

MA 16100
EXAM 3 Version A
April 11, 2023

NAME _____ YOUR TA'S NAME _____

STUDENT ID # _____ RECITATION TIME _____

Write your final answers in the boxes provided, as applicable.

The problems are numbered 1–12.

Extra scratch paper is not permitted. Write all your work in this exam booklet.

If you finish the exam before 7:20, you may leave the room after turning in the exam booklet. If you don't finish before 7:20, you **MUST REMAIN SEATED** until your TA comes and collects your exam booklet. You may not leave the room before 6:50.

EXAM POLICIES

1. Students may not open the exam until instructed to do so.
2. Students must obey the orders and requests by all proctors, TAs, and lecturers.
3. No student may leave in the first 20 min or in the last 10 min of the exam.
4. Books, notes, calculators, or any electronic devices are not allowed on the exam, and they should not even be in sight in the exam room. Students may not look at anybody else's test, and may not communicate with anybody else except, if they have a question, with their TA or lecturer.
5. After time is called, the students have to put down all writing instruments and remain in their seats, while the TAs will collect the exams.
6. Any violation of these rules and any act of academic dishonesty may result in severe penalties. Additionally, all violators will be reported to the Office of the Dean of Students.

I have read and understand the exam rules stated above:

STUDENT SIGNATURE: _____

This page is intentionally blank and may be used for extra scratch work, but it will not be evaluated for credit.

1. (6 points) Complete the following sentence with a number (written in its simplest form):

If f is differentiable everywhere, $f(1) = 5$, and $f(3) = 11$, then the Mean Value Theorem says there is a number c with $1 < c < 3$ for which ...

$f'(c) =$

2. (9 points) Suppose the *derivative* of f is given by

$$f'(x) = 4x^2(x - 1)^3(x - 3).$$

List **each** x value where f has a critical point in the correct column below.

f has a local max at these x values	f has a local min at these x values	f has neither a local max nor a local min at these x values

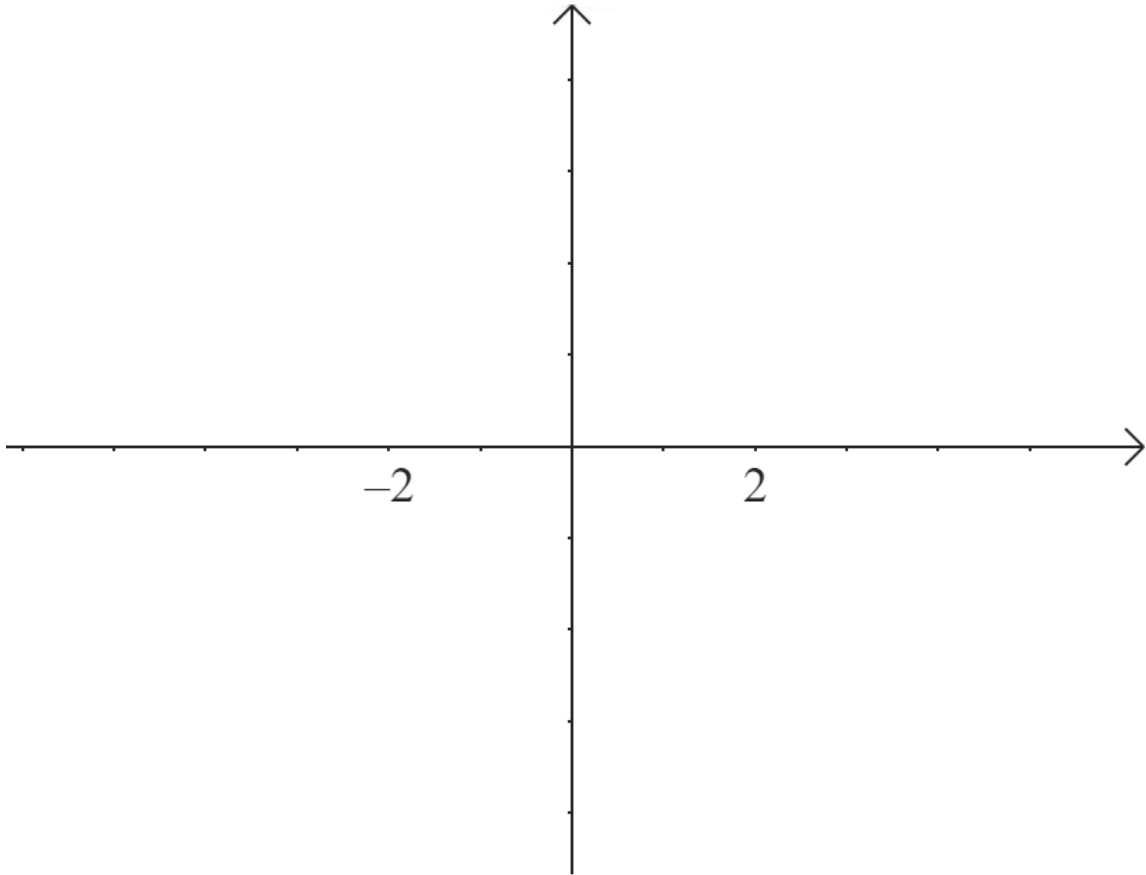
3. (9 points) Sketch the graph of a continuous function f with the following properties:

$$f' > 0 \text{ and } f'' > 0, \text{ for } x < -2$$

$$f' > 0 \text{ and } f'' < 0, \text{ for } -2 < x < 0$$

$$f' < 0 \text{ and } f'' < 0, \text{ for } 0 < x < 2$$

$$f' < 0 \text{ and } f'' > 0, \text{ for } 2 < x$$



4. (4 points each) Compute the following limits.

If the limit is ∞ or $-\infty$ then write that symbol as your final answer.

If the limit does not exist, and is neither ∞ nor $-\infty$, then write "D.N.E."

Work will not be considered; only your final answer will be evaluated for credit.

a. $\lim_{x \rightarrow 0} \frac{1 - \cos(4x)}{x^2}$

b. $\lim_{x \rightarrow \infty} \frac{\ln(3x + 1)}{\ln(x - 1)}$

c. $\lim_{x \rightarrow 0^+} (1 + x)^{\cot x}$

5. (4 points each) $\int_0^5 f(x) dx = 7$, $\int_0^5 g(x) dx = 10$, $\int_0^3 f(x) dx = 4$, and $\int_0^3 g(x) dx = 2$. Evaluate the following definite integrals.

No partial credit. Simplify your answers completely.

a. $\int_0^5 (3f(x) - 2g(x)) dx$

b. $\int_3^5 (f(x) + g(x)) dx$

6. (8 points) Find the x -coordinate of the inflection point of

$$f(x) = e^{-2x^2}$$

on the domain $x \geq 0$. *Show your work.*

$x =$

7. (8 points) Indicate the interval(s) on which

$$f(x) = \sqrt[3]{x^3 + 1}$$

is concave down. *Show your work.*



8. (8 points) Use linear approximation to estimate the value of $\sqrt{1.06}$
Show your work.

$$\sqrt{1.06} \approx$$

9. (8 points) For the function

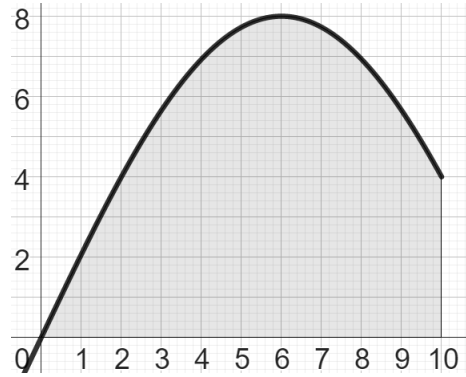
$$f(x) = x - \frac{24}{x^2} + 1$$

find the antiderivative F that satisfies $F(2) = 1$.

$$F(x) =$$

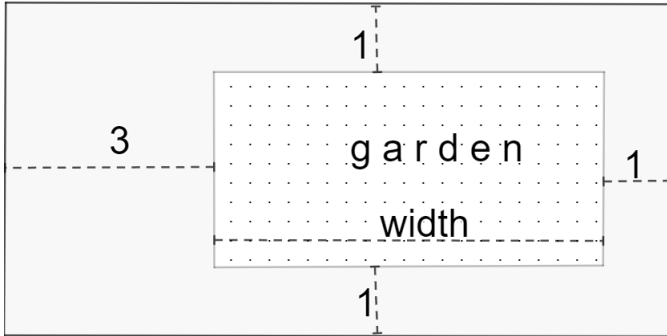
10. (8 points) Approximate the area between the graph of $y = f(x)$ and the x -axis for $0 \leq x \leq 10$ by dividing the interval $[0, 10]$ into $n = 5$ subintervals, and computing a left Riemann sum.

x	$f(x)$
0	0
1	2
2	4
3	5.7
4	7
5	7.7
6	8
7	7.7
8	7
9	5.7
10	4



area \approx

11. (8 points) A rectangular garden with an area of 15 m^2 is surrounded by a grass border that is 3 m wide on one side and 1 m wide on the other three sides, as shown below. What garden width will minimize the combined area of the garden and the borders? Show your work.



garden
width = m

12. (8 points) Find the minimum distance between the point $\left(\frac{5}{4}, 0\right)$ and the points on the graph of $y = \sqrt{x}$. *Show your work.*

dist =

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