

Your Name

Your Signature

Student ID #

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Quiz Section

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Professor's Name

TA's Name

- This exam is closed book. You may use one $8\frac{1}{2} \times 11$ sheet of notes.
- Give your answers in exact form. Do not give decimal approximations.
- Graphing calculators are not allowed. Do not share notes.
- In order to receive credit, you must show your work. Do not do computations in your head. Instead, write them out on the exam paper.
- Place a box around **YOUR FINAL ANSWER** to each question.
- If you need more room, use the backs of the pages and indicate to the reader that you have done so.
- Raise your hand if you have a question.

Problem	Total Points	Score
1	12	
2	10	
3	9	
4	10	
5	12	
6	10	
7	10	
8	12	
9	15	
Total	100	

1. [12 points total] Find the derivatives of the following functions. You do not have to simplify.

(a) [3 points] $f(x) = x \sin\sqrt{x}$

(b) [3 points] $h(\theta) = 3 \tan^2 \theta - \sec^2 \theta$

(c) [3 points] $y(x) = x^{e^x}$

(d) [3 points] $g(x) = \frac{1}{\sqrt{(x^2 - 1)(x + 5)^6}}$

2. [10 points total] Evaluate the following limits.

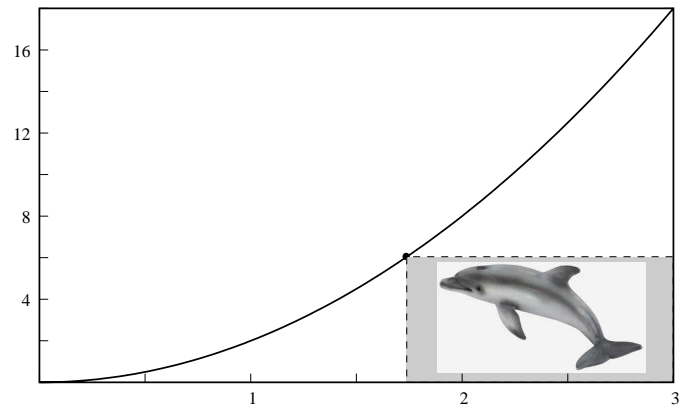
(a) [3 points] $\lim_{x \rightarrow 0} \frac{\cos x}{\cos x - 1}$

(b) [3 points] $\lim_{x \rightarrow 1} \frac{x^2 - 3x + 2}{x - 1}$

(c) [4 points] $\lim_{x \rightarrow \infty} \frac{\ln(\ln x)}{\ln x}$

3. [9 points total] A car is traveling along a straight road. After t seconds the velocity is $v(t) = t^2 + 2t$. Compute the acceleration of the car after 3 seconds. Use ONLY the definition of the derivative and no differentiation formulas.

4. [10 points total] Waterpark management decided to install a rectangular billboard with a picture of a dolphin under a popular waterslide. The end of the slide is three meters away from the wall where it starts (see picture). According to the manual, the slide has the shape of a parabola with equation $y = 2x^2$. Compute the area of the largest possible billboard that can fit into the space between the slide and the wall.



5. [12 points total] Consider the curve given by the equation

$$x^2 + xy + y^2 = x^2y^2$$

- (a) [8 points] Check that the point $(\sqrt{3}, \sqrt{3})$ is on the curve. Compute the equation of the tangent line to the curve at this point.

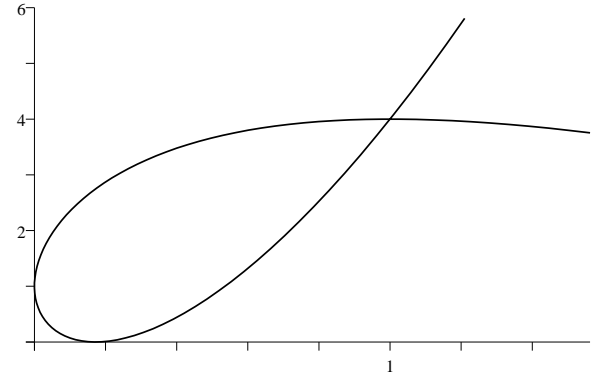
- (b) [4 points] Let $(a, 1.7)$ be a point on the curve close to the point $(\sqrt{3}, \sqrt{3})$. Using a linear approximation, estimate a . Leave your answer in exact form.

6. [10 points total] Consider the curve given by the following parametric equations:

$$x(t) = t^2 - 2t + 1$$

$$y(t) = t^4 - 4t^2 + 4$$

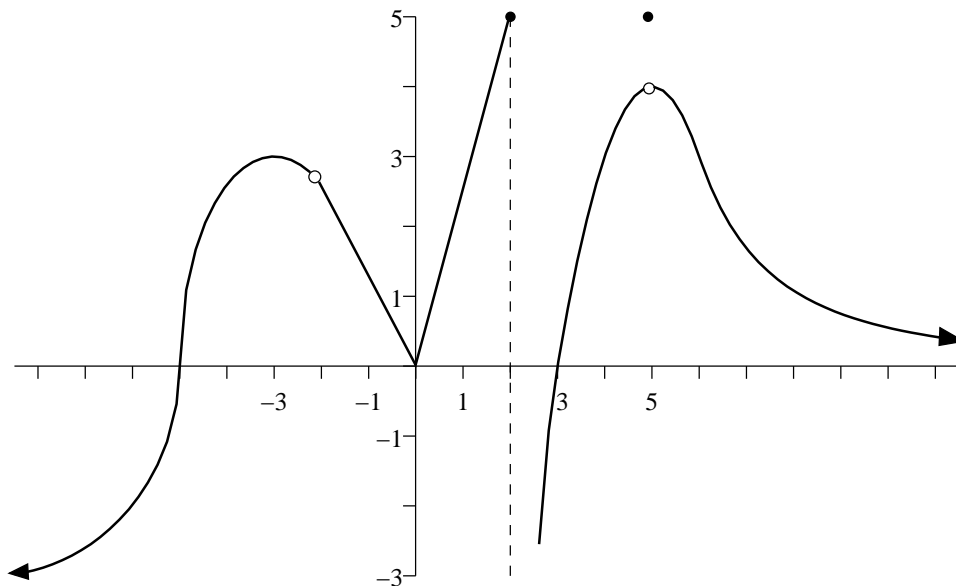
- (a) [3 points] Find all values t for which the curve goes through the point with coordinates $(1, 4)$.



- (b) [7 points] Find the equations of the two tangent lines to the curve at the point $(1, 4)$.

7. [10 points total] A balloon leaves the ground 500 feet away from an observer, and rises vertically at the rate of 140 feet per minute. At what rate is the angle of inclination of the observer's line of sight increasing at the instant when the balloon is at an altitude 500 feet higher than the observer's head? Include units.

8. [12 points total] Below is a sketch of the graph of $y = f(x)$. Answer the following questions, no justification is necessary.



- (a) [2 points] What is the domain of $f(x)$?
- (b) [2 points] State all the values c for which $\lim_{x \rightarrow c} f(x)$ does not exist.
- (c) [2 points] State all the values c for which $f(x)$ is not continuous at c .
- (d) [2 points] What is the equation of the tangent line to $f(x)$ at $x = -5$?
- (e) [2 points] What is the equation of the tangent line to $f(x)$ at $x = 1$?
- (f) [2 points] State all the values c for which $f(x)$ is not differentiable at c .

9. [15 points total] Let $f(x) = \frac{1}{4}x^4 - x^2$.

(a) [5 points] Find the critical points for this function. For each, determine whether it is a local minimum, local maximum or neither.

(b) [3 points] Identify the intervals on which $f(x)$ is concave up and concave down.

- (c) [**7 points**] Use the curve sketching procedure to carefully and clearly graph $f(x)$.
(Include BOTH coordinates of all local minima and maxima, inflection points, x-intercept(s) and y-intercept(s).)