[First Name] [Last Name] [Net ID] [Problem Section]

Instructions:

1. Fill in the requested information on the line above.
2. This handout is due at the beginning of problem section.
3. This handout must be printed out and stapled. You may print it double sided.
4. Your work must be hand written on this handout.
5. You must show all work. You may receive zero or reduced points for insufficient work.
6. Your work must be neatly organized and written. You may receive zero or reduced points for sloppy work.
7. Only a subset of these questions will be graded. You will not be told which questions will be graded in advance.

Questions	1	2	3	4	5	6	7	8	9	Total
Points	10	10	10	10	10	10	10	10	10	90
Score										

1. (10 points) Find the limit if it exists. If it doesn't exist, explain why.

   (a) $\lim_{x\to 3^+} \dfrac{\sqrt{x}-3}{x-9}$

   (b) $\lim_{x\to 5^+} \dfrac{x-5}{|x-5|}$

   (c) $\lim_{h\to 0^-} \dfrac{(x-h)^2+x-h-x^2-x}{h}$

2. (10 points) Find the x-values (if any) at which f is not continuous. Which of the discontinuities are removable?

(a) $f(x) = \dfrac{5}{3-x}$

(b) $f(x) = \sec(x)$

(c) $f(x) = \begin{cases} 3-x, & x < -1 \\ x^2, & x \geq -1 \end{cases}$

3. (10 points) Find value(s) of parameter c (if exists) that make f continuous everywhere.

(a) $f(x) = \dfrac{2}{x + c}$

(b) $f(x) = \dfrac{2}{x^2 + 4x + c}$

4. (10 points) Does the function has a zero in the given interval? Explain why.

   (a) $f(x) = x^4 - 5$ on $[-1, 2]$

   (b) $f(x) = \tan(2x) - 4$ on $[-\pi, \pi]$

5. (10 points) Let $f(x) = 3x^2 + ax + b$.

   Find values of the parameters a and b so that the following equations are true.

   (i) $\lim_{x \to 2} f(x) = 12$ and

   (ii) $\lim_{x \to -1} f(x) = 6$

6. (10 points) Find all values of the parameters a and b so that the following function has vertical asymptotes at $x = 2$ and $x = -3$.

$$f(x) = \frac{x+7}{x^2+ax+b}$$

7. (10 points) Find all vertical asymptotes of the following function.

$$f(x) = \frac{\sqrt{x-3}\,\sqrt{x^2+4}}{(x+4)(x-3)(x-5)}$$

8. (10 points) Compute the derivative of the following function using the limit definition of derivative.
$g(x) = x - \dfrac{1}{x}$

9. (10 points) Consider the following function.

$$f(x) = \begin{cases} x, & x \leq 0 \\ x^2, & x > 0 \end{cases}$$

Away from the join point $x = 0$, it is clear that $f(x)$ is differentiable because x and x^2 are polynomials and polynomials are differentiable. Is this function differentiable at $x = 0$, i.e., did we "glue" these polynomials together "smoothly"? Use the definition of derivative to show that $f(x)$ is *not* differentiable at $x = 0$. To do this, you must show the limit as $\Delta x \to 0^-$ (from the left) is different from the limit as $\Delta x \to 0^+$ (from the right) in the definition of derivative.