

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

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

MA 109

Fall 2013

Exam 4

December 16, 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 25 multiple choice questions. There is a possibility for up to 125 points on the exam (but 25 of these count as extra credit). **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

10.  A  B  C  D  E

19.  A  B  C  D  E

2.  A  B  C  D  E

11.  A  B  C  D  E

20.  A  B  C  D  E

3.  A  B  C  D  E

12.  A  B  C  D  E

21.  A  B  C  D  E

4.  A  B  C  D  E

13.  A  B  C  D  E

22.  A  B  C  D  E

5.  A  B  C  D  E

14.  A  B  C  D  E

23.  A  B  C  D  E

6.  A  B  C  D  E

15.  A  B  C  D  E

24.  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

25.  A  B  C  D  E

9.  A  B  C  D  E

18.  A  B  C  D  E

**For grading use:**

Number Correct (out of 25 questions)	Total Points Earned (questions worth 5 points each)

**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:

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

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

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

**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 which of the following equations is the number 3 a solution?

**Choices:**

(a)  $2x^2 + 2x - 8 = 16$

(b)  $4(3 - x) = 12$

(c)  $\frac{4}{x} + 2 = \frac{1}{x - 3}$

(d)  $3x^2 - 6 = 0$

(e)  $|2x| = -6$

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2. Solve for  $r$ .

$$(3r - 15)(r^2 - 4) = 0$$

**Choices:**

(a) The only real solutions are 5 and 4.

(b) The only real solutions are 3 and 4.

(c) The only real solutions are 3 and 0.

(d) The only real solutions are 5 and  $\pm 2$ .

(e) The only real solutions are  $\pm 2$ .

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3. Let

$$f(x) = \begin{cases} 3x - 1 & \text{if } x \leq -2 \\ x^2 + 3 & \text{if } -2 < x \leq 1 \\ -2x - 5 & \text{if } x > 1 \end{cases}$$

Find  $f(0)$ .

**Choices:**

(a) -5

(b) -1

(c) 3

(d) -15

(e) 0

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4. Solve for  $z$ .

$$3z^2 - 9z + 1 = 0$$

**Choices:**

- (a)  $\frac{-9}{6} \pm \sqrt{69}$
  - (b)  $\frac{9 \pm \sqrt{69}}{6}$
  - (c)  $\frac{-9 \pm \sqrt{69}}{6}$
  - (d)  $\frac{9 \pm \sqrt{93}}{6}$
  - (e)  $\frac{-9 \pm \sqrt{93}}{6}$
- 

5. Use the Intersect or Intercept Method to approximate all real solutions to the equation below using your calculator.

$$x^4 - 4x^3 + 3x^2 = 3 + x$$

**Choices:**

- (a)  $x \approx -0.6383$  and  $x \approx 3.1915$
  - (b)  $x \approx 3.2605$  and  $x \approx 6.2605$
  - (c)  $x \approx -0.6320$  and  $x \approx 2.3680$
  - (d)  $x \approx 6.2605$  and  $x \approx 2.3680$
  - (e)  $x \approx -0.6320$  and  $x \approx 3.2605$
- 

6. Let  $f(x) = 3^x$ . Which of the following is  $f^{-1}(81)$ ?

**Choices:**

- (a) 4
  - (b) 27
  - (c)  $\frac{1}{27}$
  - (d)  $\frac{1}{3}$
  - (e) 2
-

7. The number of bacteria in a culture is modeled by the function  $n(t) = 60e^{0.3t}$  where  $t$  is measured in hours. When will the number of bacteria reach 2500? Round your answer to the nearest hundredth of an hour.

**Choices:**

- (a) About 13.15 hours
  - (b) About 51.09 hours
  - (c) About 12.43 hours
  - (d) About 5.40 hours
  - (e) About 3.73 hours
- 

8. Find an equation for the line through the points  $(-4, 7)$  and  $(5, 12)$ .

**Choices:**

- (a)  $y - 7 = \frac{5}{9}(x + 4)$
  - (b)  $y - 4 = -\frac{9}{5}(x - 7)$
  - (c)  $y - 5 = \frac{5}{9}(x - 12)$
  - (d)  $y + 7 = \frac{5}{9}(x - 4)$
  - (e)  $y - 12 = -\frac{9}{5}(x - 5)$
- 

9. Which of the following statements best describes the system of equations?  $\begin{cases} x + y = 7 \\ 2x + 2y = 8 \end{cases}$

**Choices:**

- (a) The system is dependent. Two solutions to the system are  $(4, 3)$  and  $(2, 2)$ . One point that is NOT a solution to the system is  $(1, 1)$ .
  - (b) The system is consistent. It has exactly one solution which is  $(1, 6)$ .
  - (c) The system is dependent. Every point is a solution to the system.
  - (d) The system is inconsistent. Therefore the system has no solutions.
  - (e) The system is dependent. Two solutions to the system are  $(1, 1)$  and  $(7, 8)$ . One point that is NOT a solution to the system is  $(0, 0)$ .
-

10. A merchant wants to mix peanuts that cost \$1.50 per pound and cashews that cost \$4.50 per pound to obtain 39 pounds of a nut mixture that costs \$2.90 per pound. How many pounds of peanuts are needed?

**Choices:**

- (a) 20.8 pounds
  - (b) 113.1 pounds
  - (c) 4.5 pounds
  - (d) 15.6 pounds
  - (e) 32.7 pounds
- 

11. Let  $f(x) = 3x^2 - 1$ . Find  $\frac{f(x+h) - f(x)}{h}$  and simplify. (Assume  $h \neq 0$ .)

**Choices:**

- (a) 1
  - (b)  $3h$
  - (c)  $\frac{6xh + 3h^2 - 2}{h}$
  - (d)  $18x + 9h$
  - (e)  $6x + 3h$
- 

12. Let  $g(x) = \sqrt{x^2 - 4}$ . Find the domain of  $g(x)$ .

**Choices:**

- (a)  $(-\infty, -2] \cup [2, \infty)$
  - (b)  $[2, \infty)$
  - (c)  $(-\infty, -2) \cup (2, \infty)$
  - (d)  $(-\infty, -2) \cup (-2, 2) \cup (2, \infty)$
  - (e)  $(2, \infty)$
-

The next three problems refer to the same function.

$$\mathbf{P(x) = x^3 - 5x^2 + 3x + 9}$$

13. Which of the following is a factor of  $P(x)$ ? (*See the top of the page.*)

**Choices:**

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

14. Determine the end behavior of the graph of  $y = P(x)$ . (*See the top of the page.*)

**Choices:**

- (a)  $y \rightarrow \infty$  as  $x \rightarrow \infty$  and  $y \rightarrow \infty$  as  $x \rightarrow -\infty$
  - (b)  $y \rightarrow -\infty$  as  $x \rightarrow \infty$  and  $y \rightarrow \infty$  as  $x \rightarrow -\infty$
  - (c)  $y \rightarrow \infty$  as  $x \rightarrow \infty$  and  $y \rightarrow -\infty$  as  $x \rightarrow -\infty$
  - (d)  $y \rightarrow -\infty$  as  $x \rightarrow \infty$  and  $y \rightarrow -\infty$  as  $x \rightarrow -\infty$
  - (e) None of the above.
- 

15. Find the remainder of the division problem. (*See the top of the page.*)

$$\frac{P(x)}{x + 4}$$

**Choices:**

- (a)  $x^2 - 1$
  - (b)  $39x + 9$
  - (c)  $5$
  - (d)  $-147$
  - (e)  $217$
-

16. Suppose the graph of  $y = f(x)$  is a parabola with vertex  $(-1, 3)$  and goes through the points  $(0, 0)$  and  $(-4, -24)$ . What is the average rate of change of  $f$  with respect to  $x$  from  $x = -4$  to  $x = -1$ ?

**Choices:**

- (a)  $-8$
  - (b)  $-12$
  - (c)  $9$
  - (d)  $12$
  - (e)  $6$
- 

17. Suppose the graph of  $y = f(x)$  is a parabola with vertex  $(-1, 3)$  and goes through the points  $(0, 0)$  and  $(-4, -24)$ . Which of the following is an formula for  $f(x)$ ?

**Choices:**

- (a)  $f(x) = (x - 1)^2 + 3$
  - (b)  $f(x) = x^2 + 3x$
  - (c)  $f(x) = 2x^2 + 4x + 5$
  - (d)  $f(x) = (x + 1)(x + 4)$
  - (e)  $f(x) = -3(x + 1)^2 + 3$
- 

18. Solve for  $x$ .

$$6 \log_4 (x + 5) = 12$$

**Choices:**

- (a)  $x = 11$
  - (b)  $x = -4.5$
  - (c)  $x = \sqrt[6]{12}$
  - (d)  $x = 0$
  - (e)  $x = \frac{12}{6 \log(4)}$
-



19. Let  $P(x) = 7x^{50} + 4x^{40} - 31x^{30} + 3x^{20} + 4$ . List all possible rational zeros of  $P(x)$  given by the Rational Zeros Theorem (but do not check to see which are actually zeros).

**Choices:**

- (a)  $\pm 1, \pm 4, \pm 4/7$
  - (b)  $\pm 1, \pm 4, \pm 7/4$
  - (c)  $\pm 1, \pm 2, \pm 4, \pm 1/7, \pm 2/7, \pm 4/7$
  - (d)  $\pm 1, \pm 2, \pm 4, \pm 7, \pm 7/2, \pm 7/4$
  - (e)  $\pm 1, \pm 1/2, \pm 1/4, \pm 7, \pm 7/2, \pm 7/4$
- 

20. When a high school basketball team charges  $p$  dollars per ticket, the total revenue  $R$  from ticket sales is given by the formula

$$R(p) = 2160p - 120p^2.$$

What is the team's maximum revenue?

**Choices:**

- (a) \$9980
  - (b) \$10360
  - (c) \$8
  - (d) \$9
  - (e) \$9720
- 

21. Let  $r(x) = \frac{x+4}{x+7}$ . Find the asymptotes of  $r$ .

**Choices:**

- (a) The vertical asymptote is  $x = -7$  and the horizontal asymptote is  $y = 1$ .
  - (b) The vertical asymptote is  $x = 1$  and the horizontal asymptote is  $y = -7$ .
  - (c) The vertical asymptote is  $x = -4$  and the horizontal asymptote is  $y = 1$ .
  - (d) The vertical asymptote is  $x = -4$  and the horizontal asymptote is  $y = -7$ .
  - (e) The vertical asymptote is  $x = -7$  and the horizontal asymptote is  $y = -4$ .
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22. Explain how the graph of  $g(x) = (x + 5)^2 - 8$  is obtained from the graph of  $f(x) = x^2$ .

**Choices:**

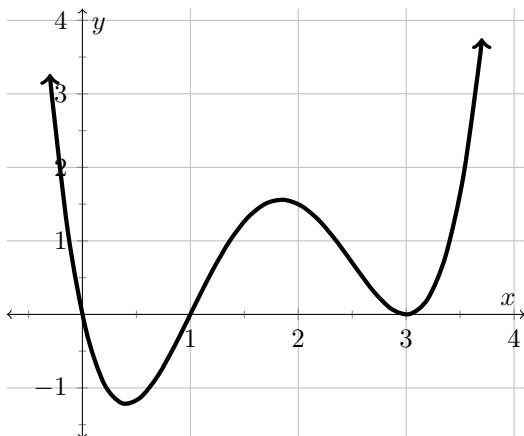
- (a) Shift the graph of  $f$  right 5 units and shift up 8 units to obtain the graph of  $g$ .
  - (b) Shift the graph of  $f$  left 8 units and shift down 5 units to obtain the graph of  $g$ .
  - (c) Shift the graph of  $f$  left 5 units and shift down 8 units to obtain the graph of  $g$ .
  - (d) Shift the graph of  $f$  right 5 units and shift down 8 units to obtain the graph of  $g$ .
  - (e) Shift the graph of  $f$  right 8 units and shift up 5 units to obtain the graph of  $g$ .
- 

23. The sales tax (in dollars) for an item costing  $x$  dollars can be modeled by the function  $T(x) = 0.06x$ . What does  $T^{-1}(3.18)$  represent?

**Choices:**

- (a) The sales tax for an item that costs \$3.18.
  - (b) The original cost of an item if the sales tax is \$3.18.
  - (c) One divided by the original cost of an item.
  - (d) The original cost of an item divided by 3.18.
  - (e) The total tax for an item divided by 3.18.
-

The next two problems refer to the graph shown. In the picture below, the graph of the polynomial function  $P(x)$  is shown.



24. For the graph of the polynomial  $P(x)$  drawn above, which of the following can you conclude about  $P$ ?

**Choices:**

- (a) The degree of the polynomial is odd and the leading coefficient is positive.
- (b) The degree of the polynomial is even and the leading coefficient is positive.
- (c) The degree of the polynomial is odd and the leading coefficient is negative.
- (d) The degree of the polynomial is even and the leading coefficient is negative.
- (e) The parity (even or odd) of the degree of the polynomial or the sign of the leading coefficient can not be determined by the graph.

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25. For the graph of the polynomial  $P(x)$  drawn above, which of the following statements can be concluded?

- (I).  $(x + 1)$  is a factor of  $P(x)$
- (II). When  $P(x)$  is divided by  $(x - 2)$  the remainder is six.
- (III).  $x = 3$  is a root with even multiplicity.

**Choices:**

- (a) Statements (I), (II), and (III) are all true.
  - (b) Only statement (III) is true.
  - (c) Only statement (II) is true.
  - (d) Only statement (I) and (II) are true.
  - (e) None of the statements are true.
-