

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



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)

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.

1. Determine the derivative of $f(x) = \sqrt[9]{x} \cdot \ln(7x^2 + 15)$ using the product rule. **You must determine each derivative in the product rule, but do NOT simplify your answer.** Circle your final answer.

2. Determine the minimum value of $g(x) = \frac{x^2 + 5x - 15}{x - 3}$ on the interval $[4, 9]$. **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.

3. Let $f(x) = \ln(6)$. Determine the derivative $f'(x)$.

Possibilities:

(a) $6 \ln(5)$

(b) $\frac{1}{6}$

(c) 0

(d) $\ln(6)$

(e) 1

4. Let $f(x) = 3e^x - 9x^e$. Determine the derivative $f'(x)$.

Possibilities:

(a) $3e^{x-1} - 9e$

(b) $3xe^{x-1} - 9x^e$

(c) $3e^x - 9ex^{e-1}$

(d) $3xe^{x-1} - 9ex^{e-1}$

(e) $3e^x - 9e$

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5. A coal-burning electrical generating plant emits sulfur dioxide into the surrounding air. The concentration $C(x)$, in parts per million, is approximately given by the function

$$C(x) = \frac{0.9}{x^2},$$

where x is the distance away from the plant in miles. Determine the instantaneous rate of change of the sulfur dioxide concentration 8 miles from the plant.

Choose the numeric value that most closely approximates the answer.

Possibilities:

- (a) -0.0035 parts per million per mile
- (b) -57.6000 parts per million per mile
- (c) -0.2250 parts per million per mile
- (d) 0.0141 parts per million per mile
- (e) -14.4000 parts per million per mile

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6. The number of bacteria in a culture doubles every 13 hours. How many hours will it take before 7 times the original number of bacteria is present?

Choose the numeric value that most closely approximates the answer.

Possibilities:

- (a) 29.25
 - (b) 16.29
 - (c) 4.63
 - (d) 49.59
 - (e) 36.50
-

7. Let $f(x) = x^5 - 7x^2$. Determine $f^{(3)}(x)$.

Possibilities:

(a) $x^{15} - 21x^{12} + 147x^9 - 343x^6$

(b) $60x^2$

(c) $x^{15} - 343x^6$

(d) $20x^3 - 14$

(e) $x^2 - \frac{7}{x}$

8. Let $f(x) = x^5 - 8x^3 + 6$. Determine the derivative $f'(x)$.

Possibilities:

(a) $5x^5 - 24x^3 + 6$

(b) $4x^5 - 16x^3 + 6$

(c) $4x^4 - 16x^2$

(d) $5x^4 - 24x^2$

(e) $5x^6 - 24x^4$

9. The total cost (in dollars) of producing x items is given by $C(x) = 4300 + 70x - 0.6x^2$. Determine the average cost function $\bar{C}(x)$.

Possibilities:

(a) $-\frac{4300}{x^2} - 0.6$

(b) $4370 - 0.6x$

(c) $70 - 1.2x$

(d) $\frac{4300}{x} + 70 - 0.6x$

(e) $4370 - 0.6x^2$

10. Determine the minimum value of

$$f(x) = \begin{cases} x^2 + 4x + 5 & \text{if } x \leq 1, \\ 8x + 2 & \text{if } x > 1 \end{cases}$$

on the interval $[0,10]$.

Possibilities:

(a) 5

(b) 4

(c) 1

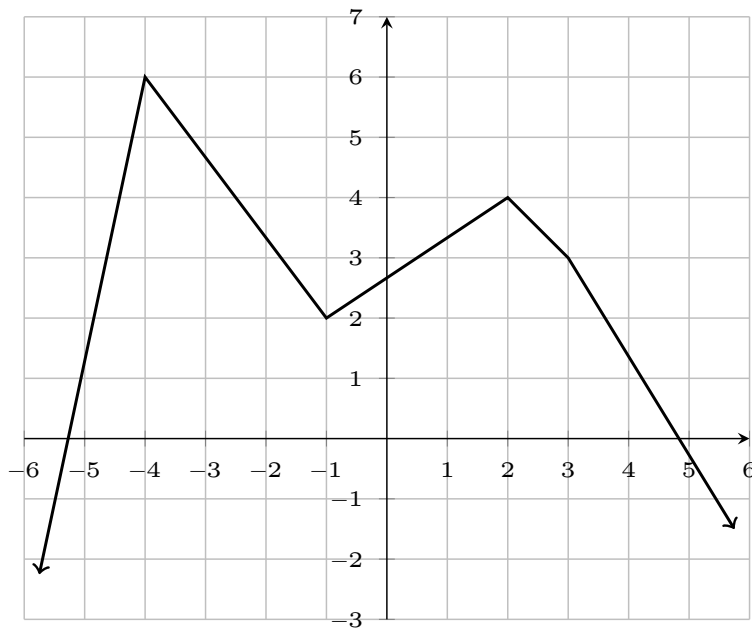
(d) 82

(e) 10

11. The graph of $y = f(x)$ is shown below. What is the maximum value of $f(x)$ on the interval $[-1, 3]$?

Possibilities:

- (a) 3
- (b) 4
- (c) 2
- (d) There is no maximum value on the given interval.
- (e) 6



12. Let $f(x) = \frac{x^8 + x^3}{x^3}$. Determine the derivative $f'(x)$.

Possibilities:

- (a) $5x^4$
 - (b) $\frac{8}{3}x^5 + 1$
 - (c) $8x^7$
 - (d) $11x^4 + 6x^{-1}$
 - (e) $8x^7 + 1$
-

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

$$f(x) = x^2e^x$$

at $x = 3$.

Possibilities:

(a) $6e^3 + 27e^2$

(b) $18e^2$

(c) $6e^3$

(d) $15e^3$

(e) $9e^3$

14. Suppose $f(-4) = 3$, $f'(-4) = -1$, $g(-4) = 6$, and $g'(-4) = 2$. If $h(x) = \sqrt{f(x) + g(x)}$, determine $h'(-4)$.

Possibilities:

(a) $-\frac{1}{54}$

(b) 6

(c) $-\frac{1}{6}$

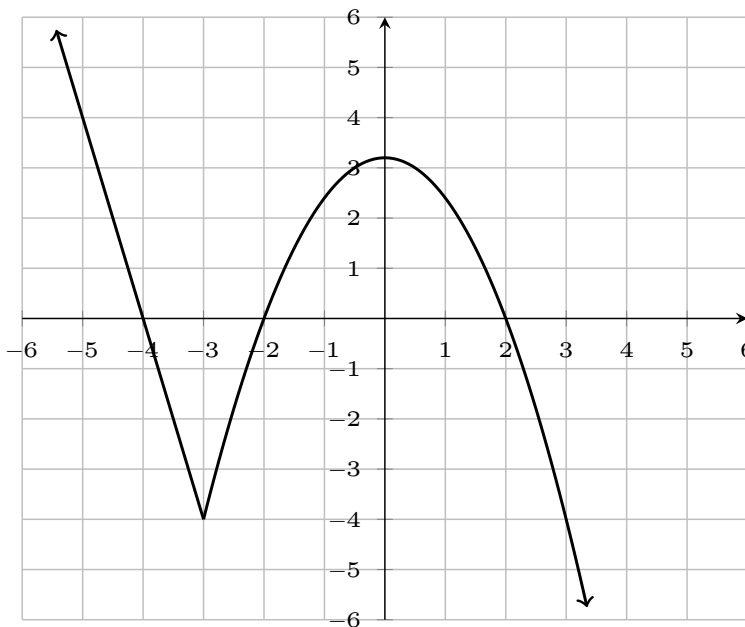
(d) 3

(e) $\frac{1}{6}$

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15. 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) $-4, -3, -2, 0,$ and 2
- (b) $-4, -3, -2,$ and 2
- (c) -3 and 0
- (d) $-4, -2,$ and 2
- (e) $-4, -2, 0,$ and 2



-
16. Suppose $f(3) = 7$ and $f'(3) = 17$. If $g(x) = \ln(f(x))$, determine $g'(3)$.

Possibilities:

- (a) $17 \ln(7)$
 - (b) 1
 - (c) $\frac{17}{3}$
 - (d) $\frac{17}{7}$
 - (e) $\frac{3}{7}$
-

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

$$R(x) = 1500x - 6x^2.$$

Use the marginal revenue function to approximate the additional revenue from selling the 51st machine.

Possibilities:

- (a) Approximately \$1200.
- (b) Approximately \$1194.
- (c) Approximately \$888.
- (d) Approximately \$1044.
- (e) Approximately \$900.

18. Suppose $f(-1) = 4$, $f'(-1) = 8$, $f(2) = 5$, and $f'(2) = -6$. If $g(x) = f(x^3 - 9)$, determine $g'(2)$.

Possibilities:

- (a) -8
 - (b) 96
 - (c) 66
 - (d) 48
 - (e) 16
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19. Let $f(x) = \frac{4x + 6}{7x - 8}$. Determine the derivative $f'(x)$.

Possibilities:

(a) $-\frac{74}{(7x - 8)^2}$

(b) $\frac{56x + 10}{(4x + 6)^2}$

(c) $-\frac{74}{(4x + 6)^2}$

(d) $\frac{4}{7}$

(e) $\frac{56x + 10}{(7x - 8)^2}$

20. A company that makes whatzits has a start up cost of \$18250. It costs the company \$3.97 to make each whatzit. The company charges \$5.72 for each whatzit. Determine the minimum number of whatzits the company must produce and sell to make a profit.

Possibilities:

(a) 1884

(b) 10818

(c) 10429

(d) 8909

(e) 3191
