MA 123 Fall 2023
Elementary Calculus

Exam 2
10/19/23

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)   12. (a) (b) (c) (d) (e)

4. (a) (b) (c) (d) (e)   13. (a) (b) (c) (d) (e)

5. (a) (b) (c) (d) (e)   14. (a) (b) (c) (d) (e)

6. (a) (b) (c) (d) (e)   15. (a) (b) (c) (d) (e)

7. (a) (b) (c) (d) (e)   16. (a) (b) (c) (d) (e)

8. (a) (b) (c) (d) (e)   17. (a) (b) (c) (d) (e)

9. (a) (b) (c) (d) (e)   18. (a) (b) (c) (d) (e)

10. (a) (b) (c) (d) (e)   19. (a) (b) (c) (d) (e)

11. (a) (b) (c) (d) (e)   20. (a) (b) (c) (d) (e)

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.

1. Determine the derivative of $f(x) = \sqrt[3]{x} \cdot e^{7x^4}$ using the product rule. **Do NOT simplify your answer.** Circle your final answer.

2. Determine the minimum value of $f(x) = 3x^2 - 6x - 22$ over the interval $[-4, 7]$. **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.
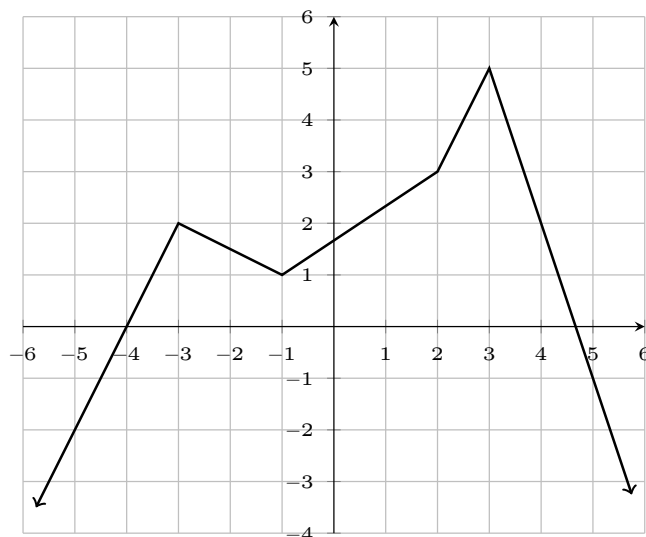
Multiple Choice Questions

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

3. The graph of $y = f(x)$ is shown below. What is the maximum value of $f(x)$ on the interval $[-3, 2]$?

Possibilities:

(a) There is no maximum value on the given interval.

(b) 1

(c) 3

(d) 5

(e) 2

4. Let $f(x) = \ln(x^6 + 5)$. Determine the derivative $f'(x)$.

Possibilities:

(a) 1

(b) $\dfrac{6x^5}{x^6 + 5}$

(c) $\dfrac{x^6 + 5}{x}$

(d) $6x^4$

(e) $\dfrac{x^6 + 5}{6x^5}$

5. Let $f(x) = e^8$. Determine the derivative $f'(x)$.

Possibilities:

(a) e^8

(b) 0

(c) $8e^7$

(d) 1

(e) $\dfrac{1}{8}$

6. Let $f(x) = \dfrac{8x + 6}{7x - 4}$. Determine the derivative $f'(x)$.

Possibilities:

(a) $\dfrac{8}{7}$

(b) $-\dfrac{74}{(8x + 6)^2}$

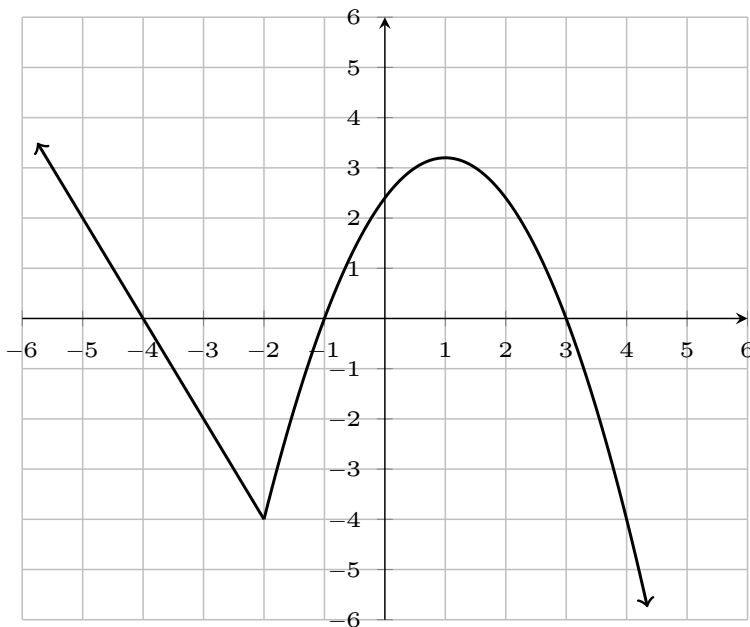(c) $\dfrac{112x + 10}{(7x - 4)^2}$

(d) $\dfrac{112x + 10}{(8x + 6)^2}$

(e) $-\dfrac{74}{(7x - 4)^2}$

7. 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) $-4, -1, 1$, and 3

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

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

(d) -2 and 1

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

8. The number of bacteria in a culture doubles every 15 hours. How many hours will it take before 9 times the original number of bacteria is present?

Possibilities:

(a) $\ln\left(\dfrac{135}{2}\right)$

(b) $\dfrac{135}{2}$

(c) 135

(d) $\dfrac{15\ln(2)}{\ln(9)}$

(e) $\dfrac{15\ln(9)}{\ln(2)}$

9. Suppose $g(x) = \sqrt{f(x)}$ and the equation of the tangent line to $f(x)$ at $x = 5$ is

$$y = 49 + 4(x - 5).$$

Determine $g'(5)$.

Possibilities:

(a) $\dfrac{2}{7}$

(b) $\dfrac{49}{4}$

(c) 6

(d) $\dfrac{1}{14}$

(e) $\dfrac{1}{4}$

10. Suppose $f(3) = 19$ and $f'(3) = 23$. If $g(x) = \ln(f(x))$, determine $g'(3)$.

Possibilities:

(a) $\dfrac{23}{19}$

(b) $\dfrac{19}{3}$

(c) $\dfrac{19}{23}$

(d) 1

(e) $\dfrac{23}{3}$

11. Suppose $f(x) = x^5 - 9$, $g(3) = 7$, and $g'(3) = -6$. If $h(x) = f(x) \cdot g(x)$, determine $h'(3)$.

Possibilities:

(a) 94728

(b) 4239

(c) 1431

(d) $\dfrac{4239}{49}$

(e) -2430

12. Determine the minimum value of

$$f(x) = \begin{cases} x^2 + 2x + 4 & \text{if } x \le 1, \\ 8x - 1 & \text{if } x > 1 \end{cases}$$

on the interval $[0,10]$.

Possibilities:

(a) 7

(b) 4

(c) 2

(d) 79

(e) 3

13. A company produces gumball machines. It costs the company $70 to make each machine. Fixed manufacturing costs are $6000. The price-demand equation for selling x gumball machines is given by $p = 245 - \dfrac{x}{81}$. Determine the average profit function.

Possibilities:

(a) $-\dfrac{x^2}{81} - 5825$

(b) $-\dfrac{2x}{81} + 175$

(c) $\dfrac{5671}{81} - \dfrac{5755}{x}$

(d) $-\dfrac{x}{81} + 175 - \dfrac{6000}{x}$

(e) $-\dfrac{x^2}{81} + 175x - 6000$

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

$$C(t) = \frac{0.14t}{t^2 + 6}.$$

Determine the instantaneous rate of change of the Acetaminophen concentration with respect to time (in units per hour) at $t = 1$ hour.

Possibilities:

(a) $-\dfrac{7}{50}$

(b) $\dfrac{1}{50}$

(c) $\dfrac{63}{50}$

(d) $\dfrac{7}{100}$

(e) $\dfrac{1}{70}$

15. Suppose $g(8) = 5$ and $g'(8) = 4$. If

$$f(x) = \frac{e^{g(x)}}{x^2 + 7},$$

determine $f'(8)$.

Possibilities:

(a) $-\dfrac{268}{e^5}$

(b) $\dfrac{268}{e^5}$

(c) $\dfrac{300e^5}{5041}$

(d) $\dfrac{268e^5}{5041}$

(e) $-\dfrac{268e^5}{5041}$

16. Let $f(x) = x^9 - 7x^2$. Determine $f^{(3)}(x)$.

Possibilities:

(a) $x^{27} - 21x^{20} + 147x^{13} - 343x^6$

(b) $9x^6 - \dfrac{14}{x}$

(c) $x^{27} - 343x^6$

(d) $9x^8 - 14x$

(e) $504x^6$

17. Let $f(x) = \sqrt[5]{9x + 6}$. Determine the derivative $f'(x)$.

Possibilities:

(a) $\dfrac{9^{1/5}}{5}x^{-4/5}$

(b) $-45x(9x + 6)^{-6}$

(c) $\dfrac{9}{5}(9x + 6)^{-4/5}$

(d) $\dfrac{9}{5}x^{-4/5}$

(e) $\dfrac{1}{5}(9x + 6)^{-4/5}$

18. The total cost (in dollars) of producing x machines is

$$C(x) = 1800 + 60x - 0.4x^2.$$

Use the marginal cost function to approximate the cost of producing the 51st machine.

Possibilities:

(a) Approximate cost of the 51st machine $\approx$ \$20.00.

(b) Approximate cost of the 51st machine $\approx$ \$19.60.

(c) Approximate cost of the 51st machine $\approx$ \$18.40.

(d) Approximate cost of the 51st machine $\approx$ \$76.00.

(e) Approximate cost of the 51st machine $\approx$ \$19.20.

19. Let $f(x) = \sqrt{x^7} + \dfrac{5}{x^6}$. Determine the derivative $f'(x)$.

Possibilities:

(a) $\dfrac{7}{2}x^3 - \dfrac{5}{6}x^{-5}$

(b) $\dfrac{7}{2}x^{5/2} - 30x^{-7}$

(c) $14x^{13} - 30x^{-7}$

(d) $\dfrac{7}{2}x^{5/2} - 30x^5$

(e) $\dfrac{7}{2}x^3 - 30x^5$

20. Suppose $f(2) = 9$, $f'(2) = -1$, $f(3) = 6$, and $f'(3) = 7$. If $g(x) = f(x^3 - 5)$, determine $g'(2)$.

Possibilities:

(a) 84

(b) 57

(c) 72

(d) 21

(e) 105