

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

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 $f(x) = (8x^{-3} - \ln(x)) \cdot e^{x^2+7}$ 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 $g(x) = x^4 + 4x^3 - 108x^2 + 900$ on the interval $[-1, 8]$. **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. If helpful, you may use $x^3 + 3x^2 - 54x = x(x - 6)(x + 9)$.

Name: _____

Multiple Choice Questions

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

3. Suppose $g(6) = 7$ and $g'(6) = 5$. If

$$f(x) = \frac{e^{g(x)}}{x^2 + 8},$$

determine $f'(6)$.

Possibilities:

(a) $-\frac{208}{e^7}$

(b) $\frac{13e^7}{121}$

(c) $\frac{208}{e^7}$

(d) $-\frac{13e^7}{121}$

(e) $\frac{29e^7}{242}$

4. The total revenue (in dollars) from selling x items is given by $R(x) = 7700x - \frac{x^2}{75}$. Determine the average revenue function $\bar{R}(x)$.

Possibilities:

(a) $7700 - \frac{x}{75}$

(b) $\frac{7700}{x} - \frac{2}{75}$

(c) $7700x^2 - \frac{x^3}{75}$

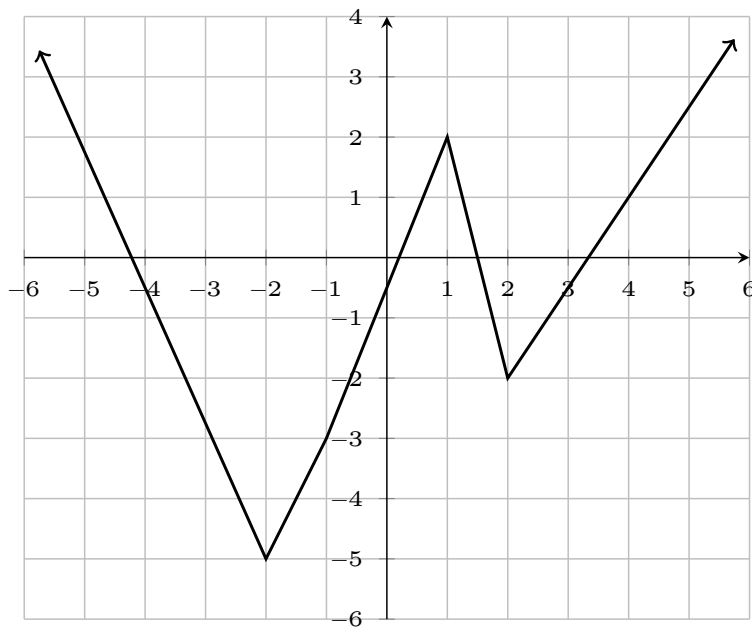
(d) $7700 - \frac{2x}{75}$

(e) $-\frac{1}{75}$

5. The graph of $y = f(x)$ is shown below. What is the minimum value of $f(x)$ on the interval $[-1, 2]$?

Possibilities:

- (a) -5
- (b) There is no minimum value on the given interval.
- (c) 2
- (d) -3
- (e) -2



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

$$f(x) = x^2 \ln(x)$$

at $x = 3$.

Possibilities:

- (a) $15 \ln(3)$
 - (b) $9 \ln(3)$
 - (c) 3
 - (d) 2
 - (e) $6 \ln(3) + 3$
-

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

Possibilities:

(a) 77

(b) 54

(c) 14

(d) 24

(e) 18

8. Let $f(x) = \frac{7x + 9}{5x - 4}$. Determine the derivative $f'(x)$.

Possibilities:

(a) $\frac{(5x - 4)(7) + (7x + 9)(5)}{(7x + 9)^2} = \frac{70x + 17}{(7x + 9)^2}$

(b) $\frac{7}{5}$

(c) $\frac{(5x - 4)(7) + (7x + 9)(5)}{5x - 4} = \frac{70x + 17}{5x - 4}$

(d) $\frac{(5x - 4)(7) - (7x + 9)(5)}{7x + 9} = -\frac{73}{7x + 9}$

(e) $\frac{(5x - 4)(7) - (7x + 9)(5)}{(5x - 4)^2} = -\frac{73}{(5x - 4)^2}$

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9. A bacteria culture starts with 3000 bacteria and the population doubles after 9 hours. Determine the number of bacteria after 25 hours if the population grows exponentially.

Choose the numeric value that most closely approximates the answer.

Possibilities:

- (a) 24930
- (b) 21759
- (c) 20574
- (d) 16326
- (e) 19891

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

Possibilities:

- (a) 232
 - (b) $\frac{344}{81}$
 - (c) -224
 - (d) 344
 - (e) 193
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11. Let $f(x) = 6e^x - 9x^e$. Determine the derivative $f'(x)$.

Possibilities:

(a) $6e^x - 9ex^{e-1}$

(b) $6e^{x-1} - 9e$

(c) $6xe^{x-1} - 9ex^{e-1}$

(d) $6xe^{x-1} - 9x^e$

(e) $6e^x - 9e$

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

$$C(t) = \frac{0.27t}{t^2 + 5}.$$

Determine the instantaneous rate of change of the Acetaminophen concentration at $t = 7$ hours.

Choose the numeric value that most closely approximates the answer.

Possibilities:

(a) 0.0141 units per hour

(b) 0.7600 units per hour

(c) 0.0193 units per hour

(d) -0.2200 units per hour

(e) -0.0041 units per hour

13. Let $f(x) = \frac{x^9 + x^2}{x^2}$. Determine the derivative $f'(x)$.

Possibilities:

(a) $11x^6 + 4x^{-1}$

(b) $\frac{9}{2}x^7 + 1$

(c) $7x^6$

(d) $9x^8$

(e) $9x^8 + 1$

14. Let $f(x) = \ln(12)$. Determine the derivative $f'(x)$.

Possibilities:

(a) $\frac{1}{12}$

(b) $12 \ln(11)$

(c) $\ln(12)$

(d) 0

(e) 12

15. Determine the maximum value of

$$f(x) = \begin{cases} -x^2 + 8x + 3 & \text{if } x < 9, \\ 5x - 51 & \text{if } x \geq 9 \end{cases}$$

on the interval $[0,10]$.

Possibilities:

- (a) 8
- (b) -1
- (c) 19
- (d) -6
- (e) 3

16. The total cost (in dollars) of producing x machines is given by

$$C(x) = 2100 + 50x - 0.4x^2.$$

Use the marginal cost function to approximate the cost of producing the 61st machine.

Possibilities:

- (a) Approximate cost of the 61st machine \approx \$61.00.
 - (b) Approximate cost of the 61st machine \approx \$2.00.
 - (c) Approximate cost of the 61st machine \approx \$1.60.
 - (d) Approximate cost of the 61st machine \approx \$0.40.
 - (e) Approximate cost of the 61st machine \approx \$1.20.
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17. Let $f(x) = x^8 - 6x^3$. Determine $f^{(3)}(x)$.

Possibilities:

(a) $8x^5$

(b) $x^{24} - 216x^9$

(c) $336x^5 - 36$

(d) $56x^6 - 36x$

(e) $x^{24} - 18x^{19} + 108x^{14} - 216x^9$

18. Suppose

$$g(x) = \frac{x^2 + 8}{f(x)}.$$

If $f(6) = 7$ and $f'(6) = 5$, determine $g'(6)$.

Possibilities:

(a) $\frac{304}{49}$

(b) $-\frac{136}{49}$

(c) $\frac{136}{25}$

(d) $\frac{136}{49}$

(e) $-\frac{136}{25}$

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19. A company that makes whatzits has a start up cost of \$17500. It costs the company \$1.07 to make each whatzit. The company charges \$2.69 for each whatzit. Determine the minimum number of whatzits the company must produce and sell to make a profit.

Possibilities:

- (a) 6506
- (b) 13545
- (c) 4655
- (d) 19346
- (e) 10803

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20. Let $f(x) = \sqrt[4]{7x + 9}$. Determine the derivative $f'(x)$.

Possibilities:

- (a) $\frac{1}{4}(7x + 9)^{-3/4}$
 - (b) $\frac{7^{1/4}}{4}x^{-3/4}$
 - (c) $\frac{7}{4}x^{-3/4}$
 - (d) $\frac{7}{4}(7x + 9)^{-3/4}$
 - (e) $-28x(7x + 9)^{-5}$
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