

Department of Mathematics
University of Notre Dame
Math 10250 – Elem. of Calc. I
Fall 2022

Name:_____

Instructor:_____

Time MWF class meets:_____

Practice Exam 3

November 17, 2022

This exam is in 2 parts on 10 pages and contains 12 problems worth a total of 100 points. You have 1 hour and 15 minutes to work on it. **No books, notes, phones or other aids other than calculators are permitted.** Be sure to write your name on this title page, and in case pages become detached put your initials at the top of each.

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You must record here your answers to the multiple choice problems by placing an \times through your answer to each problem.

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|----|-----|-----|-----|-----|-----|
| 1. | (a) | (b) | (c) | (d) | (e) |
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Multiple Choice

1. (5 pts.) Find the absolute minimum (y -value) of $f(x) = x^3 - 12x + 13$ on the interval $[-3, 1]$.
- (a) 2
 - (b) -3
 - (c) 0
 - (d) 29
 - (e) There is no absolute minimum value on $[-3, 1]$.
2. (5 pts.) Let $f(x) = \ln(e^{3x})$. Find the values of x where the tangent to the graph of $f(x)$ is horizontal.
- (a) Only at $x = 1$.
 - (b) Only at $x = e$.
 - (c) Only at $x = 0$.
 - (d) All numbers x .
 - (e) No numbers x .

3. (5 pts.) Evaluate the limit:

$$\lim_{t \rightarrow \infty} (72 - 27e^{-72.27t})$$

- (a) 45
- (b) 72
- (c) 71
- (d) ∞
- (e) $-\infty$

4. (5 pts.) Solve the equation $\ln(x + 2) = \ln(x^2 + 2x)$. (Hint: be careful about the domain of the natural log.)

- (a) $x = 1$
- (b) $x = 0$
- (c) $x = 1$ and $x = e$
- (d) $x = -2$
- (e) There are no solutions.

5. (5 pts.) Find the derivative of the function $f(x) = x\ln(x^2)$.

- (a) 2
- (b) $\ln(x^2) + \frac{1}{x}$
- (c) $\frac{2}{x}$
- (d) $2\ln(x) + 2$
- (e) $2\ln(x) + 2x$

6. (5 pts.) Suppose that an investment grows at a rate of 4% compounded **twice a year**. If the initial investment is $P_0 = 900$, which of the following expressions gives the accumulated amount of the investment after 4 years?

- (a) $900 \cdot (1.04)^4$
- (b) $900 \cdot (1.04)^8$
- (c) $900 \cdot (1.02)^4$
- (d) $900 \cdot (1.02)^8$
- (e) $900 \cdot (1.02)^2$

7. (5 pts.) If $h(t) = Ae^{kt}$ and if $h(0) = 3$ and $h(1) = 6$, which of the functions below is equal to $h(t)$?

- (a) $h(t) = 2 \cdot 3^t$
- (b) $h(t) = 2 \cdot e^t$
- (c) $h(t) = 3 \cdot 2^t$
- (d) $h(t) = 3 \cdot e^t$
- (e) The function can not be determined from the given information.

8. (5 pts.) For $x > 0$, which of the following functions $F(x)$ is an **antiderivative** of

$$f(x) = \ln(x)?$$

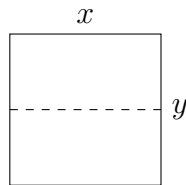
(In other words, for which of the following is it true that $F'(x) = f(x)$?)

- (a) $F(x) = x\ln(x) - x$
- (b) $F(x) = \frac{1}{x}$
- (c) $F(x) = \frac{\ln(x)}{x}$
- (d) $F(x) = \ln(x) + C$ (C is a constant)
- (e) $F(x) = C - \ln(x^2)$ (C is a constant).

Partial Credit

You must **show your work** on the partial credit problems to receive credit!

9. (15 pts.) A peafowl rancher wants to build a rectangular pen which encloses 500 ft^2 . In order to separate the peacocks from the peahens, he divides the pen into two equal sections with a barrier that is parallel to one of the sides. The fencing around the perimeter of the pen costs \$1 per foot, and the barrier costs \$8 per foot. Let x and y denote the side lengths of the pen, and assume the barrier is parallel to the side of length x .



- (a) Write an expression for y in terms of x .

- (b) Find the total cost function for building the pen $C(x)$ as a function of x only.

- (c) Find the critical numbers in the domain of $C(x)$.

- (d) Find the dimensions (x and y) that achieve the minimum cost. Be sure to justify that this is the absolute minimum.

10. (15 pts.)

A rabbit population grows according to the equation

$$P(t) = A_0 e^{kt},$$

where time is measured in weeks. Initially, there are 12 rabbits. After 2 weeks, the population has grown to 15 rabbits.

(a) Find A_0 .

(b) Find the value of k .

(c) Write down a formula for $P(t)$.

(d) How long does it take, in weeks, for the population of rabbits to reach 30?

11. (15 pts.)

(a) Let $f(x) = (\ln(x))^7$. Find $f'(x)$.

(b) Let $f(x) = x\sqrt{e^x}$. Find $f'(x)$.

(c) $\int \left(\frac{1}{x} - \sqrt{x} + 1 \right) dx =$

(d) $\int 8 \, dz =$

12. (15 pts.)Let $f(x)$ be a function with the property that

$$f'(x) = \frac{1}{\sqrt{x}}.$$

(a) Find a general formula for $f(x)$. (Your answer should involve an unknown constant C .)(b) If $f(4) = 2$, find $f(x)$.(c) Evaluate $f(9)$.

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