This exam has 7 questions, for a total of 100 points. Answer the questions in the space provided below. Show your work and simplify your answers to receive full credit. **You may use a calculator, but show work to receive full credit.** You have 50 minutes.

1. (a) Locate the critical points of \( f(x) = \frac{2}{3}x^3 - 4x^2 + 6x \)

(b) Find the intervals on which \( f \) is increasing and decreasing.

(c) Find the intervals on which \( f \) is concave up and concave down

(d) Identify the local minimum and local maximum values of \( f \).

(e) Identify the absolute minimum and maximum values of \( f \) on \([-1, 2]\).
2. Use L'Hopital’s Rule to evaluate $\lim_{w \to 1} \frac{w^\pi - 1}{\pi^2 w - \pi^2}$.
3. Sketch a single function satisfying the following set of conditions:

\[ f''(x) < 0 \text{ on } (-5, 0), \]
\[ f''(x) > 0 \text{ on } (0, 5), \]
\[ f'(x) > 0 \text{ on } (-5, 5), \]
and \( f(0) = 1 \).
4. Does the Mean Value Theorem apply to the function \( f(x) = \frac{1}{x} \) over the interval \([1, 3]\)? Why or why not? You must use complete sentences in your explanations. If the MVT does apply, find the value \( c \) it guarantees exists.
5. Find numbers $x$ and $y$ satisfying the equation $7x - 2y = 13$ such that the product of $x$ and $y$ is as small as possible. Give exact answers.
6. Find an antiderivative of each of the following:

(a) \( \frac{1}{1 + x^2} \)

(b) \((x^2 + 1)x^{1/2}\)
7. Find the following:

(a) \( \int e^{5x} \, dx \)

(b) \( \int (x + 2)(x + 3) \, dx \)