

Name: \_\_\_\_\_

Section: \_\_\_\_\_

MA 109

Fall 2013

Exam 3

November 20, 2013

**Directions:**

- Do not remove this 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 a graphing calculator during the exam, but NO calculator with a Computer Algebra System (CAS) or a QWERTY keyboard is permitted. Absolutely no cell phone use during the exam is allowed.
- The exam consists of multiple choice and short answer questions. Record your answers on this page by filling in the appropriate selection, for example:

A  B  C  D  E.

- The exam is out of 100 total points: 5 points for each of 20 questions. **Only** this front page will be graded and **no partial credit** will be awarded. It is recommended that you check your work!

1.  A  B  C  D  E

12.  A  B  C  D  E

2.  A  B  C  D  E

13.  A  B  C  D  E

3.  A  B  C  D  E

14.  A  B  C  D  E

4.  A  B  C  D  E

15.

5.  A  B  C  D  E

16.

6.  A  B  C  D  E

17.

7.  A  B  C  D  E

18.

8.  A  B  C  D  E

19.

9.  A  B  C  D  E

20.

10.  A  B  C  D  E

11.  A  B  C  D  E

**For grading use:**

<b>Total</b>	
	<b>(out of 100 pts)</b>

**Formula Sheet:**

**Compound Interest:** If a principal  $P_0$  is invested at an interest rate  $r$  for a period of  $t$  years, then the amount  $P(t)$  of the investment is given by:

$$P(t) = P_0 \left(1 + \frac{r}{n}\right)^{nt} \quad (\text{if compounded } n \text{ times per year})$$

$$P(t) = P_0 e^{rt} \quad (\text{if compounded continuously}).$$

**Change of Base Formula:** Let  $a$  and  $b$  be two positive numbers with  $a, b \neq 1$ . If  $x > 0$ , then:

$$\log_a(x) = \frac{\log_b(x)}{\log_b(a)}$$

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**Multiple Choice:** Show your work in the space below and shade the correct answer on the front page for each of the following.

1. For  $f(x) = x^2 + 1$  and  $g(x) = \sqrt{x - 3}$ , find a formula for the composition  $g(f(x))$ .

**Choices:**

- (a)  $x + \sqrt{2}$
  - (b)  $x - 2$
  - (c)  $\sqrt{x^2 - 2}$
  - (d) 2
  - (e)  $\sqrt{x - 3}$
- 

2. Which of the following functions are one-to-one?

$$f(x) = x - 5$$

$$g(x) = |x - 5|$$

$$h(x) = \sqrt{x - 5}$$

**Choices:**

- (a)  $f(x)$  and  $h(x)$  are the only one-to-one functions.
  - (b)  $g(x)$  and  $h(x)$  are the only one-to-one functions.
  - (c)  $f(x)$ ,  $g(x)$  and  $h(x)$  are all one-to-one functions.
  - (d)  $f(x)$  is the only one-to-one function.
  - (e)  $f(x)$  and  $g(x)$  are the only one-to-one functions.
- 

3. Translate the following exponential statement into an equivalent logarithmic statement.

$$37^t = 9261$$

**Choices:**

- (a)  $\log_{37}(9261) = t$
  - (b)  $\log_{9261}(t) = 37$
  - (c)  $\log_{9261}(37) = t$
  - (d)  $\log_{37}(t) = 9261$
  - (e)  $\log_t(37) = 9261$
-

4. Write the logarithmic expression below as a single logarithm.

$$\ln(a) - 2\ln(b) + 3\ln(c)$$

**Choices:**

- (a)  $\ln\left(\frac{a}{b^2c^3}\right)$
  - (b)  $\ln(a - b^2 + c^3)$
  - (c)  $\ln\left(\frac{ac^3}{b^2}\right)$
  - (d)  $\ln\left(\frac{a}{6bc}\right)$
  - (e)  $\ln\left(\frac{3ac}{2b}\right)$
- 

5. For  $f(x) = x^2 + 1$  and  $g(x) = 2x + 3$ , find the domain of  $\frac{f}{g}(x)$  in interval notation.

**Choices:**

- (a)  $(-\infty, 0)$
  - (b)  $\left(\frac{-3}{2}, \infty\right)$
  - (c)  $(-\infty, \infty)$
  - (d)  $\left(-\infty, \frac{-3}{2}\right) \cup \left(\frac{-3}{2}, \infty\right)$
  - (e)  $(-\infty, 0) \cup (0, \infty)$
- 

6. Find all real solutions to the equation below.

$$\log_4(x) + \log_4(x - 6) = 2$$

**Choices:**

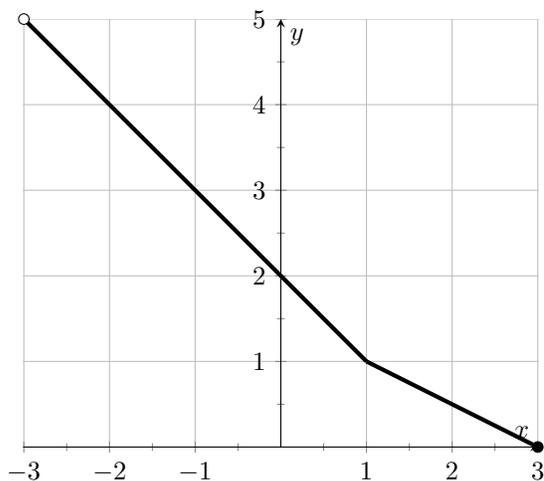
- (a)  $-2$  and  $-8$
  - (b)  $6$
  - (c)  $6$  and  $2$
  - (d)  $8$
  - (e)  $-2$
-

7. Let  $f(x) = \sqrt{x-1}$ . Which of the following is  $f^{-1}(2)$ ?

**Choices:**

- (a) 1
  - (b) 2
  - (c) 3
  - (d) 4
  - (e) 5
- 

8. In the graph below the graph of  $y = f(x)$  is depicted. What is the domain of  $f^{-1}(x)$ ?



**Choices:**

- (a)  $[0, 5)$
  - (b)  $[5, 0)$
  - (c)  $(-3, 3]$
  - (d)  $f^{-1}(x)$  does not exist
  - (e)  $(-3, 1) \cup (1, 3]$
- 

9. At what annual interest rate should \$4000 be invested, compounded continuously, so that 6 years later the investment will be worth \$5000?

**Choices:**

- (a) 3.79%
  - (b) 3.72%
  - (c) 1.25%
  - (d) -1.57%
  - (e) 1.57%
-

10. A colony of bacteria grows exponentially according to the following data. Find a formula for the number of bacteria  $f$  as a function of the number of days  $x$ .

Day	0	1	2	3	4
Population	6	102	1,734	29,478	501,126

**Choices:**

- (a)  $f(x) = 102(17)^x$
  - (b)  $f(x) = 17^x$
  - (c)  $f(x) = 17(6)^x$
  - (d)  $f(x) = 96x + 6$
  - (e)  $f(x) = 6(17)^x$
- 

11. A colony of bacteria grows exponentially according to the following data. Find the average rate of change in population with respect to time from Day 0 to Day 3.

Day	0	1	2	3	4
Population	6	102	1,734	29,478	501,126

**Choices:**

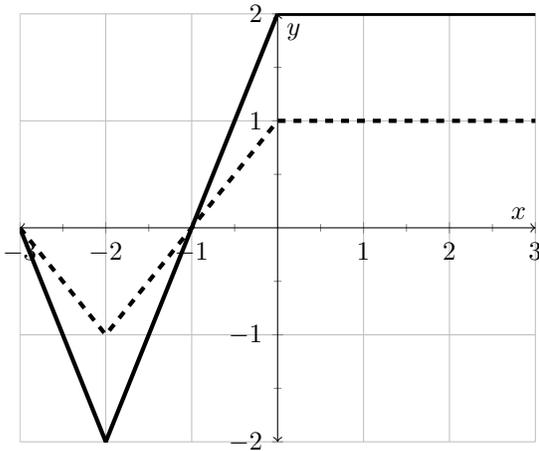
- (a) 17 bacteria per day
  - (b) 14736 bacteria per day
  - (c) 102 bacteria per day
  - (d) 14742 bacteria per day
  - (e) 9824 bacteria per day
- 

12. Suppose the graph of  $y = f(x)$  is a line with slope  $\frac{1}{2}$  and which goes through the point  $(0, 3)$ . Find the average rate of change of  $f(x)$  as  $x$  changes from 5 to  $5 + h$ .

**Choices:**

- (a) 1
  - (b)  $h$
  - (c)  $1/2$
  - (d)  $2x + h$
  - (e)  $5/3$
-

13. In the picture below, the graph of  $y = f(x)$  is the solid graph, and the graph of  $y = g(x)$  is the dashed graph. Find a formula for  $g(x)$ .



**Choices:**

- (a)  $g(x) = \frac{f(x)}{2}$
- (b)  $g(x) = f\left(\frac{x}{2}\right)$
- (c)  $g(x) = f(x - 4)$
- (d)  $g(x) = f(x) - 0.75$
- (e)  $g(x) = 2f(x)$

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14. If \$150 is invested at an annual interest rate of 3.50% per year compounded monthly, find the amount of the investment at the end of five years.

**Choices:**

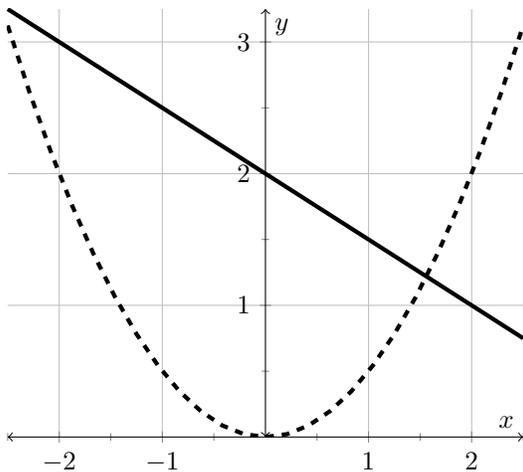
- (a) \$178.64
  - (b) \$1181.71
  - (c) \$178.15
  - (d) \$776.68
  - (e) \$787.83
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**Short Answer:** Show your work below and place the appropriate answer on front page for each of the following.

15. Let  $f(x) = \frac{x}{7} - 3$ . Find a formula for  $f^{-1}(x)$ .

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16. In the picture below, the graph of  $y = f(x)$  is the solid graph, and the graph of  $y = g(x)$  is the dashed graph. Evaluate  $f(g(-2))$ .



17. Find the average rate of change of the function  $f(x) = x^2 - 2x + 7$  as  $x$  changes from 1 to 5.

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18. Let  $f(x) = \log_3(4x + 20)$ . Find the domain of  $f(x)$ . **Be sure to write your answer in interval notation.**

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19. If  $(6, -2)$  lies on the graph of  $f(x)$ , find a point on the graph of  $y = g(x)$  if  $g(x) = f(2x) + 4$ .

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20. Solve the equation for  $x$ :  $127^{19x} = 127^{38}$