

**Department of Mathematics – University of Tennessee**  
**Math 131 Calculus 1A**  
**Test 3**

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**Name:** \_\_\_\_\_

**Time allowed: 50 minutes**

**Instructions:**

- Calculators are not allowed.
- All electronic devices must be put away.
- Answers with insufficient or incorrect working will not receive full credit.
- Simplify answers whenever possible.

Page	Points	Score
2	10	
3	10	
4	10	
5	10	
6	10	
Total:	50	

1. Find the derivative of each function. *Simplify your answers.*

(a) (3 points)  $f(x) = 3x^4 + \frac{3}{x^4}$

(b) (3 points)  $r(\theta) = \sec \theta + \sin \pi$

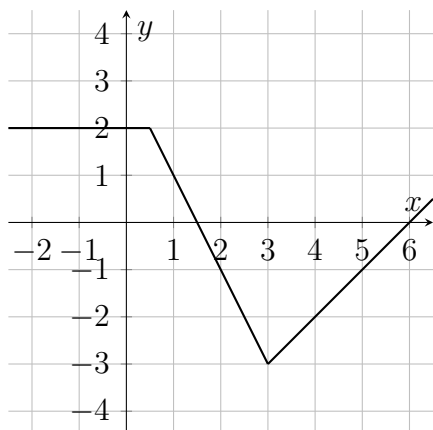
(c) (4 points)  $y = \frac{e^x}{x^2 + 1}$

2. (6 points) Consider the function  $f(x) = x \cos(\pi x)$ . Find the slope of the tangent line to the graph  $y = f(x)$  at  $x = \frac{1}{2}$ .

3. (4 points) Use the quotient rule to show that  $\frac{d}{dx}[\cot x] = -\csc^2 x$ .

*Hint: write the cotangent function in terms of the sine and cosine functions, and then apply the quotient rule.*

4. (4 points) Suppose that  $g(x) = x^2 f(x)$ , where  $f(x)$  is graphed below. Evaluate  $g'(2)$ .



5. Consider the graph  $y = x^3 - 6x^2 + 9x$ .

(a) (4 points) Find the  $x$ -value(s) where the graph has a horizontal tangent line.

(b) (2 points) Find an equation of the tangent line to the graph at  $x = 0$ .

6. The position of an object is given by  $s(t) = \sqrt{4t + 1}$  for  $t \geq 0$ , where position is measured in meters and time is measured in seconds.

(a) (3 points) Find the velocity of the object when  $t = 2$ . *Include the appropriate units.*

(b) (3 points) Find the acceleration function for the object.

7. (4 points) Find the second derivative of the function  $f(x) = e^{-3x}$ .

8. The voltage  $V(t)$  (in volts), current  $I(t)$  (in amperes), and resistance  $R(t)$  (in ohms) in a circuit are related by Ohm's Law:

$$V(t) = I(t) R(t).$$

Suppose that at time  $t = 5$  seconds, the current is 6 amperes and is decreasing at a rate of 2 amperes per second, and the resistance is 4 ohms and is increasing at a rate of 1 ohm per second.

- (a) (1 point) Find the voltage when  $t = 5$ . *Include the appropriate units.*
- (b) (5 points) Find the rate at which the voltage is changing when  $t = 5$ . *Include the appropriate units.*

9. (4 points) Find the derivative of the function  $y = \left(e^{x^3} + \tan(x^2)\right)^8$ .

*You do not need to simplify your answer.*