

Your Name

Your Signature

Student ID #

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Quiz Section

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Professor's Name

TA's Name

- Turn off all cell phones, pagers, radios, mp3 players, and other similar devices.
- This exam is closed book. You may use one 8.5" × 11" sheet of handwritten notes (both sides OK).  
Do not share notes. No photocopied materials are allowed.
- You can only use a Texas Instruments TI-30X IIS calculator.
- In order to receive credit, you must **show all of your work**. If you do not indicate the way in which you solved a problem, you may get little or no credit for it, even if your answer is correct.
- Place a box around your answer to each question.
- If you need more room, use the backs of the pages and indicate that you have done so.
- Raise your hand if you have a question.
- This exam has 9 pages, plus this cover sheet. Please make sure that your exam is complete.

Question	Points	Score
1	14	
2	12	
3	12	
4	12	

Question	Points	Score
5	10	
6	12	
7	12	
8	16	
Total	100	

1. (14 total points) Compute the following derivatives.

(a) (4 points)  $\frac{d}{dx} (e^e + x^e + e^x + x^x)$

(b) (4 points)  $\frac{d}{dt} \arctan\left(\frac{t + \pi}{1 - \pi t}\right)$

(c) (6 points) Let  $f(x) = \begin{cases} x^2 \sin\left(\frac{1}{x}\right) & \text{if } x \neq 0; \\ 0 & \text{if } x = 0. \end{cases}$

i. Find  $f'(x)$  when  $x$  is not zero.

ii. Using the definition of the derivative, find  $f'(0)$  (if it exists).

2. (12 total points) Compute the following limits. Your answers should be one of  $\infty$ ,  $-\infty$ , DNE or a number. If you conclude that the limit does not exist, explain why not.

(a) (4 points)  $\lim_{x \rightarrow 1^+} \left( \frac{1}{x-1} - \frac{1}{(x-1)^2} \right)$

(b) (4 points)  $\lim_{x \rightarrow \infty} \sqrt{x + \sqrt{5x}} - \sqrt{x}$

(c) (4 points)  $\lim_{x \rightarrow 1} \frac{(x^2 - 4x + 3)(x^2 + x + 1)}{x^2 + x - 2}$

3. (12 points) A line of negative slope  $m$  passes through the point  $(4, 6)$ . Consider the triangle in the first quadrant bounded by this line, the  $x$ -axis, and the  $y$ -axis. For what value of  $m$  is the area a minimum? Be sure to justify why it is a minimum.

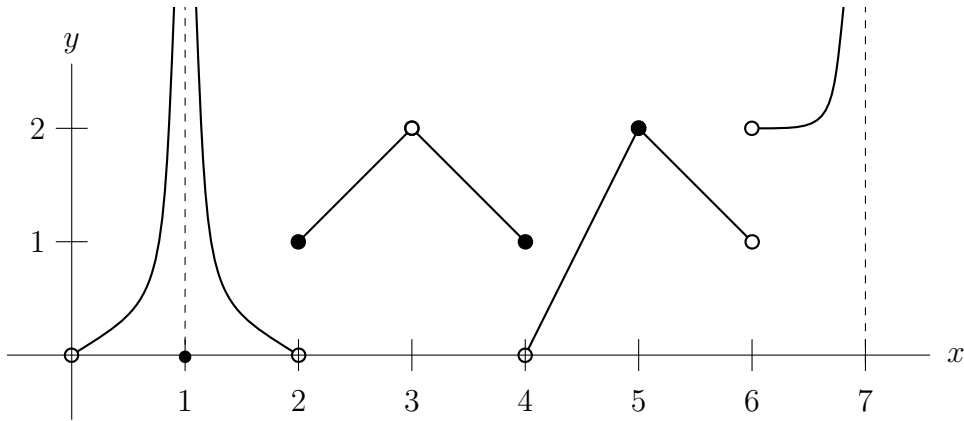
4. (12 total points) The point  $(2, 1)$  lies on the curve

$$\frac{1}{(x-1)^2 + y^2} + \frac{5}{x^2 + (y-x)^2} = \frac{3}{2}.$$

(a) (8 points) Find the equation of the tangent line to the curve at this point.

(b) (4 points) Use the tangent line approximation to approximate a value  $x$  near 2 with  $(x, 1.2)$  on the curve. Give your answer to three decimal places.

5. (10 total points) The graph below shows  $y = f(x)$ .



(a) (2 points) Evaluate  $\lim_{x \rightarrow 4} f(x)$ .

(b) (2 points) Evaluate  $\lim_{x \rightarrow 3} f(x)$ .

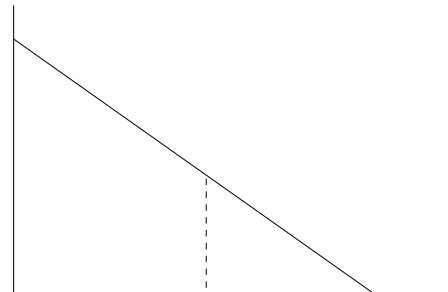
(c) (2 points) For which  $x$  is  $f$  continuous? Circle all that apply: 0 1 2 3 4 5 6 7

(d) (2 points) Assuming that  $f$  is linear on  $4 \leq x \leq 5$ , what is  $f'(4.5)$ ?

(e) (2 points) Assuming that  $f$  is linear on  $3 \leq x \leq 4$ , what is  $f''(3.5)$ ?

6. (12 points) A 13 foot long ladder leans against a wall and the foot of the ladder is sliding away from the wall at a constant rate of 3 feet/sec. Meanwhile, a firefighter is climbing up the ladder at a constant rate of 2 feet/sec. At the instant the firefighter has climbed 4 feet of the ladder, the foot of the ladder is 5 feet from the wall.

Let  $h$  be the vertical height of the firefighter above the ground. Find  $dh/dt$  at that instant.



7. (12 points) Consider the curve given by the following parametric equations:

$$x(t) = 9t - t^3 + 2, \quad y(t) = 3t^3 - t^4 + 1.$$

The curve passes through the point  $(2, 1)$  for two different values of  $t$ .  
Find the equations of the two tangent lines to the curve at the point  $(2, 1)$ .



8. (16 total points) Consider the function  $f(x) = \frac{x^3}{(x+1)^2}$ .

(a) (2 points) Give the horizontal asymptotes of the graph of  $y = f(x)$ , if there are any.

(b) (2 points) Give the vertical asymptotes of the graph of  $y = f(x)$ , if there are any.

(c) (4 points) Find the critical numbers for  $f(x)$  and determine if each gives a local minimum, a local maximum, or neither.

8. (continued) Recall the function  $f(x) = \frac{x^3}{(x+1)^2}$

- (d) (4 points) Does the graph of  $y = f(x)$  have any inflection points? In which interval(s) is the graph concave up?

- (e) (4 points) Sketch the graph of  $y = f(x)$  on the axes provided below. Be sure to include asymptotes (if any) in your picture. Also, mark the coordinates of any local maximum, local minimum or inflection point. Make sure your picture matches the information you provided in parts (a)-(d).

