Name

• This test is closed notes, closed book.

• Laptops and calculators are NOT allowed.

• There are 8 pages and 9 questions total.

• You can leave an answer as a numerical expression without computing the final value.
  For example, this is a perfectly acceptable answer:
  
  \[ \frac{(250 - 63)}{(1 - e^{-6 \times 3.5})} \times \ln(27/168). \]  
  Show your work clearly !

• The maximum score in the test is 70 points.

Signature
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<th>Problem</th>
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1. Find the following limits.

(a) (5 pts) (Hint: Factorize and divide out)

\[
\lim_{x \to 3} \frac{x^2 - 9}{x^2 - 5x + 6}.
\]

(b) (5 pts) (Hint: Rationalize the numerator)

\[
\lim_{x \to 4} \frac{\sqrt{x} - 2}{x - 4}.
\]
(c) (6 pts) (Hint: Add fractions first)

$$\lim_{x \to 0} \frac{\frac{1}{x+1} + \frac{1}{x-1}}{x}.$$ 

(d) (4 pts)

$$\lim_{x \to \infty} \frac{2x^2 + 3x}{500 + 3x^2}.$$
2. (3 pts) Let $f(x) = x + 2$ and $g(x) = x^2 - 5x$. Write the expression for $g(f(x))$.

3. (4 pts) Let $h(x) = \frac{1}{(x+3)^2}$ and $f(x) = x + 3$. What should $g(x)$ be such that $h(x) = g(f(x))$?

4. (8 pts) Find the inverse of the function : $f(x) = 7 - \sqrt{x - 3}$.
5. (5 pts) Determine if the following function is continuous at $x = 1$.

$$f(x) = \begin{cases} 
  x^2 + 3x + 1 & x < 1 \\
  3 & x = 1 \\
  \sqrt{x + 8} & x > 1 
\end{cases}$$

Show all your work and justify your answer for full credit.

6. (5 pts) Find all points of intersection of the curves defined by the two equations: $y = x^2 + x$ and $y = 2x^2 - 2x + 2$. 


7. **(5 pts)** Find the equation of the circle whose diameter has end-points given by \((-1, 3)\) and \((3, 1)\).

8. **(10 pts)** Use the definition of the derivative

\[
f'(x) = \lim_{h \to 0} \frac{f(x + h) - f(x)}{h}
\]

to find the derivative of \(f(x) = 2x^2 - 3x + 7\).
9. **(10 pts)** Find the horizontal and vertical asymptotes for the function 
\[ f(x) = \frac{x^2 + x - 6}{(x+1)(x-2)}. \]