Arkansas Council of Teachers of Mathematics
2019 Algebra I State Exam

Work the multiple-choice questions first, choosing the single best response from the choices available. Indicate your answer here and on your answer sheet. Then attempt the tie-breaker questions at the end starting with tie-breaker #1, then #2, and then #3. Turn in your answer sheet and the tie-breaker pages when you are finished. You may keep the pages with the multiple-choice questions. Figures are not necessarily drawn to scale.

1. Given: $L = \sqrt{2}$ $M = 3\sqrt{3}$ $N = \sqrt{16}$ $P = \sqrt{9}$
   Find the sum of the two rational numbers. Then find the product of the two irrational numbers. What is the product of these two numbers?

   a. $9\sqrt{5}$
   b. $3\sqrt{30}$
   c. $21\sqrt{6}$
   d. $36\sqrt{41}$

2. Michelle is 52 inches tall. Her father is 6 feet 3 inches tall. How many feet taller is Michelle's father than Michelle? Round to the nearest hundredth.

   a. 1.92 ft
   b. 1.96 ft
   c. 2.00 ft
   d. 1.90 ft

3. The sum of two binomials is $5x^2 - 6x$. If one of the binomials is $3x^2 - 2x$, what is the product of the two binomials?

   a. $6x^4 - 16x^3 + 8x^2$
   b. $15x^4 - 8x^2$
   c. $2x^3 + 16x^2 + 4$
   d. $2x^2 - 4x$

4. Which equation has the same solution as $x^2 - 6x - 12 = 0$?

   a. $(x + 3)^2 = 21$
   b. $(x - 3)^2 = 21$
   c. $(x + 3)^2 = 3$
   d. $(x - 3)^2 = 3$

5. Which operation between two polynomials will not always result in a polynomial?

   a. Addition
   b. Multiplication
   c. Subtraction
   d. Division

6. Which statement about $g(x) = x^2 - 576$ is true?

   a. The zeros,-288 and288, can be found when: $0 = (x + 288)(x - 288)$
   b. The only zero, 288, can be found when: $0 = (x - 288)^2$
   c. The zeros, -24 and 24, can be found when: $0 = (x + 24)(x - 24)$
   d. The only zero,24, can be found when: $0 = (x - 24)^2$

7. Which expression is equivalent to $(h^2 + 9h - 1)(-4h + 3)$?

   a. $-4h^3 - 33h^2 + 31h - 3$
   b. $4h^3 + 39h^2 - 23h - 3$
   c. $-4h^3 - 39h^2 + 23h + 3$
   d. $4h^3 + 33h^2 - 31h + 3$

8. Which function is equivalent to $f(x) = -4(x + 7)^2 - 6$?

   a. $f(x) = -4x^2 - 56x - 202$
   b. $f(x) = -4x^2 + 14x + 43$
   c. $f(x) = -4x^2 - 56x - 172$
   d. $f(x) = -4x^2 + 190$

9. At a restaurant, jars of tomato sauce are stored in boxes in the pantry. Each box contains 8 jars of tomato sauce. A cook uses 2 jars from 1 of the boxes. Which function shows the relationship between y, the total number of jars of tomato sauce remaining in the pantry, and x, the number of boxes in the pantry?

   a. $y = 8x + 6$
   b. $y = 8x$
   c. $y = 8x - 2$
   d. $y = 6x$

10. What are the solutions to $(x + 7)^2 = 81$?

   a. $-74 \; and \; 88$
   b. $-2 \; and \; 16$
   c. $-88 \; and \; 74$
   d. $-16 \; and \; 2$

11. What is the range of the function $y = -x^2 - 2x + 3$?

   a. $x \leq 4$
   b. $y \geq -4$
   c. $y \leq 4$
   d. $x \geq 4$

12. What is the simplified form of $\left(2\sqrt{5} + 3\right)\left(\sqrt{5} - 1\right)$?

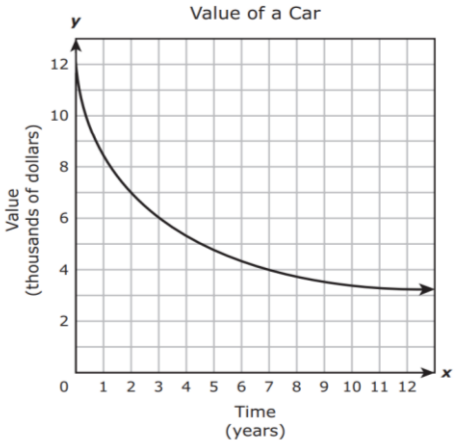
   a. $\sqrt{5} - 3$
   b. $\sqrt{5} + 7$
   c. $2\sqrt{5} - 3$
   d. $2\sqrt{5} + 7$

13. How can the graph of $f(x) = 0.7|x - 6| + 5$ be obtained from the graph of $y = |x|$?

    a. Shift it horizontally 6 units to the left. Shrink it vertically by a factor of 0.7. Shift it vertically 5 units upward.
    b. Shift it horizontally 6 units to the right. Shrink it vertically by a factor of 0.7. Shift it vertically 5 units upward.
    c. Shift it horizontally 6 units to the right. Stretch it vertically by a factor of 0.7. Shift it vertically 5 units downward.
    d. Shift it horizontally 6 units to the left. Stretch it vertically by a factor of 0.7. Shift it vertically 5 units upward.

14. The graph to the right shows the change in the value of a car over several years. Based on the graph, which of the following statements is true?

    a. The car lost about one-half of its value every 3 years.
    b. The car lost about one-quarter of its value every year.
    c. The car lost less of its value between years 9 and 10 than between years 1 and 2.
    d. The car lost more of its value between years 9 and 10 than between years 1 and 2.



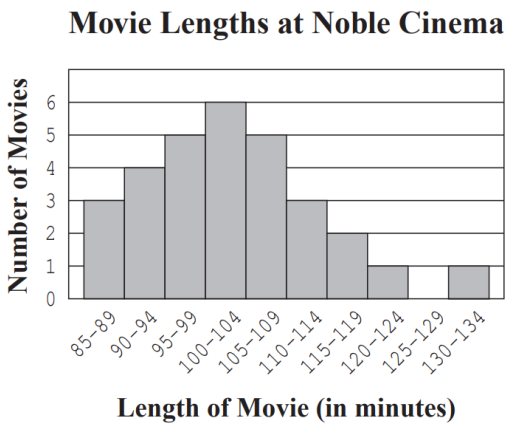
15. The table to the right shows the linear relationship between the balance of a student's savings account and the number of weeks he has been saving. Based on the table, what was the rate of change of the balance of the student's savings account in dollars and cents per week?

Savings Account

Week	0	1	3	6	8	13
Balance (dollars)	32	39	53	74	88	123

    a. $6.00
    b. $6.50
    c. $7.00
    d. $7.50

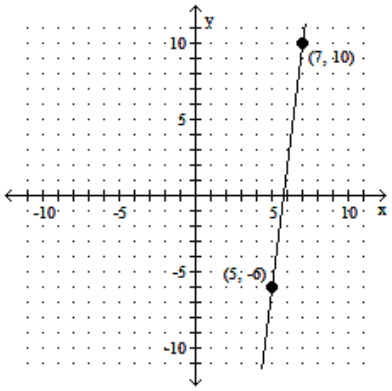
16. The histogram on the right shows the lengths, in minutes, of the movies shown at the Noble Cinema last month. Based on the histogram, which of the following statements is true?



a. The median movie length was between 105 and 109 minutes.
b. A majority of movies were between 130 and 134 minutes long.
c. There were a total of twelve movies which were less than 100 minutes long.
d. The number of movies shorter than 105 minutes was the same as the number of movies longer than 104 minutes.

17. The half-life of a medication is the time it takes for the medication to reduce to half of its original amount in a patient's bloodstream. A certain antibiotic has a half-life of about 8 hours. How much of the 1600 milligram dose will be in the patient's bloodstream after 24 hours?
    a. 50
    b. 100
    c. 200
    d. 400

18. What is the slope of the line graphed to the right?



    a. $-\frac{1}{8}$
    b. -8
    c. $\frac{1}{8}$
    d. 8

19. A rectangular prism has a volume of $8x^3 + 14x^2 + x - 2$ and a height of $2x - 1$. Which expression represents the area of the base of the prism?

    a. $4x^2 + 5x - 2$
    b. $4x^2 + 5x + 2$
    c. $4x^2 + 5x + 5 - \frac{3}{2x-1}$
    d. $4x^2 + 9x + 5 + \frac{3}{2x-1}$

20. The tables of ordered pairs on the right represent some points on the graphs of lines q and v. Which system of equations is represented by lines q and v?

Line q

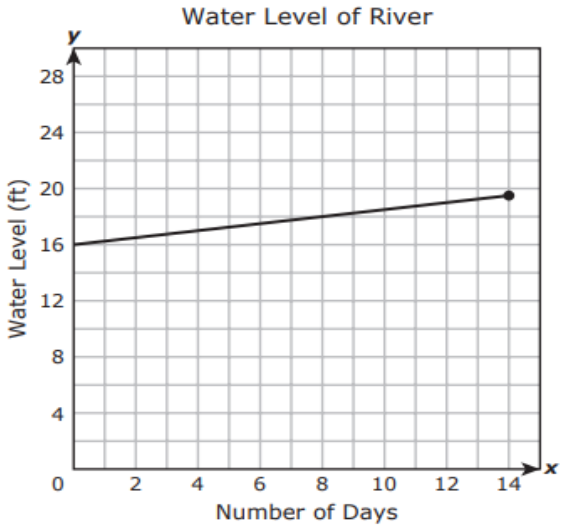
x	-9	-3	2
y	0	18	33

Line v

x	-4	0	10
y	10	8	3

    a. $21x - y = 9 \quad and \quad 5x + 6y = 40$
    b. $3x - y = -27 \quad and \quad x + 2y = 16$
    c. $21x - y = 9 \quad and \quad 5x + 6y = 20$
    d. $9x - y = -27 \quad and \quad x + 2y = 8$

21. The water level of a river was measured each day during a two-week period. The graph to the right models the linear relationship between the water level of the river in feet and the number of days the water level was measured. Which statement best describes the y-intercept of the graph?



    a. The water level increased by 0.25 ft per day
    b. The maximum water level was 19.5 ft
    c. The initial water level was 16 ft
    d. The water level was measured for 14 days

22. There are 1,024 players in a tennis tournament. In each round, half the players are eliminated. Which function can be used to find the number of players remaining in the tournament at the end of x rounds?

    a. $f(x) = 1{,}024(1.50)^x$
    b. $f(x) = 1{,}024(0.50)^x$
    c. $f(x) = 1{,}024(1.05)^x$
    d. $f(x) = 1{,}024(0.05)^x$

23. If $g(x) = 2x + 7$and $h(x) = 3x^2 - 1$, what expression represents$h(g(x))$?

    a. $6x^2 + 5$
    b. $6x^2 + 12$
    c. $3x^2 - 2x - 8$
    d. $3x^2 + 2x + 6$

24. What is the domain of $f(x) = 9 - x^2$?

    a. $f(x) \geq 9$
    b. All real numbers
    c. $-3 \leq x \leq 3$
    d. $x \leq 9$

25. A projectile is launched into the air from the ground. The table on the right shows the height of the projectile, $h(t)$, rounded to the nearest whole meter, at different times. Based on the table, which function can best be used to model this situation?

    a. $h(t) = 99t^2 + 858$
    b. $h(t) = -4.9t^2 + 295t + 0.6$
    c. $h(t) = -4.9t^2 + 295t + 2$
    d. $h(t) = 99t^2 + 1{,}470.3$

Projectile Height

Time (seconds)	Height (meters)
5	1,353
10	2,460
15	3,323
20	3,940
25	4,313
30	4,440
35	4,323

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Tie Breaker #1

Name: _____

School: _____

Algebraically determine all zeros to the following function. Give exact values.

$$f(x) = x^3 - 3x^2 + x - 3$$

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Tie Breaker #2

Name: _____

School: _____

Rationalize the denominator of the following value. Express your answer in a simplified and exact form. Show all work.

$$\frac{4\sqrt{12} - 7\sqrt{6}}{5\sqrt{6} - 2\sqrt{12}}$$

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Tie Breaker #3

Name: _____

School: _____

L_1	L_2
1	1.98
2	3.93
3	8.56
4	13.7
5	24.53
6	48.53
7	93.88
8	186.47
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Eight students performed an experiment called "the clapping wave." They recorded the time it took x students to do the "wave" in y seconds.

- That is, the time for one student to stand up, clap their hands twice, and then sit down was recorded.
- The next time the first student did the same, but now the second student stood up, clapped four times, then sat down. The time was again recorded.
- The third time, the first student clapped twice, the second clapped four times, and now the third student clapped eight times. The time for all three was recorded.
- By the last time, the eighth student clapped two hundred fifty-six times after the other students clapped and sat down.

The results are found in the table on the right. Column L_1 contains the values for x, the number of students in the clapping wave. Column L_2 contains the values for y, the time for x students to complete the clapping wave.

Describe a model equation using regression to relate the number of students in the clapping wave to the number of seconds recorded. What type of model makes the most sense, given the context? Completely explain your reasoning.

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Answer Key:

1	C	10	D	19	D
2	A	11	C	20	B
3	A	12	B	21	C
4	B	13	B	22	B
5	D	14	C	23	A
6	C	15	C	24	B
7	A	16	C	25	B
8	A	17	C		
9	C	18	D		

Tie Breaker #1

$x \in \{3, -i, i\}$

Tie Breaker #2

$$\frac{-19 + 6\sqrt{2}}{17}$$

Tie Breaker #3

Exponential; $y \approx 1.1(1.9)^x$. It is an exponential model with a base of approximately 2 because the number of claps doubles for each additional student participating.