Math 124 - Fall 2010
Exam 1
October 26, 2010

Name: _____

Section: _____

Student ID Number: _____

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- There are 7 questions spanning 5 pages. Make sure your exam contains all these questions.
- You are allowed to use a scientific calculator (**no graphing calculators**) and one **hand-written** 8.5 by 11 inch page of notes.
- Check that your exam contains all the problems listed above.
- You must show your work on all problems. The correct answer with no supporting work may result in no credit. **Put a box around your FINAL ANSWER for each problem and cross out any work that you don't want to be graded.** Give exact answers wherever possible.
- If you need more room, use the backs of the pages and indicate to the grader that you have done so.
- Raise your hand if you have a question.
- Any student found engaging in academic misconduct will receive a score of 0 on this exam.
- You have 80 minutes to complete the exam. Budget your time wisely.
  SPEND NO MORE THAN 15 MINUTES PER PAGE!

GOOD LUCK!

1. (16 pts) Determine the values of the following limits or state that the limit does not exist. If it is correct to say that the limit equals ∞ or $-\infty$, then you should do so. In all cases, show your work/reasoning.

   (a) $\lim_{x\to 3} \dfrac{5x^2 - 5x - 30}{2x - 6}$

   (b) $\lim_{x\to 1^-} \sin^{-1}\left(\dfrac{|x-1|}{x-1}\right)$

   (c) $\lim_{x\to\infty} \left(\sqrt{3x + 4x^2 - 1} - 2x\right)$

   (d) $\lim_{x\to 5^+} \dfrac{1 - x^2}{\sqrt{x-5}}$

2. (5 pts) Determine the value of the limit (explain your work): $\lim_{x \to -\infty} \dfrac{(2+e^x)x^2 + 3\cos(x)}{x^2 \tan^{-1}(x) - 4\pi}$

3. (7 pts) Let $f(x) = e^{\sin(2x)} + \tan(x)$. Find $f'(0)$ and $f''(0)$.

4. (8 pts) Let $f(x) = \dfrac{7x+1}{\sqrt{x^2+3}}$.

   (a) Find the equations of the tangent line and normal line to $f(x)$ at the point on the graph where $x = 1$.

   (b) Find the x-coordinates of all points on the graph of $f(x)$ at which the tangent line is horizontal.

5. (4 pts) Suppose $f(x)$ is some function that is defined for all real numbers (you don't know if $f(x)$ is even, odd or neither). For each new function defined below, determine if the function **must** be even, odd, or neither:

   (a) $g(x) = f(x) - f(-x)$ CIRCLE ONE: EVEN ODD NEITHER

   (b) $h(x) = f(x) + f(-x)$ CIRCLE ONE: EVEN ODD NEITHER

   (c) $k(x) = |f(x)|$ CIRCLE ONE: EVEN ODD NEITHER

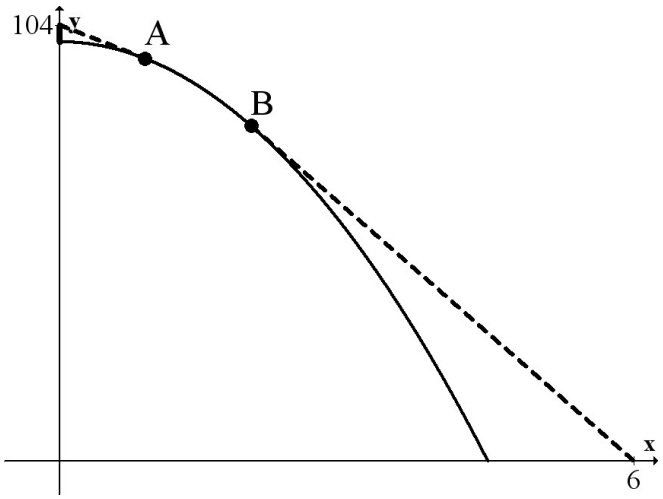
   (d) $j(x) = f(x)f(-x)$ CIRCLE ONE: EVEN ODD NEITHER

6. (10 points)

The side view of a hill, depicted to the right, is given by the function

$$y = -5x^2 + 100,$$

where x and y are in feet.
A long rope is tied to the ground at the point (6,0) and to the top of a 4 foot post at the very top of the hill. The rope is pulled tight so that it bends to form two separate straight line segments adjoining a segment of rope in the middle that follows the curve of the hill.



Find the points A and B at which the rope first touches the hill on each side.
(Hint: The straight lines form two different tangent lines to the hill).

7. (10 pts) Determine the values for the constants a and b such that the following function, f, is **continuous** and **differentiable** for all real numbers x.

$$f(x) = \begin{cases} ax^2 + bx - 1 & , \text{ if } x \leq 1; \\ \dfrac{a + bx}{x + 1} & , \text{ if } x > 1. \end{cases}$$