Part 1  Part 1 consists 8 questions worth 5 points each. Clearly indicate your answer in the space provided after each question.  
Show all of your work for full credit!
In evaluating the limits that appear in some of the problems in Part 1, use the limit theorems, limit properties, and techniques studied thus far (but no educated guessing). Consider \( \infty \) and \(-\infty\) as possible values. If a limit has no value, not even \( \infty \) or \(-\infty\), state this and indicate why the limit fails to exist.

1. If functions \( f, g \) are continuous with \( f(2) = 5 \) and \( \lim_{x \to 2} [4f(x) - g(x)] = 11 \), find \( g(2) \).

2. Evaluate \( \lim_{x \to 0} \frac{\cos x + 1}{5x - 2} \).

3. Evaluate \( \lim_{x \to -2} \frac{x^2 - x - 6}{x + 2} \).

4. If \( f(x) = x \sin(x^2) + 1 \) and \( g(x) = \sqrt{x} \), what is the function \( f \circ g \)?
5. Determine the $x$-values where the following function $y = \frac{x^2 - 1}{x^2 - 2x - 3}$ fails to be continuous.

6. Evaluate $\lim_{x \to \infty} \frac{-3x^2 + 2x}{9x^2 - 4x + 1}$

7. Evaluate $\lim_{x \to 2} \frac{1 - x}{x - 2}$

8. Evaluate $\lim_{h \to 0} \frac{(1 + h)^2 - 1}{h}$. 
Part 2. Part 2 consists of 5 problems #1 is worth 12 points, #2-4 are worth 10 each, and #5 is worth 18 points. Again, show all the work required to work the problems.
A final answer (even if correct) without the relevant steps will not earn full credit.

1. a. Suppose the position $s$ (in feet) of a particle moving along the y-axis at time $t$ (in sec) is given by $s = t^2 - 2t$, $t \geq 0$. Find the average velocity $v_{\text{ave}}$ (complete with units of measure) of the particle over the time interval from $t = 1$ to $t = 4$ seconds.

b. Find the equation of the tangent line to the function $y = f(x)$ at the point $P$ whose $x$-coordinate is 2 if it is known that $f(2) = -3$ and $f'(2) = 7$
2. a. For what value of the constant $c$ is the function $$f(x) = \begin{cases} 
 x^2 + c & \text{if } x \geq 2 \\
 -cx + 8 & \text{if } x < 2 
\end{cases}$$
continuous at $x = 2$?

b. Does the $\lim_{x \to \infty} \sin x$ have a value? If so, what is the value (include $\infty$ and $-\infty$ as possible values)? If not, why not?
3. Let \( f(x) = \frac{3}{x} \). Use the limit definition of the derivative to find the derivative \( f'(x) \).

4. Sketch the graph of an example of a function \( f \) such that

\[
\begin{align*}
\lim_{x \to 0^+} f(x) &= 1, & \lim_{x \to 0^-} f(x) &= -1, & f(0) \text{ is undefined} & \lim_{x \to \infty} f(x) &= -1 \\
\lim_{x \to 2^-} f(x) &= 0, & \lim_{x \to 2^+} f(x) &= 1, & f(2) &= 1,
\end{align*}
\]
5. a. The graph of \( y = f(x) \) is given to the right.

i. What is the domain of \( f \)?

ii. For which value (s) of \( a \) in the domain of \( f \) does \( \lim_{x \to a} f(x) \) fail to exist?

iii. For which value(s) of \( a \) in the domain of \( f \) does \( f \) fail to be continuous at \( x = a \)?

b. The graph of \( y = f(x) \) is given to the right. Which of the following statements here are true (T) and which are false (F)?

i. \( \lim_{x \to 2} f(x) \) does not exist.

ii. The function \( f \) is continuous from the right at \( x = 1 \).

iii. The function \( f \) is differentiable at \( x = 0 \).