MA 16100
EXAM 2 Version A
March 7, 2023

NAME ______________________ YOUR TA'S NAME ______________________

STUDENT ID # ____________________ RECITATION TIME ____________________

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

The problems are numbered 1–14.

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) Find the derivative. You do not need to simplify your answer.

$$f(x) = \frac{1}{2x^3} + 3\pi^2$$

$f'(x) =$

2. (6 points) Find the derivative. You do not need to simplify your answer.

$$f(x) = \frac{x}{1 + xe^x}$$

$f'(x) =$

3. (6 points) Find the derivative. You do not need to simplify your answer.

$$f(x) = -\csc x \cot x$$

$f'(x) =$

4. (6 points) Find the derivative. You do not need to simplify your answer.

$$f(x) = \cos^2(x^4)$$

$f'(x) =$

5. (6 points) Find the derivative. You do not need to simplify your answer.

$$f(x) = \sqrt{\tan\left(\frac{x}{2}\right)}$$

$f'(x) =$

6. (6 points) Find the derivative. You do not need to simplify your answer.

$$f(x) = 3^x + \ln(x^2 + 1)$$

$f'(x) =$

7. (6 points) Find the derivative. You do not need to simplify your answer.

$$f(x) = \tan^{-1}(3x)$$

$f'(x) =$

8. (6 points) Find $\frac{dy}{dx}$.

$$y = x^{2x} \qquad \text{with domain } x > 0$$

$\frac{dy}{dx} =$

9. (4 points each) Assume that $f(0) = 4$ and $f'(0) = 2$ for each question below. No partial credit. Simplify your answer completely.

(a) Find $g'(0)$, if $g(x) = f(x)e^x$.

$g'(0) =$

(b) Find $h'(0)$, if $h(x) = \dfrac{1}{\sqrt{f(x)}}$.

$h'(0) =$

(c) Find $k'(4)$, if $k(x) = f^{-1}(x)$.

$k'(4) =$

10. (8 points) Find the slope of the line tangent to the curve

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

at the point $(2, -1)$.
Show your work.

$m_{tan} =$

11. (8 points) An object thrown vertically upward reaches a height of $6 + 16t - 16t^2$ feet after t seconds. What is the height of the object at its highest point?
Use Calculus and show your work.

feet

12. (8 points) A 10-ft ladder is leaning against a vertical wall, and the top of the ladder is sliding down the wall at a speed of $\frac{1}{4}$ ft/s. How fast is the foot of the ladder sliding away from the wall when the foot of the ladder is 6 ft away from the wall?
Show your work.

ft/s

13. (8 points) An ideal gas at a fixed temperature satisfies the equation

$$pV = C,$$

where p is pressure measured in kPa = kilopascals = $\frac{kJ}{m^3}$, V is volume in m^3, and C is held constant at 240 kJ. At a certain instant the gas occupies a volume of 2 m^3, and the pressure is increasing at a rate of 3 $\frac{kPa}{s}$. Find the rate of change of the volume at this instant.

Show your work.

$\frac{m^3}{s}$

14. (8 points) List the x value(s) at which $f(x) = x + \sin x$ has an absolute maximum on the interval $[0, 2\pi]$. Justify your answer by showing your work.

f attains its maximum on $[0, 2\pi]$ when x is

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