undefined" and "denominator is zero" are not sufficient explanations).

   (a) $\lim_{x \to 4} \frac{x^2 + x - 12}{x^2 - 2x - 24}$

   (b) $\lim_{x \to 4} \frac{x - 3}{x - 4}$

   (c) $\lim_{x \to -1} \frac{x - 1}{(x + 1)^2}$
3. During the summer, a group of students runs a lawn care business. Suppose it costs them $1450 for a riding mower, and that the gas for the mower for an average lawn will cost $2. The price they charge to cut an average lawn is $60.

   a) How many lawns must the students cut to break even?
   b) How many lawns must the students cut to make a profit of $1000?

4. Find $f'(x)$ (do not simplify!) if:

   a) $f(x) = (3x^2 - 2)\left(\sqrt{x^3} + 10x\right)$

   b) $f(x) = 2x^{\frac{-1}{2}} + 3 - 15x^3 - \frac{1}{3x}$
5. Suppose the total cost of manufacturing \( q \) units is \( C(q) = 3q^2 + q + 500 \) dollars.

a) Use marginal analysis to *estimate* the cost of manufacturing the 41st unit.
b) Calculate the *actual* cost of manufacturing the 41st unit.

6. Find the equation of the line tangent to \( f(x) = \frac{x^2 - 1}{(3x^3 + x^2)(2x - 5)} \) at the point where \( x = 1 \).
7. Consider the graph of the function $f(x)$ given below.

![Graph of the function](image)

a) For what values of $x$ is $f(x)$ discontinuous?

b) Find $\lim_{x \to 2^-} f(x)$.

c) Find $\lim_{x \to 2^+} f(x)$.

d) Find $\lim_{x \to 2^-} f(x)$.

e) Find $\lim_{x \to 2^+} f(x)$.

f) Find $\lim_{x \to -1} f(x)$.

8. Is the function $f(x) = \begin{cases} 2x^2 + 1 & \text{if } x < 3 \\ 6x + 2 & \text{if } x \geq 3 \end{cases}$ continuous at $x = 3$? Explain why or why not.