DEPARTMENT OF MATHEMATICS AND STATISTICS
UNIVERSITY OF MASSACHUSETTS
MATH 131 Fall 2003
EXAM #1

Your Section Number: _____

Your Instructor's Name: _____

Print Your Name: _____

Sign Your Name: _____

This exam consists of 7 questions. It has 8 numbered pages, where the last is a blank page.

On this exam, you may use a calculator and a page of your own notes, but no books.

It is not sufficient to just write the answers. You must *explain* how you arrive at your answers.

Leave the space below empty!

1. (15) _____

2. (15) _____

3. (15) _____

4. (10) _____

5. (15) _____

6. (15) _____

7. (15) _____

TOTAL (100)

1. Find each finite or infinite limit (without giving details):

   a) (7 points)
   $$\lim_{x \to \infty} \frac{1}{3 - x} =$$

   b) (8 points)
   $$\lim_{x \to 2^-} \frac{x + 2}{x - 2} =$$

2. (10 points)

$$f(x) = xe^x + \frac{\sqrt{x^2 + 1}}{5x - 1}$$

a) Use the limit rules (showing steps) to calculate

$$\lim_{x \to 1} f(x)$$

b) (2 points) Find $f(1)$.

c) (3 points) Is f continuous at 1?

3. Let $f(x) = 2\sqrt{x} + 5$.

   a) (7 points) Find $f'(x)$ by using standard differentiation rules.

   b) (8 points) Find the equation of the tangent line to the graph of f at the point $(1, 7)$.

4. (10 points) Let f be a continuous function defined everywhere on the real line. How many **horizontal** asymptotes can f have? Circle all possible answers. For each circled response sketch a graph to illustrate this possibility, using dotted lines for asymptotes.

<div align="center">

0   1   2   more than 2

</div>

5. Let
$$y = \frac{x}{x+1}$$

a) (8 points) Use the **definition of the derivative** as a limit to compute dy/dx, showing steps.

b) (7 points) Use the **quotient rule** to compute dy/dx, showing steps.

6. The height of a ball t seconds after it is thrown vertically upwards from an initial position is
$$s(t) = 64t - 16t^2$$

a) (10 points) Use the derivative to determine the time at which the ball stops rising: when is the velocity 0?

b) (5 points) Determine at what time t the ball returns to the initial position.

7. a) (10 points) Use the derivative of $y = x^3 - 3x^2 + 4$ to determine all points $x = a$ at which the graph has a horizontal tangent line.

   b) (5 points) Draw the graph to check your answer in part a).