Math 124 F - Autumn 2015
Midterm Exam Number One
October 27, 2015

Name: ___________________________  Student ID no.: __________________

Signature: ___________________________  Section: ____________

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- This exam consists of FIVE problems on FIVE pages, including this cover sheet.
- Show all work for full credit.
- You do not need to simplify your answers.
- If you use a trial-and-error or guess-and-check method when a more rigorous method is available, you will not receive full credit.
- If you run out of room, write on the back of the page, but *indicate that you have done so!*
- You may use one hand-written double-sided 8.5” by 11” page of notes.
- You may use a *scientific calculator*. Calculators with graphing, differentiation, integration, or algebraic capabilities are not allowed.
- You have 80 minutes to complete the exam.
1. [5 points per part] Compute each limit. You may use any techniques you know. If a limit does not exist or is infinite, say so, and explain.

(a) \( \lim_{x \to 8} \frac{\sqrt{x - 4} + 2}{x - 3} \)

(b) \( \lim_{t \to 0} \frac{\sin(at) - bt + ct^2}{t} \)

(c) \( \lim_{x \to \infty} \sin \left( \frac{\pi x + 6}{\sqrt{4x^2 + 2x + 2x}} \right) \)
2. **[9 points]** Consider the curve \( y = \sqrt{x} + 4x \).

Give the equation for a tangent line to this curve which is parallel to the line \( y = 5x + 4 \).

3. **[7 points]** Consider the function \( f(x) = \sec(x) - xe^x \). Compute \( f''(x) \).
4. Consider the following multipart function:

\[ f(x) = \begin{cases} 
    ae^x + b \cos(x) + 3x & \text{if } x \leq 0 \\
    \frac{x + 5}{x^2 - 2x + 1} & \text{if } x > 0 
\end{cases} \]

(a) [10 points] Determine constants \(a\) and \(b\) so that \(f(x)\) is differentiable at \(x = 0\).

(b) [6 points] Find all horizontal asymptotes of \(f(x)\).
5. The graph of $f(x)$ is shown below.

Cool graph, right? Use it to answer the following questions.

(a) [3 points] Compute $\lim_{x \to -3} [f(x) \cdot f(x + 1)]$.

(b) [3 points] For what constant $c$ does $\lim_{x \to 3} \frac{f(x) - c}{x - 3}$ exist?

(c) [3 points] Compute the limit from part (b), using the value of $c$ you chose.

(d) [4 points] Let $g(x) = \frac{f'(x)}{f(x)}$. What is $g'(7)$?