• This is a closed-book examination. No books, notes, calculators, cell phones, communication devices of any sort, or webpages, or other aids are permitted.

• Please *show* all of your work and *justify* all of your answers.

1. Consider the line $L$ given by $x + 3y = 6$.
   (a) Sketch this line $L$.
   (b) Find the equation of the new line $M$ that is **perpendicular** to the first line $L$, $x + 3y = 6$, and passes through the point $(1, -2)$.
   (c) Sketch this new line $M$ found in (b).

2. Evaluate each of the following limits. Please *justify* your answers. Be clear if the limit equals a value, $+\infty$ or $-\infty$, or Does Not Exist.
   (a) $\lim_{x \to -7} \frac{x^2 + 5x - 14}{x^2 - 4x + 4} =$
   (b) $\lim_{x \to 4} \frac{x^2 - 9x + 20}{|4 - x|} =$
   (c) $\lim_{x \to -6} \frac{f(x^2) + 5x - 8}{[f(x)]^2 + 5x + 14} =$ where $f(x) = x + 2$
   (d) $\lim_{x \to 2} \frac{x^2 + 5x - 14}{x^2 - 4x + 4} =$
   (e) $\lim_{x \to 8} \frac{3 - \sqrt{x + 1}}{x^2 - 7x - 8} =$
   (f) $\lim_{x \to 4} \frac{3 - x - \frac{3}{x - 5}}{x^2 - x - 12} =$
   (g) $\lim_{x \to -3} \frac{x - 5}{x + 3} =$
   (h) $\lim_{x \to 8} \frac{1}{(x - 8)^2} =$
3. Suppose that \( f(x) = \frac{x + 7}{x - 3} \). Compute the difference quotient \( \frac{f(x + h) - f(x)}{h} \). Simplify your answer until the \( h \) in the denominator cancels.

4. Consider the two functions \( f(x) = \frac{1 + x}{1 - x} \) and \( g(x) = \frac{1}{x} \).

   (a) Compute \( f \circ g(x) \). Simplify your answer to a single fraction. State the Domain.

   (b) Compute \( g \circ f(x) \). Simplify your answer to a single fraction. State the Domain.

   (c) Compute \( f \circ f(x) \). Simplify your answer to a single fraction. State the Domain.

5. Consider the function defined by

\[
f(x) = \begin{cases} 
2 & \text{if } x \geq 11 \\
\sqrt{x - 7} & \text{if } 7 < x < 11 \\
1 & \text{if } x = 7 \\
7 - x & \text{if } 0 < x < 7 \\
16 - x^2 & \text{if } -4 < x \leq 0 \\
\frac{1}{x + 4} & \text{if } x < -4 
\end{cases}
\]

   (a) Carefully sketch the graph of \( f(x) \).

   (b) State the Domain of the function \( f(x) \).

   (c) Compute \( \lim_{{x \to -4}} f(x) = \)

   (d) Compute \( \lim_{{x \to 0}} f(x) = \)

   (e) Compute \( \lim_{{x \to 7}} f(x) = \)

   (f) Compute \( \lim_{{x \to 11}} f(x) = \)

   (g) State the value(s) at which \( f \) is discontinuous. Justify your answer(s) using the definition of continuity discussed in class.