

Your Name

Your Signature

Student ID #

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Quiz Section

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Professor's Name

TA's Name

- Turn off and stow away all cell phones, pagers, radios, mp3 players, and other similar devices.
- This exam is closed book. You may use one 8.5" \times 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	12	
2	12	
3	12	
4	12	

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

1. (12 total points) Compute the derivatives of the following functions. You do not have to simplify your answers.

(a) (4 points) $g(x) = \frac{\tan x}{1 + x^4}$

(b) (4 points) $f(t) = \sin^2(\cos(1 + 4^t))$

(c) (4 points) $y = 5(1 + e^{2x})^{3x}$

2. (12 total points) Find the following limits. In each case your answer should be either a number, $+\infty$, $-\infty$, or DNE. Please show your work.

(a) (4 points) $\lim_{\theta \rightarrow 2^-} \frac{\theta^2 + 3\theta - 10}{|\theta^2 - 4|}$

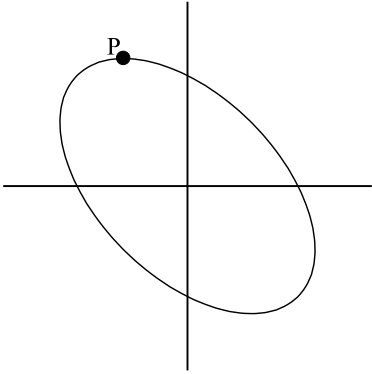
(b) (4 points) $\lim_{u \rightarrow \infty} u \sin(1/u)$

(c) (4 points) $\lim_{x \rightarrow \infty} \frac{5x^2 3^{1+x} + 3x^4 \ln(x)}{2x^2 3^{3+x} + 9x^4 \ln(x)}$

3. (12 total points) In this problem you may use the expansion $(A+B)^3 = A^3 + 3A^2B + 3AB^2 + B^3$, but you may not use derivative formulas. Let $f(x) = \sqrt{x^3 + 17}$.
- (a) (3 points) Write down the limit definition of the derivative of $f(x)$ at $x = 2$.

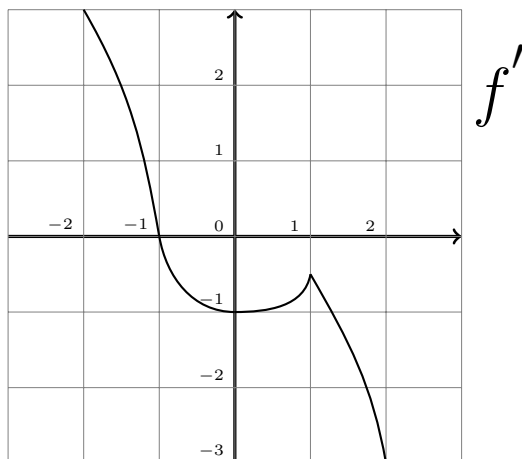
- (b) (9 points) Find $f'(2)$ by evaluating the limit in part (a). Please show all your steps clearly.

4. (12 points) Below is the graph of the ellipse $x^2 + xy + y^2 = 9$. The point P is the point on the ellipse with the maximum y coordinate. Find the coordinates of P . Give your answer in exact form.



5. (12 total points) Below is the graph of the **DERIVATIVE** of a function $f(x)$ defined on $(-2, 2)$. You also know $f(0) = 0$.

Your answers to the limit problems should be either a number, $+\infty$, $-\infty$, or DNE. You do not need to show your work on this problem.



(a) (2 points) What is $\lim_{x \rightarrow 0} \frac{f(x)}{x}$?

(b) (2 points) What is $\lim_{x \rightarrow 0} \frac{f'(x)}{x}$?

(c) (2 points) List the interval(s) where f is increasing.

(d) (2 points) List the interval(s) where f is concave up.

(e) (2 points) Find the critical numbers for f and determine if each gives a local minimum, a local maximum, or neither.

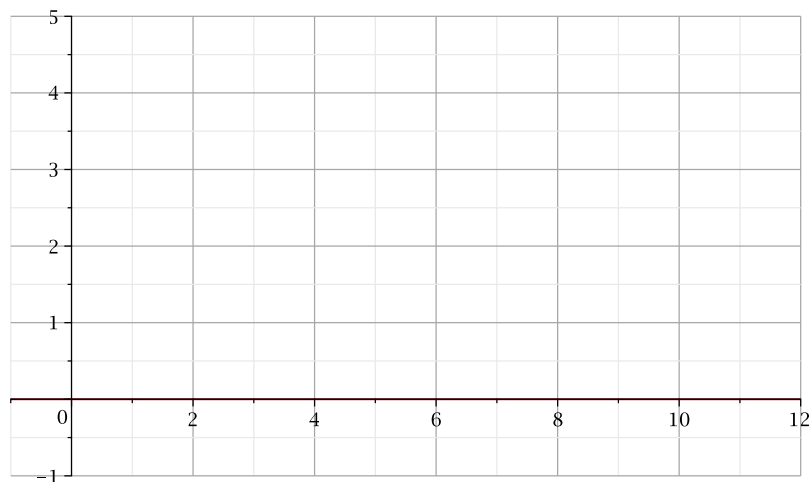
(f) (2 points) Which is biggest? : $f(-0.5)$, $f'(-0.5)$ or $f''(-0.5)$

6. (16 total points) Consider the function $f(x) = x^4 e^{-x}$.
- (a) (2 points) Give the horizontal asymptote(s) of the graph of $y = f(x)$, if there are any.
- (b) (2 points) Give the vertical asymptote(s) 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.

6. (continued) Recall the function $f(x) = x^4 e^{-x}$

- (d) (4 points) Find the inflection point(s) of $y = f(x)$. In which interval(s) is the graph concave down?

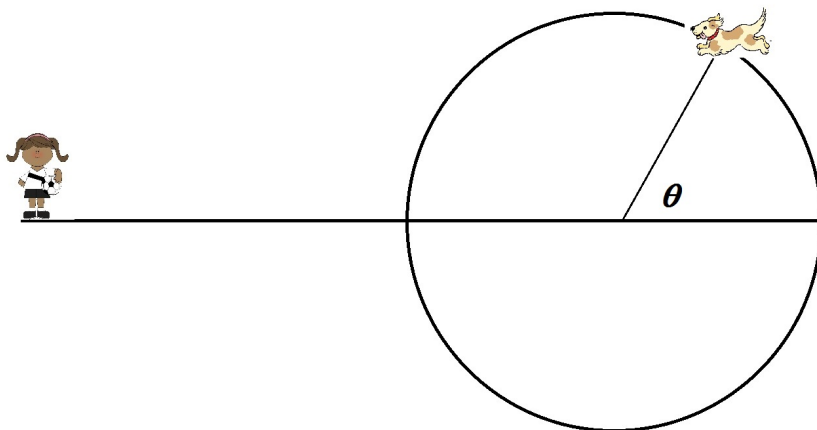
- (e) (4 points) Sketch the graph of $y = f(x)$ on the axes provided below. Be sure to include asymptotes (if any) in your picture. Also, mark the coordinates of any local maximum, local minimum or inflection point. Make sure your picture matches the information you provided in parts (a)-(d).



7. (12 points) You are designing a cylindrical container of volume 75π cubic feet. The top and bottom of the cylinder must be made of a material costing \$3 per square foot, while the side of the container (having area $2\pi rh$) is made of a more expensive material that costs \$10 per square foot. What are the dimensions of the cheapest container you can design?

Be sure to verify that your answer is a minimum.

8. (12 total points) A dog is running around a circular track of radius 14 meters at a constant speed of 9 meters per second. His owner is standing at a distance 48 meters from the center of the track.



- (a) (3 points) How fast is the angle θ changing?
- (b) (9 points) How fast is the distance between the dog and his owner changing when the dog is at the northernmost point of the track?