

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 multiple choice questions. Record your answers 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 write

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**GOOD LUCK!**

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For grading use:

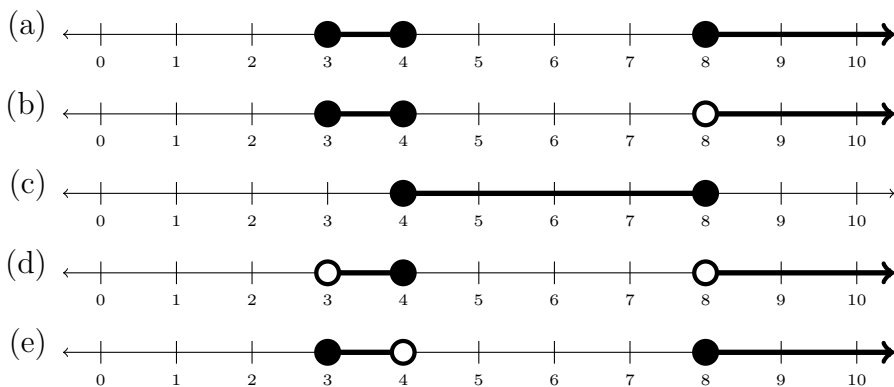
Number Correct	
	(out of 20 problems)

Total	
	(out of 100 points)

**Multiple Choice Questions**

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

1. Which of the following number lines represents the union of intervals  $[3, 4) \cup [8, \infty)$  ?

**Possibilities:**

2. Solve for  $r$  in:

$$(r^2 - 25)(2r - 14) = 0$$

**Possibilities:**

- (a) The only real solutions are  $\pm 5$ .  
(b) The only real solutions are 2 and 25.  
(c) The only real solutions are 14 and 25.  
(d) The only real solutions are 2 and 0.  
(e) The only real solutions are 7 and  $\pm 5$ .

3. The point  $(5, 2)$  is on the graph of which of the following equations?

**Possibilities:**

- (a)  $xy = 0$   
(b)  $x = y - 3$   
(c)  $4x + 10 = 4y + 10$   
(d)  $xy + 20 = xy + 8$   
(e)  $4x + 10 = xy + 20$

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4. Let

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

Find  $f(10)$ .

**Possibilities:**

- (a) 29
- (b) -25
- (c) 19
- (d) 103
- (e) -76

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5. Solve for  $z$ .

$$3z^2 - 11z + 9 = 0$$

**Possibilities:**

- (a)  $\frac{11}{6} \pm \sqrt{94}$
- (b)  $\frac{11 \pm \sqrt{13}}{6}$
- (c)  $\frac{-11 \pm \sqrt{229}}{6}$
- (d)  $\frac{11 \pm \sqrt{229}}{6}$
- (e)  $\frac{-11 \pm \sqrt{13}}{6}$

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6. Solve:  $4096^{23x-3} = 32$

**Possibilities:**

(a)  $\log(-3) - \log(23)$

(b)  $\sqrt{-3} - \sqrt{23}$

(c)  $\sqrt[4096]{-3} - \sqrt[32]{23}$

(d)  $\frac{41}{276}$

(e)  $\frac{32}{23}$

---

7. The mass  $M$  of a radioactive element at time  $T$  is given by the equation below, where  $c$  is the original mass and  $h$  is the half-life of the element. The half-life of a substance is 6.2 years. How long will it take for 175 grams to decay to 35 grams?

$$M(T) = c(.5^{T/h})$$

**Possibilities:**

(a) About 14.0 years

(b) About 14.2 years

(c) About 14.4 years

(d) About 14.6 years

(e) About 14.8 years

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8. Solve the equation.

$$\log(x - 3) + \log(x - 2) = \log(9x - 39)$$

**Possibilities:**

- (a)  $x = 5$  and  $x = 9$
- (b)  $x = -2$  and  $x = -1$
- (c)  $x = \frac{34}{7}$  only
- (d)  $x = 3$  and  $x = 2$
- (e)  $x = -4$  and  $x = -8$

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9. Write the domain of the function  $h(x) = \log(x - 10)$  in interval notation.

**Possibilities:**

- (a)  $(-\infty, \infty)$
- (b)  $(-\infty, 10) \cup (10, \infty)$
- (c)  $(10, \infty)$
- (d)  $(-\infty, -10)$
- (e)  $(-\infty, 10]$

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10. Suppose the graph of  $y = f(x)$  is a parabola with vertex  $(-1, 3)$  and goes through the point  $(0, 5)$ . Which of the following is a formula for  $f(x)$ ?

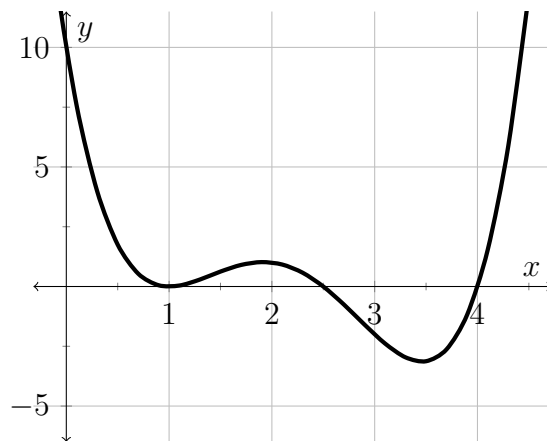
**Possibilities:**

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

- 
11. The graph of a polynomial function is shown. List each root of the polynomial in increasing order and state whether its multiplicity is even or odd.

**Possibilities:**

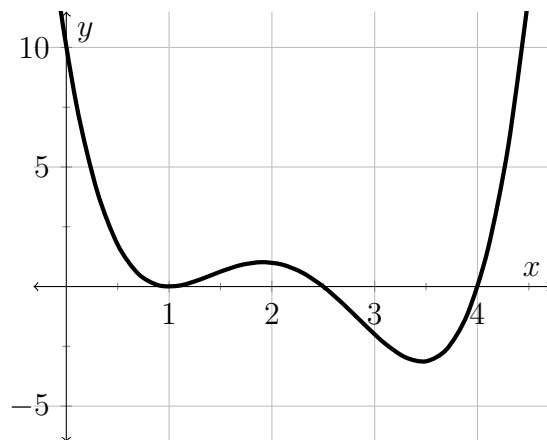
- (a) 2.0 (even) and 3.5 (odd)
- (b) 1.0 (odd), 2.5 (even), and 4.0 (even)
- (c) 2.5 (odd) and 4.0 (even)
- (d) 1.0 (even), 2.5 (odd), and 4.0 (odd)
- (e) 1.0 (odd) only



- 
12. The graph of a polynomial function is shown. What does the graph suggest about the degree and leading coefficient?

**Possibilities:**

- (a) Degree is odd, leading coefficient is negative
- (b) Degree is odd, leading coefficient is positive
- (c) Degree is even, leading coefficient is negative
- (d) Degree is even, leading coefficient is positive
- (e) Degree is zero, leading coefficient is zero



- 
13. Factor the polynomial as a product of linear factors and a factor  $g(x)$  such that  $g(x)$  is either a constant or a polynomial that has no rational roots.

$$x^4 - 13x^3 + 25x^2 - 39x + 66$$

**Possibilities:**

- (a)  $(x - 2)(x - 11)(x^2 + 3)$
- (b)  $(x + 1)(x + 2)(x + 11)(x - 13)$
- (c)  $(x - 1)(x - 2)(x - 3)(x - 11)$
- (d)  $(x - 1)(x - 2)(x - 7)(x - 13)$
- (e)  $(x - 2)(x - 13)(x^2 + 7)$

- 
14. Analyze the function algebraically. List its vertical asymptotes,  $y$ -intercept, and horizontal asymptote, if any.

$$\frac{7x^2}{(x + 2)(x - 11)}$$

**Possibilities:**

- (a) Vertical asymptotes at  $x = -2$  and  $x = 11$ ,  
 $y$ -intercept at  $y = 0$ , and  
horizontal asymptote at  $y = 7$
- (b) Vertical asymptotes at  $x = 2$  and  $x = 11$ ,  
 $y$ -intercept at  $y = \frac{7}{(2)(-11)}$ , and  
no horizontal asymptote
- (c) Vertical asymptotes at  $x = 0$  and  $x = -7$ ,  
 $y$ -intercept at  $y = 2$ , and  
horizontal asymptote at  $y = 11$
- (d) Vertical asymptotes at  $x = 0$  and  $x = 7$ ,  
 $y$ -intercept at  $y = -2$ , and  
horizontal asymptote at  $y = 11$
- (e) Vertical asymptotes at  $x = -11$  and  $x = 2$ ,  
 $y$ -intercept at  $y = 7$ , and  
horizontal asymptote at  $y = 0$

- 
15. The equation of a parabola was printed below, but ink spilled on some of the numbers. Try to answer the question anyways:

$$y = 23(x - \text{[blacked out]})^2 + \text{[blacked out]}$$

Does this parabola open up or down? What is its vertex?

**Possibilities:**

- (a) Down, but the vertex can't be read
  - (b) The vertex is (2,23), but up/down can't be read
  - (c) The vertex is (2,-23), but up/down can't be read
  - (d) The vertex is (23,2), but up/down can't be read
  - (e) Up, but the vertex can't be read
- 
16. A large apple orchard is planning how many trees to plant. They have so many acres, they just record the average number of trees per acre. When there are an average of 23.5 apple trees per acre, the average yield has been found to be 480 apples per tree. For each additional tree planted per acre, the yield per tree decreases by 16 apples per tree. How many additional trees per acre should be planted to maximize the yield? Round to the nearest 0.25 trees per acre.

**Possibilities:**

- (a) About 2.75 additional trees per acre
  - (b) About 3.00 additional trees per acre
  - (c) About 3.25 additional trees per acre
  - (d) About 3.50 additional trees per acre
  - (e) About 3.75 additional trees per acre
-



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17. Find an equation for the line through the points  $(3, 5)$  and  $(4, 9)$ .

**Possibilities:**

- (a)  $y - 5 = \frac{1}{4}(x - 3)$
- (b)  $y + 5 = \frac{1}{4}(x + 3)$
- (c)  $y - 5 = 4(x - 3)$
- (d)  $y = -\frac{1}{4}(x - 3) - 5$
- (e)  $y + 5 = 4(x + 3)$

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18. Which of the following statements best describes the system of equations?

$$\begin{cases} x + y = 4 \\ x + 2y = 8 \end{cases}$$

**Possibilities:**

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

- 
19. You have already invested \$300 in a stock with an annual return of 10%. How much of an additional \$1,350 should be invested at 20% and how much at 5% so that the total return on the entire \$1,650 is 15%?

The multiple choice problem only asks for the amount at 20%.

**Possibilities:**

- (a) \$600 at 20%
- (b) \$1000 at 20%
- (c) \$1,100 at 20%
- (d) \$550 at 20%
- (e) \$350 at 20%

- 
20. Let  $f(x) = 5x^2 + 2x - 17$ . Find  $\frac{f(x+h) - f(x)}{h}$  and simplify. (Assume  $h \neq 0$ .)

**Possibilities:**

- (a)  $5h$
  - (b) 1
  - (c)  $\frac{6xh + 3h^2 - 2}{h}$
  - (d)  $10x + 2 + 5h$
  - (e)  $10x + 5h$
-

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21. Solve for  $b$  in  $\frac{(6b - 5)^3}{3} = 9$ .

**Possibilities:**

(a)  $\frac{4}{3}$

(b)  $\frac{117649}{3}$

(c)  $\frac{7}{3}$

(d)  $\frac{3}{4}$

(e)  $5 \pm \sqrt{27}/6$

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22. Explain how the graph of  $g(x) = \sqrt{x - 9} + 4$  is obtained from the graph of  $f(x) = \sqrt{x}$ .

**Possibilities:**

(a) Shift the graph of  $f$  right 9 units and shift down 4 units to obtain the graph of  $g$ .

(b) Shift the graph of  $f$  left 4 units and shift down 9 units to obtain the graph of  $g$ .

(c) Shift the graph of  $f$  right 4 units and shift up 9 units to obtain the graph of  $g$ .

(d) Shift the graph of  $f$  right 9 units and shift up 4 units to obtain the graph of  $g$ .

(e) Shift the graph of  $f$  left 9 units and shift up 4 units to obtain the graph of  $g$ .

## 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:

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

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

**Exponential Growth Model** If  $n_0$  is the initial size of a population that experiences **exponential growth**, then the population  $n(t)$  at time  $t$  increases according to the model:

$$n(t) = n_0 e^{rt}$$

where  $r$  is the relative rate of growth of the population (expressed as a proportion of the population).

**Radioactive Decay Model:** If  $m_0$  is the initial mass of a radioactive substance with half-life  $h$ , then the mass  $m(t)$  remaining at time  $t$  is modeled by the function:

$$m(t) = m_0 e^{-rt}$$

where  $r = \frac{\ln 2}{h}$ .

**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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