MA 123 Spring 2025 Exam 4

Elementary Calculus 05/07/25

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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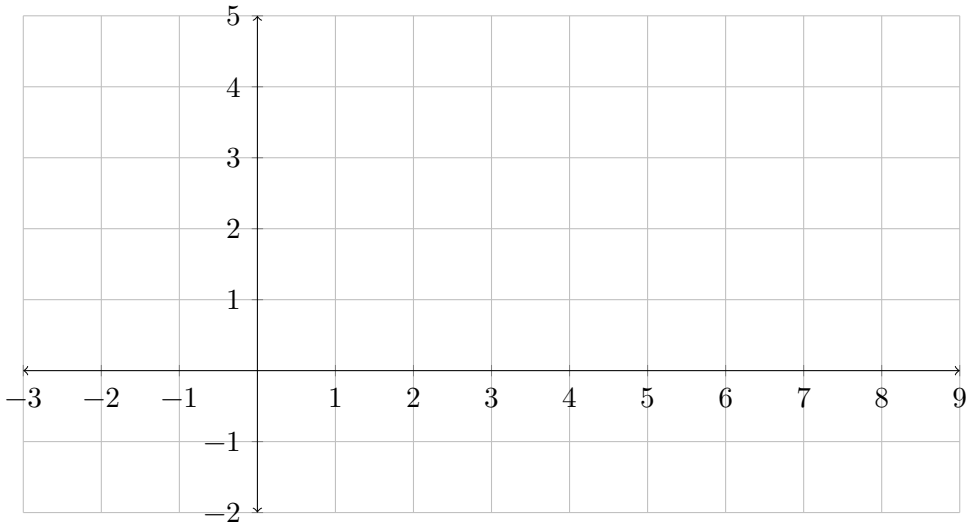
1. Sketch the graph of a function $y = f(x)$ which satisfies the following properties: $\lim_{x \to 1^-} f(x) = 4$, $f(1) = 2$, $\lim_{x \to 1^+} f(x) = 3$, $\lim_{x \to 5} f(x) = -1$, and $f(x)$ is continuous for all x except $x = 1$.



2. Use u-substitution to evaluate $\int_0^1 (3x)(6x^2 - 4)^5 \, dx$.

Name: _____

Multiple Choice Questions

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

3. Evaluate $\lim_{t \to 5} \dfrac{t^2 - 25}{t^2 - 7t + 10}$.

   Possibilities:

   (a) 1

   (b) $\dfrac{10}{7}$

   (c) 0

   (d) $\dfrac{10}{3}$

   (e) The limit does not exist.

4. Consider the function $f(x) = \begin{cases} A - 4x & \text{if } x < 7, \\ 3 - x^2 & \text{if } x \geq 7. \end{cases}$ Determine a value of A such that $f(x)$ is continuous at $x = 7$.

   Possibilities:

   (a) 2

   (b) -2

   (c) -18

   (d) -74

   (e) 0

5. Let $f(x) = x^2 + 6x - 19$. Determine a value of x such that the average rate of change of $f(x)$ from 0 to x equals 45.

Possibilities:

(a) 25

(b) 39

(c) 45

(d) 51

(e) 65

6. The graph of $y = f(x)$ and its tangent line at $x = 3$ is shown below. What is the value of $f'(3)$?

Possibilities:

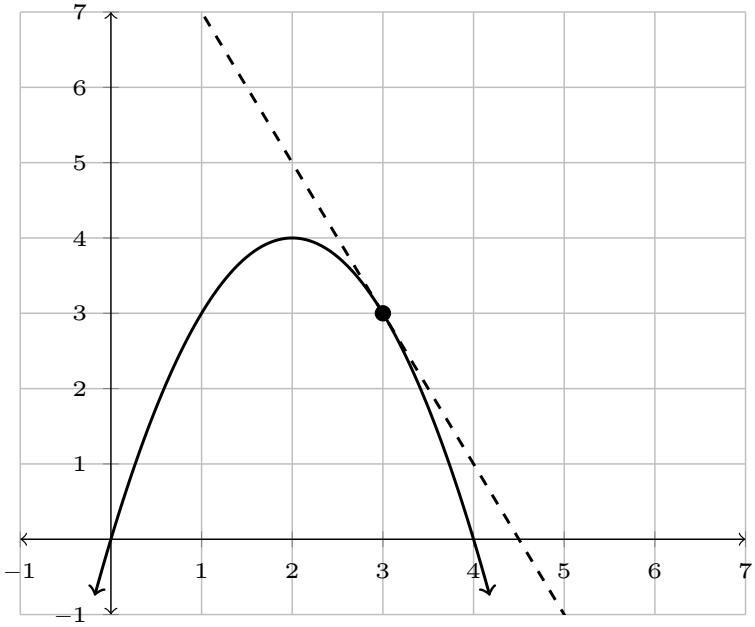
(a) 1

(b) 3

(c) $\frac{1}{2}$

(d) $-\frac{1}{2}$

(e) -2



7. A bacteria culture starts with 2500 bacteria and the population doubles after 5 hours. Determine the number of bacteria after 9 hours if the population grows exponentially.

   Choose the numeric value that most closely approximates the answer.

   Possibilities:

   (a) 8706

   (b) 4653

   (c) 11655

   (d) 7092

   (e) 12351

8. A company that makes whatzits has a start up cost of $18750. It costs the company $1.09 to make each whatzit. The company charges $2.91 for each whatzit. Determine the minumum number of whatzits the company must produce and sell to make a profit.

   Possibilities:

   (a) 10303

   (b) 10592

   (c) 6444

   (d) 4688

   (e) 5484

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

Possibilities:

(a) $7x^4$

(b) $x^{21} - 64x^9$

(c) $210x^4 - 24$

(d) $x^{21} - 12x^{17} + 48x^{13} - 64x^9$

(e) $42x^5 - 24x$

10. Suppose $f(x) = x^5 - 6$, $g(2) = 8$ and $g'(2) = -7$. If $h(x) = f(x) \cdot g(x)$, determine $h'(2)$.

Possibilities:

(a) $\dfrac{411}{32}$

(b) 458

(c) -560

(d) 2024

(e) 822

11. Let $f(x) = \dfrac{6x+3}{5x-4}$. Determine the derivative $f'(x)$.

Possibilities:

(a) $\dfrac{(5x-4)(6)-(6x+3)(5)}{(5x-4)^2} = -\dfrac{39}{(5x-4)^2}$

(b) $\dfrac{6}{5}$

(c) $\dfrac{(5x-4)(6)+(6x+3)(5)}{(6x+3)^2} = \dfrac{60x-9}{(6x+3)^2}$

(d) $\dfrac{(5x-4)(6)-(6x+3)(5)}{6x+3} = -\dfrac{39}{6x+3}$

(e) $\dfrac{(5x-4)(6)+(6x+3)(5)}{5x-4} = \dfrac{60x-9}{5x-4}$

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12. Suppose the derivative of $g(t)$ is $g'(t) = -t(t^2+9)(t-4)^2$. Determine the value of t in the interval $[-20, 20]$ where $g(t)$ takes on its maximum value.

Possibilities:

(a) -20

(b) 4

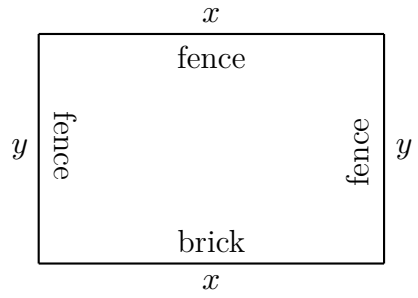
(c) -3

(d) 0

(e) 20

13. A landscape architect plans to enclose a 585 square foot rectangular garden on one side with a brick wall costing \$60 per foot and on the other three sides with a metal fence costing \$70 per foot. Determine the minimum cost to enclose the garden.

Choose the numeric value that most closely approximates the answer.



Possibilities:

(a) \$6111.27

(b) \$6331.31

(c) \$6525.95

(d) \$6930.08

(e) \$6993.34

14. Let $f(x) = x^4 - 6x^3 - 60x^2 + 48x + 36$. Determine all intervals on which $f(x)$ is concave up.

Possibilities:

(a) $(-\infty, -5) \cup (2, \infty)$

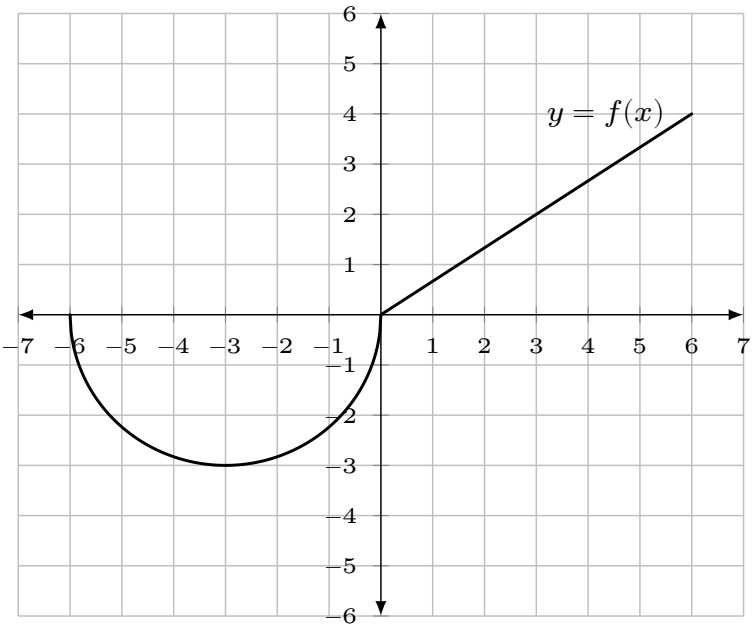
(b) $(-5, 2)$

(c) $(-\infty, -2) \cup (5, \infty)$

(d) $(-2, 5)$

(e) $(-\infty, \infty)$

15. The graph of $y = f(x)$ shown below includes a semicircle and a straight line. Evaluate the definite integral $\int_{-3}^{6} f(x)\,dx$.



Possibilities:

(a) $-\frac{9}{4}\pi + 12$

(b) $\frac{9}{4}\pi - 12$

(c) $\frac{9}{4}\pi + 12$

(d) $\frac{9}{2}\pi + 12$

(e) $\frac{9}{2}\pi - 12$

16. If $\int_{1}^{17} f(x)\,dx = 12$ and $\int_{3}^{17} f(x)\,dx = 10$, then determine $\int_{1}^{3} f(x)\,dx$.

Possibilities:

(a) 26

(b) -22

(c) 22

(d) -2

(e) 2

17. Suppose a rock is thrown from a Saturnian cliff. After t seconds, its speed in feet per second is $s(t) = 22t + 5$, at least until it hits the ground. If the rock hits the ground after 2 seconds, how high is the cliff?

Possibilities:

(a) 93 feet

(b) 54 feet

(c) 98 feet

(d) 49 feet

(e) 72 feet

18. Determine the indefinite integral $\displaystyle\int \frac{-5}{x\left(\ln|x|\right)^2}\,dx$.

Possibilities:

(a) $\dfrac{6\left(\ln|x|\right)^{-2}}{x} + C$

(b) $\dfrac{3\left(\ln|x|\right)^{-1}}{x} + C$

(c) $4\left(\ln|x|\right)^{-3} + C$

(d) $5\left(\ln|x|\right)^{-1} + C$

(e) $\dfrac{-30\left(\ln|x|\right)^{-3}}{x^2} + C$

19. Determine the indefinite integral $\int \left(\frac{1}{6x^5} + 3\sqrt{x}\right)\, dx$.

Possibilities:

(a) $\frac{1}{30}x^{-4} - \frac{3}{2}x^{-3/2} + C$

(b) $-\frac{1}{24}x^{-4} + 2x^{3/2} + C$

(c) $-3x^{-1} - \frac{1}{36}x^6 + C$

(d) $-\frac{5}{6}x^{-6} + \frac{3}{2}x^{-1/2} + C$

(e) $-\frac{5}{6}x^{-4} + \frac{3}{4}x^2 + C$

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20. Determine the indefinite integral $\int \frac{(t+6)^2}{t}\, dt$.

Possibilities:

(a) $\frac{t^3}{3} + 48t + C$

(b) $36t + C$

(c) $\frac{t^2}{2} + 36t + C$

(d) $\frac{t^3 \ln|t|}{3} + 6t^2 \ln|t| + 36 \ln|t| + C$

(e) $\frac{t^2}{2} + 12t + 36 \ln|t| + C$

Formulas

Areas:

Circle: $A = \pi r^2$

Triangle: $A = \dfrac{bh}{2}$

Rectangle: $A = lw$

Trapezoid: $A = \dfrac{b_1 + b_2}{2}\, h$

Volumes:

Rectangular Solid: $V = lwh$