

- 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) $\lim_{x \rightarrow -7} \frac{x^2 + 5x - 14}{x^2 - 4x + 4} =$

(b) $\lim_{x \rightarrow 4} \frac{x^2 - 9x + 20}{|4 - x|} =$

(c) $\lim_{x \rightarrow -6} \frac{f(x^2) + 5x - 8}{[f(x)]^2 + 5x + 14} =$ where $f(x) = x + 2$

(d) $\lim_{x \rightarrow 2} \frac{x^2 + 5x - 14}{x^2 - 4x + 4} =$

(e) $\lim_{x \rightarrow 8} \frac{3 - \sqrt{x + 1}}{x^2 - 7x - 8} =$

(f) $\lim_{x \rightarrow 4} \frac{\frac{3 - x}{x - 5} - \frac{3}{7 - x}}{x^2 - x - 12} =$

(g) $\lim_{x \rightarrow -3} \frac{x - 5}{x + 3} =$

(h) $\lim_{x \rightarrow 8} -\frac{1}{(x - 8)^2} =$

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 $\lim_{x \rightarrow -4} f(x) =$

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

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

(f) Compute $\lim_{x \rightarrow 11} f(x) =$

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