1. Compute the following derivatives, and show your work:

(a) \( \frac{d}{dt} \ln(t^2 + 1) \)

(b) \( \frac{d}{dx} \tan^{-1} \frac{1}{x} \)

(c) \( (f^{-1})'(3) \), where \( f \) is a differentiable one-to-one function satisfying \( f(1) = 3, f(3) = 2, f'(1) = -2, f'(3) = -\frac{1}{3} \).

2. Identify the critical points and find the maximum value and the minimum value for \( f(x) = x^3 - 3x + 2 \) on the interval \([0, 2]\). Show your work.
3. Sketch the graph of a function \( y = g(x) \) that has all the following properties:

(a) The domain of \( g \) is the open interval \((-3, 3)\).

(b) \( g \) is an odd function.

(c) \( \lim_{x \to -3} g(x) = +\infty \).

(d) \( g'(x) < 0 \) for \( x \) in \((-1, 1)\), while \( g'(x) > 0 \) for \( x \) in \((-3, -1)\) and for \( x \) in \((1, 3)\).

(e) \( g'(-1) = g'(1) = 0 \).

(f) \( g''(x) < 0 \) for \( x \) in \((-3, 0)\), while \( g''(x) > 0 \) for \( x \) in \((0, 3)\).

(g) \( g''(0) = 0 \).

(h) \( g(1) = -2, g(-1) = 2 \).
4. Show that for a rectangle of given perimeter 4, the one with the maximum area is a square. (Recall that for a rectangle with side lengths $a$ and $b$, the perimeter is given by $2a + 2b$, and the area is given by $ab$.)

5. Compute the following limits. Show your work if necessary. Each answer should be a real number, $\infty$, $-\infty$, or “does not exist.”

(a) \[ \lim_{x \to 1^+} \frac{3x}{x^2 - 1}. \]

(b) \[ \lim_{x \to -\infty} \frac{1}{1 - e^x}. \]

(c) \[ \lim_{\theta \to \frac{\pi}{2}} \tan \theta. \]
6. Consider \( h(t) = 2t^3 - 3t^2 + 5 \).

(a) Compute the critical points of \( h(t) \). Show your work.

(b) Compute the intervals where \( h(t) \) is increasing, and where \( h(t) \) is decreasing. Show your work.

(c) Compute the intervals where \( h(t) \) is concave up, and where \( h(t) \) is concave down. Show your work.

7. Use an appropriate linear approximation to approximate \( \sqrt[3]{1.03} \). Your answer should be a decimal number. Show your work.