1. (10 points each) Evaluate the following limits. Justify your answer by applying the limit laws, a computation, or a theorem from class. Guessing the limit from a graph or a table will receive no credit.

a. \( \lim_{x \to \infty} \frac{0.001x + 2}{\sqrt{10,000x^2 + 1}} \)

b. \( \lim_{x \to \infty} \frac{\sin(10x)}{x} \)

c. \( \lim_{x \to 1} \frac{\sqrt{x}-1}{x^2-1} \)

d. \( \lim_{x \to \pi^-} e^{10 - \tan(x/2)} \)
2. (30 points) The function \( f = f(x) \) is defined as follows:

\[
  f(x) = \begin{cases} 
    1 + \sqrt{1-x} & ; x \leq 1 \\
    1 - \frac{1}{x} & ; x > 1
  \end{cases}
\]

a. Evaluate \( f \circ f(-3), f^{-1}(3) \).

b. Find all the possible values of \( x \) at which the function \( f \) is continuous. Justify your answer.

c. Using the limit definition of the derivative, evaluate \( f'(2) \).

3. (15 points) Use the intermediate value theorem to prove that the equation: \( \arctan x = 1 - x \) has a real solution in the interval \((0, 1)\), then use your calculator to find the solution accurate to five decimal places. Include a copy of the graph that was used in the calculator.
4. (5 points each) **Multiple choice:** In each of the following, circle only the one choice that would make the corresponding statement true. You do not have to show work for this question.

(i) \( \lim_{x \to \infty} \frac{x \cos(1/x)}{\sqrt{7x^2 + x + 3}} = \)

(a) limit does not exist  
(b) 0  
(c) \(1/\sqrt{7}\)  
(d) \(1/\sqrt{3}\)

(ii) If the function \(f(x) = e^x + c|x^3|\) is differentiable everywhere, then \(c\) must be

(a) positive  
(b) negative  
(c) zero  
(d) an arbitrary real number

(iii) If \(\lim_{x \to a} f(x) = 0\) and \(\lim_{x \to a} g(x) = \infty\), then \(\lim_{x \to a} f(x)g(x) = \)

(a) never exists  
(b) 0  
(c) infinity  
(d) depends on the the functions \(f(x), g(x)\)

(iv) If \(\lim_{x \to a} f(x) = 0\) and \(\lim_{x \to a} g(x) = \infty\), then \(\lim_{x \to a} f(x)/g(x) = \)

(a) never exists  
(b) 0  
(c) infinity  
(d) depends on the the functions \(f(x), g(x)\)

(v) The function \(y = \sqrt{x}\) is

(a) differentiable everywhere  
(b) continuous but not differentiable  
(c) discontinuous  
(d) not enough information to decide