Exam is 7 pages plus cover page. Follow the instructions for each question. Show enough of your work that we can understand what you are doing.

1 (12 points) Determine the infinite limit. \[ \lim_{x \to 2^+} \frac{x^2 - 2x - 3}{x - 2}. \]

2 (12 points) Evaluate the limit, if it exists. \[ \lim_{x \to 2} \frac{\frac{1}{x} - \frac{1}{4}}{x - 2}. \]

3 (12 points) Given \( f(x) = \sqrt{x + 1} \), find \( f'(a) \) using \( f'(a) = \lim_{x \to a} \frac{f(x) - f(a)}{x - a} \). No credits if you use any other formulas.
4 (12 points) Differentiate \( f(\theta) = \frac{\cos(2\theta)}{\sin \theta + \cos \theta} \) with respect to \( \theta \).

5 (12 points) Find the derivative of \( y = \sqrt{x}(1 + x)^2 \) with respect to \( x \).

6 (12 points) Given \( xy^2 = y \sin(x) - 1 \). Find \( dy/dx \) by implicit differentiation.
7 (12 points) Find the linearization $L(x)$ of the function $f(x) = \frac{x - 1}{x + 1}$ at $a = 4$.

8 (14 points) Let $f(x) = x^{4/3} - 4x^{1/3}$. Find the critical numbers of $f$. 

9 (14 points) Given \( y = \frac{x + 1}{x - 2} \). Sketch the graph indicating the local maximum/minimum points, and points of inflection.

10 (14 points) If 1200\( \pi \) cm\(^2\) of the material is available to make a circular cylindrical tank with an open top, find the largest possible volume of the tank.
11 (12 points) Express the integral as a limit of Riemann sums, \( \int_{0}^{1} x^3 \sqrt{1 + x^2} \, dx \).

12 (12 points) Evaluate the integral \( \int_{0}^{1} 6u(1 + u^2)^2 \, du \).

13 (12 points) Evaluate the indefinite integral \( \int \frac{(1 + \sqrt{x})^2}{\sqrt{x}} \, dx \).
14 (14 points) Sketch the region enclosed by the given curves and find the area. \( y = 4 - x^2, \ y = x - 2 \).

15 (12 points) Set up an integral for the volume of the solid obtained by rotating the region bounded by the curves \( x = y^2, x = 1 \) about the \( y \)-axis.

16 (12 points) A variable force of \( F = x(4 - x) \) pounds moves an object along a straight line when it is \( x \) feet from the origin. Calculate the work done in moving the object from \( x = 0 \) ft to \( x = 4 \) ft.
17 (Bonus, 8 points) Prove the statement using the $\epsilon, \delta$ definition of a limit. \[ \lim_{x \to 2} \frac{3x - 2}{4} = 1. \]

18 (Bonus, 8 points) Use the method of cylindrical shells to set up an integral for the volume generated by rotating the region bounded by $y = x^{1/3}; y = 0; x = 1$ about the $y = 1$.