Name \_\_\_\_\_

Millersville University Department of Mathematics MATH 161, Calculus I, Test 3 November 10, 2006

Please answer the following questions. Your answers will be evaluated on their correctness, completeness, and use of mathematical concepts we have covered. Please show all work and write out your work neatly. Answers without supporting work will receive no credit. The point values of the problems are listed in parentheses.

1. (4 points each) Consider the function

$$f(x) = x^3 - \frac{3}{400}x.$$

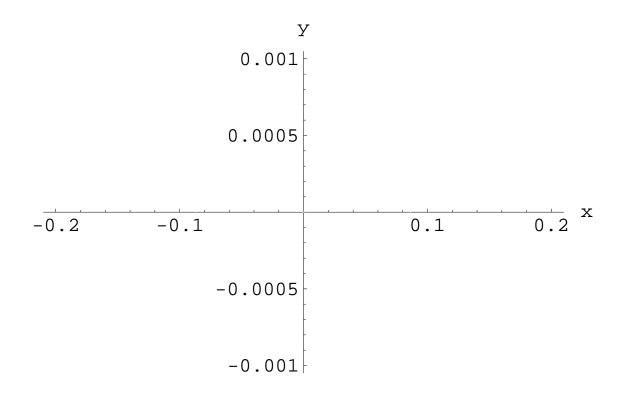
(a) Find the horizontal and vertical asymptotes of the function, if any.

(b) Find the critical numbers of the function (if any) and the intervals where the function is increasing and decreasing.

(c) Find the local extrema of the function, if any. Classify each extremum as a local minimum or local maximum.

(d) Find the points of inflection of the function (if any) and the intervals where the graph of the function is concave up and concave down.

(e) Sketch a graph of the function on the axes provided below.



2. (10 points) An advertisement consists of a rectangular printed region plus 1-inch margins on the sides and 2-inch margins on the top and bottom. The area of the printed region is to be 92 inch<sup>2</sup>. Find the dimensions of the printed region that minimize the total area of the advertisement.

3. (8 points each) Find the exact values of the following limits, if they exist.

(a) 
$$\lim_{x \to 1} \frac{e^{x-1} - 1}{x^2 - 1}$$

(b) 
$$\lim_{x \to 0^+} (\cos x)^{1/x}$$

4. (10 points) A camera tracks the launch of a vertically ascending spacecraft. The camera is located at ground level 5 miles from the launchpad. If the spacecraft is 4 miles up and traveling at 0.3 miles per second, at what rate is the camera angle (measured from the horizontal) changing?

5. (7 points each) Evaluate the following indefinite integrals.

(a) 
$$\int \left(2x^{-1} + \frac{1}{\sqrt{x}}\right) dx, \qquad x \neq 0$$

(b) 
$$\int x^{2/3} (x^{-4/3} - 2) dx$$

6. (10 points) Find the absolute extrema of the function  $f(x) = x^2 e^{-2x}$  on the interval [0,2]. Classify each extremum as an absolute maximum or absolute minimum.