MA 123 Fall 2024
Elementary Calculus

Exam 2
10/24/24

Name: _____

Student ID #: 9_____ **Sec:** _____

Do not remove this answer page — you will turn in the entire exam. You have two hours to do this exam. No books or notes may be used. You may use an ACT-approved calculator during the exam, but NO calculator with a Computer Algebra System (CAS), networking, or camera is permitted. Absolutely no cell phone use during the exam is allowed.

The exam consists of 2 short answer questions and 18 multiple choice questions. Answer the short answer questions on the back of this page, and record your answers to the multiple choice questions on this page. For each multiple choice question, you will need to fill in the circle corresponding to the correct answer. For example, if (a) is correct, you must shade

a **b** **c** **d** **e**

It is your responsibility to make it CLEAR which response has been chosen. **You will not get credit unless the correct answer has been clearly marked on this page.**

GOOD LUCK!

3. **a** **b** **c** **d** **e**

4. **a** **b** **c** **d** **e**

5. **a** **b** **c** **d** **e**

6. **a** **b** **c** **d** **e**

7. **a** **b** **c** **d** **e**

8. **a** **b** **c** **d** **e**

9. **a** **b** **c** **d** **e**

10. **a** **b** **c** **d** **e**

11. **a** **b** **c** **d** **e**

12. **a** **b** **c** **d** **e**

13. **a** **b** **c** **d** **e**

14. **a** **b** **c** **d** **e**

15. **a** **b** **c** **d** **e**

16. **a** **b** **c** **d** **e**

17. **a** **b** **c** **d** **e**

18. **a** **b** **c** **d** **e**

19. **a** **b** **c** **d** **e**

20. **a** **b** **c** **d** **e**

Short Answer Questions

Each question is an opportunity to earn 5 points. Points are earned on the clarity and correctness of your work, not merely on having a correct answer somewhere.

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1. Determine the derivative of $f(x) = \dfrac{e^{9x^4}}{\sqrt[6]{x} - 15}$ using the quotient rule. **You must determine each derivative in the quotient rule, but do NOT simplify your answer.** Circle your final answer.

2. Determine the minimum value of $g(x) = x^3 - 3x^2 - 72x + 20$ on the interval $[-2, 9]$. **Show all work** and circle your final answer. You can use a calculator to check your answer, but credit is only given for methods that use calculus.

Name: _____

Multiple Choice Questions

Clearly mark your answer on the cover page on this exam for credit.

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3. The concentration of Acetaminophen in the bloodstream t hours after the drug is administered is given by

$$C(t) = \frac{0.11t}{t^2 + 7}.$$

Determine the instantaneous rate of change of the Acetaminophen concentration at $t = 5$ hours.

Choose the numeric value that most closely approximates the answer.

Possibilities:

(a) 0.0110 units per hour

(b) -0.0019 units per hour

(c) -0.0619 units per hour

(d) 0.2819 units per hour

(e) 0.0088 units per hour

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4. Suppose $f(0) = -8$, $f'(0) = 5$, $f(3) = 7$ and $f'(3) = -4$. If $g(x) = f(x^2 - 9)$, determine $g'(3)$.

Possibilities:

(a) 67

(b) 0

(c) 30

(d) 48

(e) 42

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5. Suppose $f(x) = x^4 - 6$, $g(2) = 9$ and $g'(2) = -7$. If $h(x) = f(x) \cdot g(x)$, determine $h'(2)$.

Possibilities:

(a) $\dfrac{358}{81}$

(b) -224

(c) 257

(d) 358

(e) 218

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6. The total cost (in dollars) of producing x items is given by $C(x) = 7400 + 50x - 0.1x^2$. Determine the average cost function $\bar{C}(x)$.

Possibilities:

(a) $-\dfrac{7400}{x^2} - 0.1$

(b) $\dfrac{7400}{x} + 50 - 0.1x$

(c) $7450 - 0.1x$

(d) $50 - 0.2x$

(e) $7450 - 0.1x^2$

7. Let $f(x) = x^4 - 9x^3$. Determine $f^{(3)}(x)$.

Possibilities:

(a) $24x - 54$

(b) $12x^2 - 54x$

(c) $x^{12} - 729x^9$

(d) $x^{12} - 27x^{11} + 243x^{10} - 729x^9$

(e) $4x$

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8. Let $f(x) = \ln(x^4 + 3)$. Determine the derivative $f'(x)$.

Possibilities:

(a) 1

(b) $4x^2$

(c) $\dfrac{4x^3}{x^4 + 3}$

(d) $\dfrac{x^4 + 3}{x}$

(e) $\dfrac{x^4 + 3}{4x^3}$

9. Suppose $f(7) = -5$, $f'(7) = 3$, $g(14) = 8$ and $g'(14) = -4$. If $h(x) = f(x) \cdot g(2x)$, determine $h'(7)$.

Possibilities:

(a) 64

(b) 44

(c) -12

(d) -16

(e) -36

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10. Determine the maximum value of

$$f(x) = \begin{cases} -x^2 + 6x + 4 & \text{if } x < 1, \\ -2x + 11 & \text{if } x \geq 1 \end{cases}$$

on the interval [0,10].

Possibilities:

(a) 11

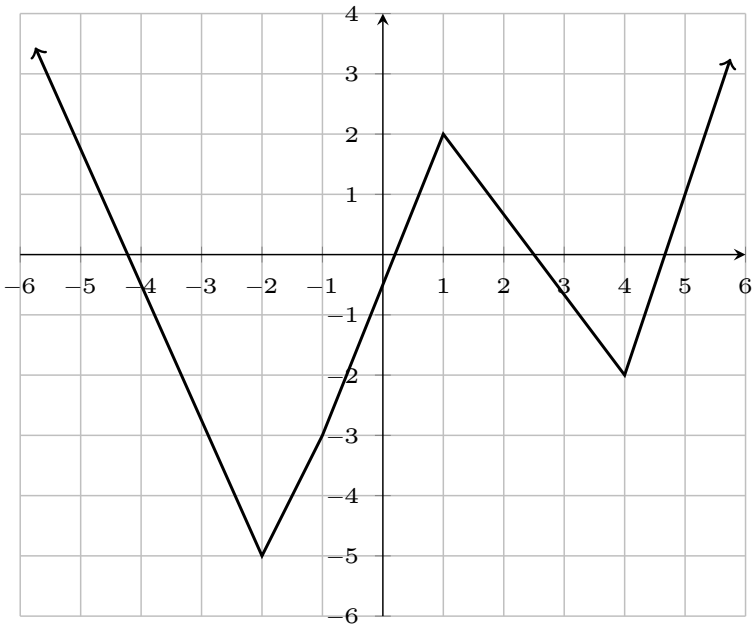
(b) 4

(c) -9

(d) 9

(e) 13

11. The graph of $y = f(x)$ is shown below. What is the minimum value of $f(x)$ on the interval $[-1, 4]$?



Possibilities:

(a) 2

(b) -5

(c) There is no minimum value on the given interval.

(d) -3

(e) -2

12. Determine the slope of the tangent line to the graph of the function

$$f(x) = x^3 \ln(x)$$

at $x = 2$.

Possibilities:

(a) 2

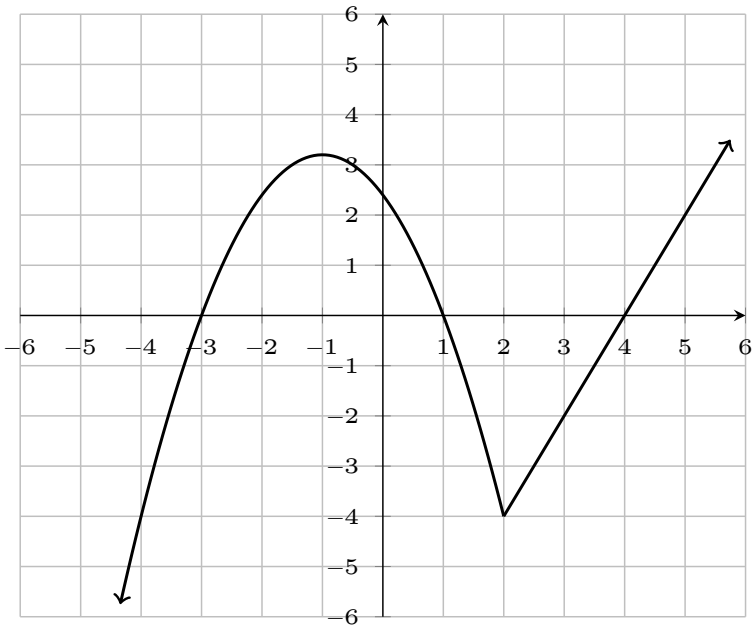
(b) 6

(c) $12 \ln(2) + 4$

(d) $20 \ln(2)$

(e) $8 \ln(2)$

13. The graph of $y = f(x)$ is shown below. Determine all values of x for which $f'(x) = 0$ or $f'(x)$ does not exist.



Possibilities:

(a) $-3, -1, 1, 2$ and 4

(b) $-3, 1$ and 4

(c) $-3, 1, 2$ and 4

(d) $-3, -1, 1$ and 4

(e) -1 and 2

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14. Let $f(x) = \dfrac{3x+8}{6x-9}$. Determine the derivative $f'(x)$.

Possibilities:

(a) $\dfrac{1}{2}$

(b) $\dfrac{(6x-9)(3)-(3x+8)(6)}{(6x-9)^2} = -\dfrac{75}{(6x-9)^2}$

(c) $\dfrac{(6x-9)(3)-(3x+8)(6)}{3x+8} = -\dfrac{75}{3x+8}$

(d) $\dfrac{(6x-9)(3)+(3x+8)(6)}{(3x+8)^2} = \dfrac{36x+21}{(3x+8)^2}$

(e) $\dfrac{(6x-9)(3)+(3x+8)(6)}{6x-9} = \dfrac{36x+21}{6x-9}$

15. The total revenue (in dollars) from selling x machines is

$$R(x) = 1190x - 5x^2.$$

Use the marginal revenue function to approximate the additional revenue from selling the 70th machine.

Possibilities:

(a) Approximately \$668.

(b) Approximately \$845.

(c) Approximately \$490.

(d) Approximately \$500.

(e) Approximately \$840.

16. A company that makes whatzits has a start up cost of \$10000. It costs the company \$1.97 to make each whatzit. The company charges \$3.54 for each whatzit. Determine the minumum number of whatzits the company must produce and sell to make a profit.

Possibilities:

(a) 14964

(b) 6370

(c) 12563

(d) 1815

(e) 2825

17. Let $f(x) = \sqrt{x^5} + \dfrac{3}{x^4}$. Determine the derivative $f'(x)$.

Possibilities:

(a) $\dfrac{5}{2}x^2 - \dfrac{3}{4}x^{-3}$

(b) $10x^9 - 12x^{-5}$

(c) $\dfrac{5}{2}x^{3/2} - 12x^{-5}$

(d) $\dfrac{5}{2}x^2 - 12x^3$

(e) $\dfrac{5}{2}x^{3/2} - 12x^3$

18. Let $f(x) = 2e^x - 7x^{5e}$. Determine the derivative $f'(x)$.

Possibilities:

(a) $2e^x - 35ex^{5e-1}$

(b) $2e^x - 35x^{5e}$

(c) $2xe^{x-1} - 7x^{5e}$

(d) $\dfrac{2}{x} - 7x^{5e}$

(e) $\dfrac{2}{x} - 35ex^{5e-1}$

19. Suppose

$$g(x) = \frac{x^2 + 4}{f(x)}.$$

If $f(5) = 8$ and $f'(5) = 6$, determine $g'(5)$.

Possibilities:

(a) $\dfrac{127}{32}$

(b) $-\dfrac{47}{18}$

(c) $\dfrac{47}{18}$

(d) $-\dfrac{47}{32}$

(e) $\dfrac{47}{32}$

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20. The number of bacteria in a culture triples every 12 hours. How many hours will it take before 25 times the original number of bacteria is present if the population grows exponentially?

Choose the numeric value that most closely approximates the answer.

Possibilities:

(a) 35.16

(b) 24.67

(c) 25.44

(d) 4.10

(e) 46.97