

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 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. For each multiple choice question, you will need to fill in the box corresponding to the correct answer. For example, if (a) is correct, you must write

a  b  c  d  e

Do not circle answers on this page, but please do circle the letter of each correct response in the body of the exam. It is your responsibility to make it CLEAR which response has been chosen. You will not get credit unless the correct answer has been marked on both this page and in the body of the exam.

**GOOD LUCK!**

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| 4. <input type="checkbox"/> a <input type="checkbox"/> b <input type="checkbox"/> c <input type="checkbox"/> d <input type="checkbox"/> e  | 14. <input type="checkbox"/> a <input type="checkbox"/> b <input type="checkbox"/> c <input type="checkbox"/> d <input type="checkbox"/> e |
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| 6. <input type="checkbox"/> a <input type="checkbox"/> b <input type="checkbox"/> c <input type="checkbox"/> d <input type="checkbox"/> e  | 16. <input type="text"/>   |
| 7. <input type="checkbox"/> a <input type="checkbox"/> b <input type="checkbox"/> c <input type="checkbox"/> d <input type="checkbox"/> e  | 17. <input type="text"/>   |
| 8. <input type="checkbox"/> a <input type="checkbox"/> b <input type="checkbox"/> c <input type="checkbox"/> d <input type="checkbox"/> e  | 18. <input type="text"/>   |
| 9. <input type="checkbox"/> a <input type="checkbox"/> b <input type="checkbox"/> c <input type="checkbox"/> d <input type="checkbox"/> e  | 19. <input type="text"/>   |
| 10. <input type="checkbox"/> a <input type="checkbox"/> b <input type="checkbox"/> c <input type="checkbox"/> d <input type="checkbox"/> e | 20. <input type="text"/>   |

For grading use:

Total	
	(out of 100 pts)

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

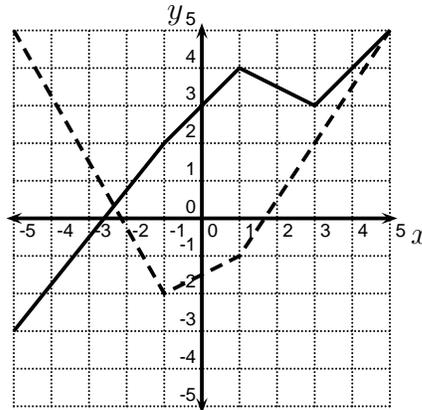
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### Multiple Choice Questions

Show all your work on the page where the question appears.  
Clearly mark your answer both on the cover page of this exam  
and in the corresponding questions that follow.

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1. 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. Use the graphs to evaluate  $(f + g)(1)$ .



**Possibilities:**

- (a) 2
  - (b) 4
  - (c) 3
  - (d) 0
  - (e) -1
- 

2. Let  $f(x) = 3^x$ . Find  $f^{-1}(81)$ .

**Possibilities:**

- (a) 4
  - (b) 5
  - (c) 6
  - (d) 7
  - (e) 8
- 

3. Explain how the graph of  $g(x) = (x + 3)^3 - 11$  is obtained from the graph of  $f(x) = x^3$ .

**Possibilities:**

- (a) Shift right 11 units and shift up 3 units.
  - (b) Shift right 3 units and shift up 11 units.
  - (c) Shift left 11 units and shift down 3 units.
  - (d) Shift right 3 units and shift down 11 units.
  - (e) Shift left 3 units and shift down 11 units.
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4. If \$2,000 is invested at an interest rate of 8% per year compounded quarterly, find the amount of the investment at the end of 13 years.

**Possibilities:**

- (a) \$2,164.86
  - (b) \$2,587.21
  - (c) \$5,600.66
  - (d) \$10,9412.08
  - (e) \$28,143.24
- 

5. Let  $f(x) = 18 + 14x$ . Find the average rate of change of  $f(x)$  from  $x = a$  to  $x = a + h$ . (Assume  $h \neq 0$ ).

**Possibilities:**

- (a)  $\frac{28a + 14h}{h}$
  - (b)  $\frac{18 + 14h}{h}$
  - (c) 1
  - (d) 14
  - (e) -14
- 

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

$$f(x) = x^3 + 9$$

$$g(x) = 2 - x$$

$$h(x) = |x|$$

**Possibilities:**

- (a) Only  $f(x)$  and  $g(x)$  are one-to-one.
  - (b) Only  $g(x)$  and  $h(x)$  are one-to-one.
  - (c) All of  $f(x)$ ,  $g(x)$ , and  $h(x)$  are one-to-one.
  - (d) Only  $f(x)$  is one-to-one.
  - (e) Only  $g(x)$  is one-to-one.
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7. Solve for  $x$ .

$$\log_2(x + 3) = 3$$

**Possibilities:**

- (a) 9
- (b) 5
- (c) 3
- (d) 6
- (e) 11

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8. Express the equation in logarithmic form.

$$12^3 = 1728$$

**Possibilities:**

- (a)  $\log_3(12) = 1728$
- (b)  $\log_{12}(1728) = 3$
- (c)  $\log_3(1728) = 12$
- (d)  $\log_{1728}(3) = 12$
- (e)  $\log_{12}(3) = 1728$

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9. If  $(8, 2)$  lies on the graph of  $f(x)$ , find a point on the graph of  $g(x)$  if  $g(x) = f(2x) + 4$ .

**Possibilities:**

- (a)  $(4, -2)$
  - (b)  $(18, 4)$
  - (c)  $(16, 6)$
  - (d)  $(16, -2)$
  - (e)  $(4, 6)$
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10. Owen leaves at 11:30AM from Lexington and drives 25 miles to Frankfort to stop and have lunch. At 1:00PM, Owen leaves Frankfort and heads to Louisville. He arrives in Louisville at 2:00PM. From Frankfort to Louisville, Owen's average speed is 65mph. What is his average speed from Lexington to Louisville (including the time he took for lunch)?

**Possibilities:**

- (a) 65 miles per hour
- (b) 25 miles per hour
- (c) 36 miles per hour
- (d) 90 miles per hour
- (e) 50 miles per hour

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11. Let  $f(x) = 14 - x$  and  $g(x) = x - 5$ . Find the domain of  $\left(\frac{f}{g}\right)(x)$ .

**Possibilities:**

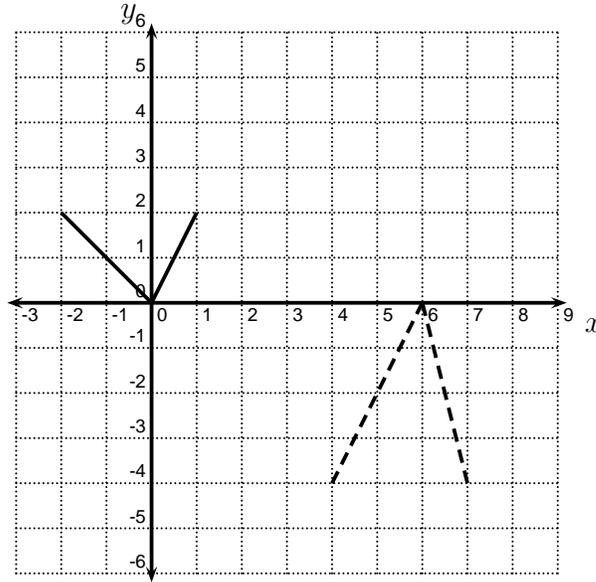
- (a)  $(-\infty, 5) \cup (5, \infty)$
- (b)  $(-\infty, 14]$
- (c)  $(5, 14)$
- (d)  $(-\infty, 5) \cup (5, 14)$
- (e)  $(-\infty, 14)$

- 
12. It is estimated that the tuition at UK will be  $M(t) = 4838(1.04)^t$  dollars per semester, where  $t$  is the number of years after the 2012-2013 academic school year. What is the expected tuition per semester for the 2020-2021 school year (i.e. 8 years after the 2012-2013 school year)?

**Possibilities:**

- (a) \$7, 147.93 per semester
  - (b) \$6, 621.14 per semester
  - (c) \$6, 386.16 per semester
  - (d) \$40, 252.16 per semester
  - (e) \$6, 128.63 per semester
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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  $g(x)$ .



**Possibilities:**

- (a)  $g(x) = -2f(x + 6)$
- (b)  $g(x) = f(x - 6) - 2$
- (c)  $g(x) = \frac{-1}{2}f(x + 6)$
- (d)  $g(x) = -2f(x - 6)$
- (e)  $g(x) = \frac{-1}{2}f(x - 6)$

14.  $\log\left(\frac{x^{-3}y^5}{z^9}\right) =$

**Possibilities:**

- (a)  $-3\log(x) + 5\log(y) - 9\log(z)$
- (b)  $-3\log(x) + 5\log(y) + 9\log(z)$
- (c)  $-3\log(x) - 5\log(y) - 9\log(z)$
- (d)  $\frac{-3\log(x) + 5\log(y)}{9\log(z)}$
- (e)  $\frac{-3\log(x)5\log(y)}{9\log(z)}$

### Short Answer Questions

Clearly write your answers in the spaces provided on the following pages.

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15. Let  $f(x) = 3 - x^2$ . Find the average rate of change of  $f(x)$  from  $x = 4$  to  $x = 9$ .

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16. Find the inverse function of  $f(x) = 5x + 3$ .

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17. Let  $f(x) = \log_4(-11 - x)$ . Find the domain of  $f(x)$ . **Be sure to write your answer in interval notation.**

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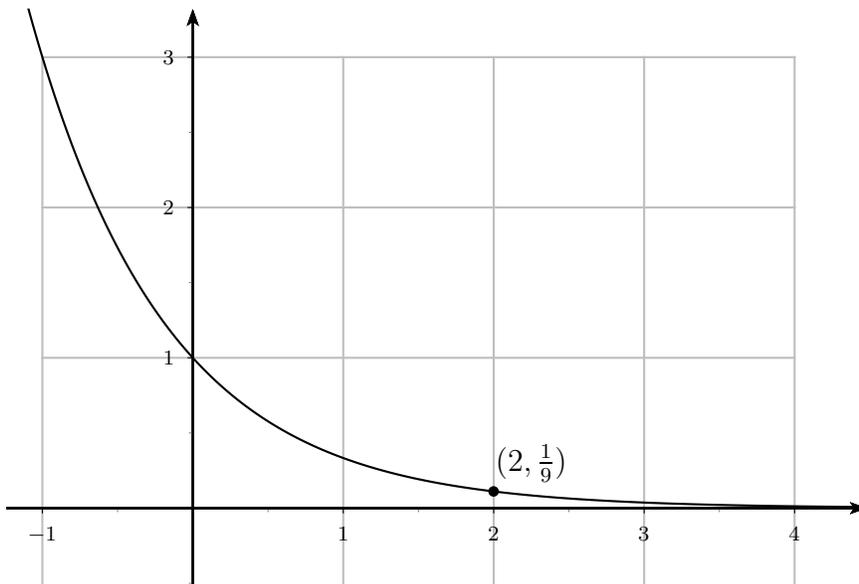
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18. Find all real solutions or state that there are NONE.

$$8e^{x-6} = 7.$$

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19. The graph of the exponential function  $y = a^x$  is shown below. Find  $a$ .



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20. Let  $f(x) = 3x + 7$  and  $g(x) = x - 4$ . Find  $g(f(-5))$ .

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**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:

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