Math 1500 Distance Assignment 2 Due June 5.

This HW covers Sections 2.3 to 2.8. It is important that you only upload your assignment ONCE.

1. Evaluate the following limits. Write a finite limit, $\pm\infty$ or DNE ('does not exist').
   (a) $\lim_{x\to 0} \ln x$
   (b) $\lim_{x\to 0} \begin{cases} -x^2, & x \le 0; \\ x^4, & x > 0. \end{cases}$
   (c) $\lim_{x\to 0} \begin{cases} -x^2, & x < 0; \\ 1, & x = 0; \\ x^4, & x > 0. \end{cases}$
   (d) $\lim_{x\to 0} \sqrt{|x|}$
   (e) $\lim_{x\to 0} \sqrt{1+|x|}$
   (f) $\lim_{x\to 0} x^{-4}$
   (g) $\lim_{x\to 0} x^{-5}$
   (h) $\lim\limits_{x\to 1} \dfrac{x^2-5x+4}{x-1}$
   (i) $\lim\limits_{x\to 1} \dfrac{x^2-5x+4}{(x-1)^2}$
   (j) $\lim\limits_{x\to 0} \dfrac{\sqrt{x+4}-2}{x}$
   (k) $\lim\limits_{x\to 0} \dfrac{\tan(x^2)}{x^2}$
2. Show that $\lim_{x\to 0} x \sin(\ln|x|) = 0$.
3. Find $\lim_{x\to 0_+}$ of the following:
   (a) $\ln x$
   (b) $\sqrt{x}$
   (c) x^{-5}
4. Find $\lim_{x\to -\infty}$ of the following:
   (a) $\ln|x|$
   (b) x^{-5}
   (c) $3 - e^{2x}$
   (d) $\dfrac{2x^2+1}{x^2+5}$
   (e) $\dfrac{2x^2+1}{x+5}$
   (f) $\dfrac{2x^2+1}{x^3+5}$
   (g) $\dfrac{\sqrt{x^2+1}}{x+2}$
   (h) $\sqrt{1+x^2}+x$
   (i) $3\tan^{-1} 2x$
5. Define all points where the following functions are continuous:
$$f(x) = |x+1|, \qquad g(x) = \begin{cases} -x^2, & x \le 0; \\ x^4, & x > 0. \end{cases} \qquad h(x) = \begin{cases} -x^2, & x < 0; \\ 1, & x = 0; \\ x^4, & x > 0. \end{cases}.$$
6. Find all values of k so that the following function is continuous at $x = 0$:
$$f(x) = \begin{cases} 2x^2 + k^2, & x < 0; \\ 9, & x = 0; \\ x + k^2 - k - 3, & x > 0. \end{cases}$$

7. Suppose the distance from the origin of a particle along the x axis at time t is given by $s(t) = 3t^2 + 5t$. Use the definition of the derivative to find the instantaneous velocity at time t.

8. Given $f(x) = (1 + 2x)^{-1/2}$. Use the definition of the derivative to find $f'(1)$. Find the equation of the tangent line to f at $x = 1$.

9. Find all points where the following functions are differentiable:

$$f(x) = |1 + x|, \qquad g(x) = \begin{cases} -x^2, & x \leq 0; \\ x^4, & x > 0. \end{cases} \qquad h(x) = \begin{cases} -x^2, & x < 0; \\ 1, & x = 0; \\ x^4, & x > 0. \end{cases}$$

10. Show that $f(x) = x^4 - 5x + 1$ has a zero in the interval $[0, 1]$.