Name: ________________________________

Write all of your responses on the exam paper. If you need extra space, please use the backs of the exam pages. Make sure that you show all of your work.

1. (15 points) Find the following limit using algebraic techniques, you may not use Bernoulli’s rule.

\[
\lim_{x \to \infty} \sqrt{x^2 - 3x + 2} - x
\]

2. (15 points) Find the following limit, you may use Bernoulli’s rule, if it applies.

\[
\lim_{x \to \infty} \left(1 + \frac{\pi}{x}\right)^x
\]
3. (20 points) Using the definition of the derivative find $f'(x)$ of

$$f(x) = \frac{x}{x + 1}$$
4. (25 points) Find $f'(x)$ of the following functions, do not simplify your answers.

(a) $f(x) = e^x + \cos(x) - 4x^3$

(b) $f(x) = \tan(x) \left( \ln(x) + \frac{1}{x^2} - \sqrt{x} \right)$

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

(d) $f(x) = \sin \left( \sqrt{2x - 7} \right)$

(e) $f(x) = \sinh(x^3 - 3x + 2)$
5. (15 points) Find the equation of the tangent line to the curve $f(x) = x^3 - 3x^2 - x + 1$ at $x = 2$.

6. (15 points) Find $\frac{dy}{dx}$ of $3x^2y^3 + x^3 = y^2 - y^4$.

7. (15 points) Using differentials approximate $\sqrt{82}$. 

8. (20 points) For the function

\[ f(x) = \frac{x^2 + 1}{x^2 - 1} \]

find the domain, intercepts, symmetries, asymptotes, intervals of increase or decrease, local maximum and minimum values, intervals of concavity and inflection points. Sketch a graph of the function.
9. \( (15 \text{ points}) \) Find \( f(x) \) given that \( f''(x) = 20x^3 + 18x \), \( f(1) = 7 \) and \( f(0) = 5 \).

10. \( (15 \text{ points}) \) Find

\[
\int \sin(x) \sqrt{\cos(x) + 7} \, dx
\]