# Math 1311 Spring 2008

## Calculus I

### Second Midterm Exam

### Thursday, March 13, 7:00 pm - 9:00 pm

Your name (please print):

**Instructions:** This is a closed book, closed notes exam. **Use of calculators is not permitted.** You must justify all of your answers to receive credit. Notation is important, and points will be deducted for incorrect use. Please do all of your work on the paper provided.

**The Honor Code requires that you neither give nor receive any aid on this exam.**

If you are bound by the Academic Honor Code, please indicate that you have read and understood these guidelines by signing your name in the space provided:

**Pledged:** _____

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Do not write below this line

| Problem | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
|---|---|---|---|---|---|---|---|---|
| Points | 15 | 10 | 10 | 10 | 20 | 20 | 10 | 5 |
| Score | | | | | | | | |

**Total:**_____

**1.** Find the first two derivatives of the following functions.

a. $f(x) = \ln(x^2+1)$

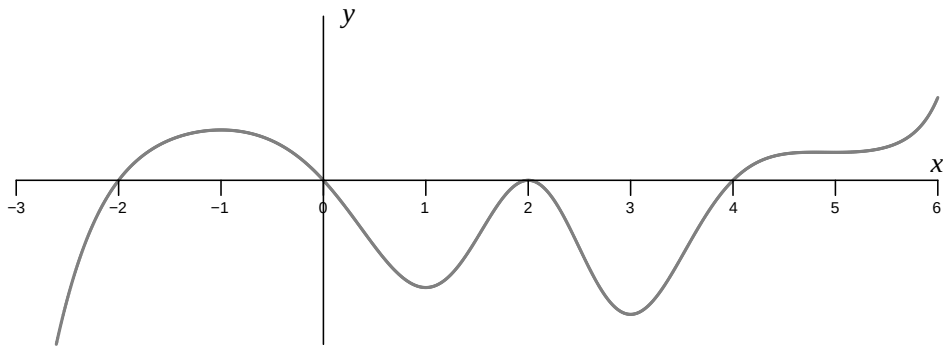
b. $g(x) = e^{\cos x}$

c. $h(x) = x^x$

**2.** Find an equation for the tangent line to the curve $y^2 - xy - x^3 - x = 0$ at the point $(1, -1)$. Express your answer in the form $ax + by = c$.

**3.** Use a linear approximation to estimate $\sqrt{99.8}$.

**4.** The figure below shows the graph of the *derivative* of a differentiable function $f(x)$ over the interval $[-3, 6]$. Use this figure to answer the questions below. You do not have to show any work.




The graph of $y = f'(x)$

a. Determine the intervals on which $f(x)$ is increasing and those on which it is decreasing.

b. Find and classify the critical points of $f(x)$.

c. Determine the intervals on which $f(x)$ is concave up and those on which it is concave down.

d. Find the inflection points of $f(x)$.

**5.** An airplane flying horizontally at an altitude of 3 mi and at a speed of 480 mi/h passes directly over a radar station on the ground. Find the rate at which the distance from the airplane to the station is increasing 30 s later.

**6.** A rectangle of fixed perimeter 27 cm is rotated around one of its sides, thus sweeping out a figure in the shape of a right circular cylinder. What is the maximum possible volume of that cylinder?

**7.** Let $f(x) = (x+1)\sqrt[3]{x-1}$.

a. Find the critical points of $f(x)$. [*Hint:* There are two of them.]

b. The function $f(x)$ has exactly one global extremum. Find it.

**8.** If $f(1) = 10$ and $f'(x) \geq 2$ for $1 \leq x \leq 4$, how small can $f(4)$ possibly be? [*Hint:* Apply the Mean Value Theorem.]