MATHEMATICS 113/114
Midterm Examination, Version 3

Fall 2011

Date: Wednesday, October 26, 2011
Time: 50 minutes

LAST NAME: ___________________ FIRST NAME: ___________________

(Please, print!)

Please, check your section/instructor!

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<th>Section</th>
<th>Instructor</th>
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<tbody>
<tr>
<td>Math 113, E1</td>
<td>E. Osmanagic</td>
</tr>
<tr>
<td>Math 114, D1</td>
<td>X. Chen</td>
</tr>
</tbody>
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Instructions

1. Books, notes or calculators are not permitted.
2. Show all your work.
3. Make sure your examination paper has 5 questions.
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1. (20 points)

(a) Find the domain of $f$ if $f(x) = \frac{\sqrt{8-x}}{\sqrt{x^2 - 4}}$

(b) Let $g(x) = e^{2x+1} f(x^2)$. Find $g'(2)$ if $f(4) = 2$, $f'(4) = 3$.
(c) Evaluate

\[
\lim_{{x \to 0}} \frac{\sin x}{1 - \sqrt{1 + x}}.
\]

(d) Find horizontal and vertical asymptotes of \( f(x) = \frac{2 + 3x}{2x - 1} \). Justify your answer.
2. (20 points) Evaluate the limit or explain why the limit does not exist:

(a) \[ \lim_{x \to 0} \frac{\tan(2x)}{\sin(3x)}. \]

(b) \[ \lim_{x \to -\infty} (\sqrt{x^2 + x} + x). \]
3. (20 points)

(a) Find all possible values of \( a \) and \( b \) so that the function

\[
f(x) = \begin{cases} 
  x + 2b, & x < 1 \\
  bx^2 - a, & 1 \leq x \leq 2 \\
  4x + 1, & x > 2 
\end{cases}
\]

is continuous at every \( x \). Justify your answer.

(b) Differentiate:

\[ f(x) = \cos(\sin(\sin(x^2))). \]
4. (20 points) Consider the function \( y = f(x) = \frac{1}{\sqrt{x-2}} \).

(a) Use the definition of the derivative to find \( f'(x) \) and state the domain for \( f \) and \( f' \). NOTE: No marks will be given if the definition is not used.

(b) Find an equation of the normal line to the graph of \( f \) at the point \((a, f(a))\) where \( a = 4 \).
5. (20 points)

A function \( y = y(x) \) is implicitly defined by the equation:

\[
3e^y \cos x - \sin(xy) = 3.
\]

(a) Find \( \frac{dy}{dx} \).

(b) Find the slope of the tangent line to the graph of \( y = y(x) \) at the point \((2\pi, 0)\).