Arkansas Council of Teachers of Mathematics   Name _____
<u>**2022 Algebra I Regional Competition**</u>

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, your tie-breaker pages, and your scratch work when you are finished. Figures are not necessarily drawn to scale.

1. Evaluate the expression below:
$$25 - [5 - (3 - 8)] + (1 - 3)^3$$
   A. 7
   B. 23
   C. -23
   D. 33
   E. None of the above

2. Evaluate the expression for when $x = -4, y = 3,$ and $a = -2.$
$$\frac{5a^3 - x}{2y - y^2}$$
   A. $-\frac{317}{8}$
   B. $-\frac{44}{3}$
   C. $-\frac{34}{3}$
   D. $\frac{26}{3}$
   E. None of the above

3. What are the x and y intercepts of the line $-x - 7y = 42$?
   A. $(-6, 0)$ and $(0, -42)$
   B. $(-42, 0)$ and $(0, -6)$
   C. $(6, 0)$ and $(0, -42)$
   D. $(-42, 0)$ and $(0, 6)$
   E. None of the above

4. Simplify the expression
$$-5(2x - 7) - (4x + 10)$$
   A. $-14x - 25$
   B. $-14x + 20$
   C. $6x + 45$
   D. $-14x + 25$
   E. None of the above

5. Solve for x.
$$-5x - 5(3x - 7) = -21 - 6x$$
   A. $x = 4$
   B. $x = -1$
   C. $x = 1$
   D. $x = \frac{7}{13}$
   E. None of the above

6. Solve for r.

$$\frac{12}{7}r - \frac{1}{21}r = r - \frac{2}{3}$$

   A. $r = \frac{2}{21}$
   B. $r = 0$
   C. $r = -1$
   D. $r = -\frac{6}{7}$
   E. None of the above

7. Solve the equation for h.

$$V = \frac{1}{3}Ah$$

   A. $h = \frac{3A}{V}$
   B. $h = \frac{A}{3V}$
   C. $h = \frac{V}{3A}$
   D. $h = \frac{3V}{A}$
   E. None of the above

8. Simplify the expression with positive exponents only.

$$(3x^3)^2(2x)^{-2}$$

   A. $\frac{27x^4}{4}$
   B. $\frac{9x^4}{4}$
   C. $\frac{9x^8}{4}$
   D. $6x^4$
   E. None of the above

9. The formula for converting degrees Celsius (C) to degrees Fahrenheit (F) is $F = \frac{9}{5}C + 32$. Find the temperature in degrees Celsius (C) when the temperature in degrees Fahrenheit (F) is 59°.
   A. 6 °C
   B. 48 °C
   C. 24 °C
   D. 27 °C
   E. None of the above.

10. The amount of a person's paycheck, p, varies with the number of hours worked, t. For 15 hours of work, the paycheck is $120.75. Write an equation to describe the relationship between hours of work and pay.
   A. $p = t + 80.05$
   B. $p = t + 8.05$
   C. $p = 80.05t$
   D. $p = 8.05t$
   E. None of the above.

11. The distance a spring will stretch varies directly with how much weight is attached to the spring. If a spring stretches 6 inches with 85 pounds attached, how far will it stretch with 70 pounds attached? Round to the nearest tenth of an inch.
    A. 7.3 in.
    B. 6.1 in.
    C. 4.9 in.
    D. 5.9 in.
    E. None of the above.

12. What is the equation of the line in slope-intercept form that passes through $(6, -11)$ and is perpendicular to the line $y = -\frac{2}{3}x + 12$.
    A. $y = \frac{3}{2}x - 20$
    B. $y = -\frac{2}{3}x - 7$
    C. $y = -\frac{2}{3}x - 20$
    D. $y = \frac{3}{2}x + 7$
    E. None of the above.

13. A beetle is walking at a constant rate. The table below records how far a beetle walks at 4, 6, 8, and 10 minutes. Find the rate of change and explain what the rate of change means in the context.

Time (minutes)	Distance (centimeters)
4	188
6	282
8	376
10	470

    A. Rate of change: 10 minutes
       Explanation: The beetle walks for 10 minutes
    B. Rate of change: $\frac{1}{47}$ centimeters per minute
       Explanation: The beetle walks 47 centimeters every minute.
    C. Rate of change: $\frac{47}{1}$ centimeters per minute
       Explanation: The beetle walks 47 centimeters every minute.
    D. Rate of change: 470 centimeters per minute
       Explanation: The beetle walks for 10 minutes
    E. None of the above.

14. List the first four terms in the geometric sequence.
$$a_1 = 12, \ \ a_n = 12\left(\frac{1}{4}\right)^{n-1}$$
    A. $12, 8, 4, 0$
    B. $1, 12, 24, 36$
    C. $12, 3, -6, -15$
    D. $12, 3, \frac{3}{4}, \frac{3}{16}$
    E. None of the above.

15. Write the equation of a line that passes through the points $(-6, -7)$ and $(5, 1)$ in standard form.
    A. Standard Form: $8x - 11y = 29$
    B. Standard Form: $-8x + 11y = 29$
    C. Standard Form: $-8x + 11y = -10$
    D. Standard Form: $8x + 11y = -29$
    E. None of the above.

16. Describe the relationship between the two lines:
$$y = -\frac{7}{2}x - 3$$
$$8x - 28y = 36$$

    A. Parallel
    B. Perpendicular
    C. Intersecting
    D. Perpendicular and Intersecting
    E. None of the above.

17. Which of the following is an extraneous solution of $\sqrt{3x - 2} = x - 2$?
    A. 1
    B. 2
    C. 3
    D. 6
    E. None of the above.

18. Determine the number of solutions to the following system of equations.
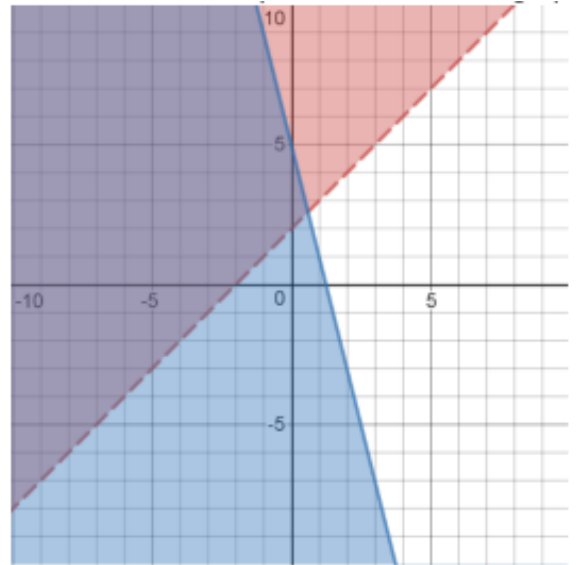$$y = -3x + 5$$
$$y - 5 = 3x$$

    A. No solutions
    B. One solution
    C. Two solutions
    D. Infinitely many solutions
    E. None of the above

19. Simplify. Assume all variables represent non-negative numbers. $\sqrt{9x^4 - 81x^2}$.
    A. $9x\sqrt{x^2 - 9x}$
    B. $9x^2\sqrt{1 - 9x}$
    C. $3x\sqrt{x^2 - 9}$
    D. $3x^2\sqrt{x^2 - 27}$
    E. None of the above.

20. What linear system of inequalities results in the beside graph?
    A. $y < -x + 2$
       $y \geq 4x + 5$
    B. $y > x + 2$
       $y \leq -4x + 5$
    C. $y < -x + 2$
       $y < 4x + 5$
    D. $y > x - 2$
       $y \leq -4x - 5$
    E. None of the above.

21. The function $f(x) = 15(1.4)^x$ represents the area in square inches of a photograph after it has been enlarged x times by a factor of 140%. What is the area of the photograph after it has been enlarged 4 times?
    A. 5.6 square inches
    B. 41.16 square inches
    C. 560 square inches
    D. 56.624 square inches
    E. None of the above

22. For which of the following conditions does $ax^2 + bx + c = 0$ have two real solutions?
    I. $b^2 = 4ac$ II. $b^2 > 4ac$ III. $a = b, c = b$
    A. I only
    B. II only
    C. III only
    D. II and III
    E. None of the above

23. Which of the following is true when the graph of $f(x) = x^2 + 4$ is transformed into the graph of $g(x) = 2x^2 + 4$?
   A. Both functions have the same vertex.
    B. The new function has more zeroes than the old function.
    C. The function is translated up.
    D. The axis of symmetry changes.
    E. None of the above.

24. Which binomial is a factor of $24x^2 - 49x + 2$?
    A. $x - 2$
    B. $x - 1$
    C. $x + 1$
    D. $x + 2$
    E. None of the above

25. What is the area of the beside figure? Write in factored form if possible.
    A. $4x^2 + 12.5x + 4$
    B. $(x + 3)(x + 4)$
    C. $5x^2 + 8x + 12$
    D. $4x(x + 3)$
    E. None of the above
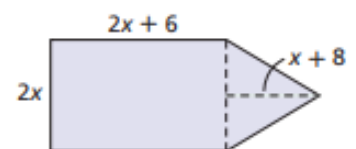
TIE BREAKER #1

Name: _____

School: _____

The area of a rectangular fountain is $(x^2 + 12x + 20)\ ft^2$. The width is $(x + 2)\ ft$.

A. Find the length of the fountain.

B. A 2-foot walkway is built around the fountain. Find the dimensions of the outside border of the walkway.

C. It costs $\$\,4.62$ per ft^2 to build the walkway. How much will it cost to build the walkway?

D. What is the total area covered by the fountain and the walkway combined?

TIE BREAKER #2

Name: _____

School: _____

Sophia has 72 feet of fencing to enclose a rectangular region on her farm for her pig.

A.   Make a sketch of three possible regions that Sophia could enclose and give the corresponding areas.

B.   If the length of the region is x, find an expression for the width.

C.   Write an equation for the area of the enclosure using the expression written in part (B). The length of the region is x.

D.   Sophia wants her fenced region to have the largest area possible with 72 feet of fencing. What dimensions of an enclosure will give her the largest area?

TIE BREAKER #3

Name: _____

School: _____

Anna has a balance of $200 that she owes on her credit card. She plans to make a $30 payment each month. There is also a 1.5% finance charge (interest) on the remaining balance each month.

A. Complete the below table. You may add more rows to the table as needed.

Month	Balance	Monthly Payment	Remaining Balance	1.5% Finance Charge	Remaining Balance
1	$200	$30	$170	$2.55	$172.55
2		$30			
3		$30			
4		$30			

B. How many months will it take Anna to pay the entire balance?

C. By the time that Anna pays the entire balance, how much total interest will she have paid?

ANSWER KEY

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

TIE BREAKER #1

A. The length is $(x + 10)$
B. $(x + 14)$ by $(x + 6)$
C. $\$(36.96x + 295.68)$
D. $x^2 + 20x + 84$

TIE BREAKER #2

A. Answers may vary, but the $l + w = 36$ for each enclosure. Some possible answers:

Dimensions	Area
1 ft × 35 ft	35 ft²
6 ft × 30 ft	180 ft²
10 ft × 26 ft	260 ft²
12 ft × 24 ft	288 ft²
14 ft × 22 ft	308 ft²
16 ft × 20 ft	320 ft²
17 ft × 19 ft	323 ft²
18 ft × 18 ft	324 ft²

B. $y = 36 - x$
C. $A = 36x - x^2$
D. 18 ft × 18 ft

TIE BREAKER #3

A. Table showing the expected values.

Month	Balance	Monthly Payment	Remaining Balance	1.5% Finance Charge	Remaining Balance
1	$200	$30	$170	$2.55	$172.55
2	$172.55	$30	$142.55	$2.14	$144.69
3	$144.69	$30	$114.69	$1.72	$116.41
4	$116.41	$30	$86.41	$1.30	$87.70
5	$87.70	$30	$57.70	$0.87	$58.57
6	$58.57	$30	$28.57	$0.43	$29.00
7	$29.00	$30	$0		

B. 7 months
C. $9.01