Name:________________________________________________________________________

Write all of your responses on the exam paper, make sure that you show all of your work and justification. You may use your calculators.

1. (10 Points) Find the following limit algebraically, if it exists.

\[
\lim_{x \to -1} \frac{x^2 - 1}{x + 1}
\]

2. (15 Points) Find \( f'(x) \) using the limit definition of the derivative.

\[
f(x) = 3x^2 + 3x - 1
\]
3. (15 Points) Use the tangent line approximation formula to approximate the value of $\sqrt{24.7}$.

4. (10 Points) Using the derivative rules find $f'(x)$

$$f(x) = \pi x^n + \ln(x^2)$$
5. (10 Points) Using the derivative rules find $f'(x)$

$$f(x) = \frac{x^3 - 1}{x^2 + 3}$$

6. (15 Points) Using the derivative rules find $f'(x)$

$$f(x) = (1 - x)^4(2x - 1)^5$$

7. (15 Points) Using the derivative rules find $f'(x)$

$$f(x) = \sqrt{e^{3x} + 2}$$
8. (15 Points) Find where the following function is increasing, decreasing, concave up and concave down. Find critical points, inflection points and where the function attains a relative maximum or relative minimum.

\[ f(x) = 5 + 8x^3 - 3x^4 \]
9. (10 Points) Find the following limit, if it exists.

\[ \lim_{x \to \infty} \sqrt{4 - \frac{1}{x}} \]

10. (15 Points) Find the absolute maximum and absolute minimum of \( f(x) = x^3 - 3x + 1 \) on \([-1, 3]\) if they exist.
11. \((15 \text{ Points})\) A fence is to be built around a 200-square-foot rectangular field. Three sides are to be made of wood costing $10 per foot, while the other side is made of stone costing $30 per foot. Find the dimensions of the enclosure that minimizes total cost.

12. \((10 \text{ Points})\) Find the following antiderivative

\[
\int 1 + \frac{3}{x} \, dx
\]
13. (15 Points) Find the following antiderivative
\[ \int \frac{x}{(x^2 + 3)^4} \, dx \]

14. (15 Points) Find the following definite integral
\[ \int_{0}^{4} \sqrt{2x + 1} \, dx \]
15. \((15 \text{ Points})\) Let \(f(t) = 20e^{-0.05t}\) be the rate of change of total income per unit time. Find

(a) The total amount of income for time 0 to 10.
(b) The present value \(P_V(T)\) for \(T = 10\) and an interest rate of 10%.
(c) The amount at time \(T = 10\) if all income is reinvested continuously at 10%.

16. \((\text{Extra Credit})\) Using the derivative rules find \(f'(x)\)

\[
f(x) = \sqrt{\sqrt{x} + 1}
\]