Math 220 Exam III
Chapter 3
April 3, 2009

NAME: ______________________________________ (Please Print)

(Discussion Section)

Circle your discussion 11am 12pm 1pm 2pm 3pm

DIRECTIONS:

• Sit in the seat indicated. DO NOT OPEN YOUR EXAM UNTIL YOU ARE TOLD TO DO SO!

• Each exam is worth 100 points and has a total of 6 pages.

• No work means no points.

• This is a closed book, closed notes exam. No calculators allowed.

• No hats or dark sunglasses.

• No cell phones. Turn them OFF now. If you are seen with a cell phone in hand during the exam or if your cell phone is heard, it will be considered cheating and you will be asked to leave.

• No other electronic devices – MP3 players, PDAs, etc. Same rules as phones.

• If you have a question, raise your hand and a proctor will come to you. Once you stand up, you are done with the exam. You will not be permitted to leave the room and return during the exam.

• Be sure to write your proper name CLEARLY and circle the discussion section for which you are registered.

• If you finish early, quietly and respectfully get up and hand in your exam. You need to show a picture ID with a clear picture when you turn in your exam.

• When time is up, you will be instructed to put down your writing utensil and close your exam. Anyone seen continuing to write after this announcement will have their exam marked and will lose all points for the page on which they are writing.
SCORES:

1. ____________/14
2. ____________/18
3. ____________/14
4. ____________/12
5. ____________/16
6. ____________/12
7. ____________/14
8. ____________/4

Total: ____________/100
Problem 1. (14 points)
Luke, Leia, Han and Chewie are stuck in the garbage compactor on the Death Star. When it begins to compact, the trash compactor is a cube. Find the rate at which the volume of the compactor is changing when the height of the compactor is 4, and the ceiling is moving towards them at rate \( \frac{2}{s} \) m, the width of the compactor is moving towards them at rate \( \frac{3}{s} \) m and the length of room is moving in at rate \( \frac{1}{2} \frac{m}{s} \).
**Problem 2.** (18 points)
Calculate the following limits. Carefully justify all steps in your calculations.

a) (6 points) \( \lim_{x \to \infty} \frac{\ln x + \tan^{-1} x}{x} \).

b) (6 points) \( \lim_{x \to 0^+} (\cos x)^{1/x} \).
c) (6 points) \( \lim_{x \to 0^+} (x)^{1/x} \).
Problem 3. (14 points)

a) (6 points) State the Extreme Value Theorem.

b) (8 points) Find the absolute extrema of \( f(x) = e^{\sin x} \) on \( \left[ \frac{\pi}{4}, \frac{3\pi}{4} \right] \).
Problem 4. (12 points)
a) (6 points) State the Second Derivative Test with all hypotheses.

b) (6 points) Graphically explain why the Second Derivative Test makes sense.
(Use a complete sentence as well.)
Problem 5. (12 points)
Given the following graphs of $f'(x)$ [left] and $f''(x)$ [right],

a) (4 points) Where is $f(x)$ increasing and decreasing?

b) (4 points) Where is $f(x)$ concave up and concave down?

c) (4 points) Classify all local extrema and inflection points. Be sure to justify your choices.
Problem 6. (12 points)
To estimate the number $\sqrt[3]{9}$,

a) (6 points) State the function $f(x)$ and the point $x_0$ you will use with Newton’s Method. Quickly explain your choices.

b) (6 points) Find $x_1$ explicitly (i.e. give a simplified answer).
Problem 7. (14 points)
Find the maximum area of a right triangle whose hypotenuse has length 5cm.
**Problem 8. (4 points)**
Sketch a plausible graph given the following information.

\[
\begin{array}{c|ccc}
\text{Interval} & (-\infty, 4) & (4, 7) & (7, \infty) \\
\hline
f'(x) & + & + & - \\
f''(x) & + & - & -
\end{array}
\]