

Arkansas Council of Teachers of Mathematics

2013 State Contest

Algebra I Exam

In each of the following choose the BEST answer and shade the corresponding letter on the Scantron Sheet. Answer all 25 multiple choice questions before attempting the tie-breaker questions. The tie-breaker questions at the end are to be used to resolve any ties between 1<sup>st</sup>, 2<sup>nd</sup>, and/or 3<sup>rd</sup> place. Be sure that your name is printed on each of the tiebreaker pages. Good Luck!

1. Toni is solving the following equation by completing the square.

$$ax^2 + bx + c = 0 \text{ (where } a \geq 0\text{)}$$

Step 1:  $ax^2 + bx = -c$

Step 2:  $x^2 + \frac{b}{a}x = -\frac{c}{a}$

Step 3: ?

Which of the following equations should be Step 3 in the solution?

A.  $x^2 = -\frac{c}{a} - \frac{b}{a}x$

B.  $x + \frac{b}{a} = -\frac{c}{ax}$

C.  $x^2 + \frac{b}{a}x + \frac{b}{2a} = -\frac{c}{a} + \frac{b}{2a}$

D.  $x^2 + \frac{b}{a}x + \left(\frac{b}{2a}\right)^2 = -\frac{c}{a} + \left(\frac{b}{2a}\right)^2$

2. What is the solution set of the inequality  $5 - |x + 4| \leq -3$ ?

A.  $-2 \leq x \leq 6$

B.  $x \leq -2$  or  $x \geq 6$

C.  $-12 \leq x \leq 4$

D.  $x \leq -12$  or  $x \geq 4$

3. Marcy has a total of 100 dimes and quarters. If the total value of the coins is \$14.05, how many quarters does she have?

A. 27

B. 40

C. 56

D. 73

4. Which expression is equivalent to  $\frac{\frac{3x^2}{5}}{\frac{x}{4} + \frac{x}{2}}$ ?

A.  $\frac{x^2}{5+x}$

B.  $\frac{9x^2}{20}$

C.  $\frac{4x}{5}$

D.  $\frac{9}{5}$

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5. This table shows the number of cans placed in a collection bin during a food drive.

Food Drive Results

Type of Food	Number of Cans
Vegetable	2,578
Fruit	1,359
Meat	1,240
Sauce	580

One can will be randomly selected from the bin. Which is closest to the probability that the can selected will contain fruit or sauce?

- A. 0.10  
B. 0.24  
C. 0.34  
D. 0.66
6. For which of the following values of “a” would the following system of equations have an infinite number of solutions.

$$\begin{aligned}2x - y &= 6 \\8x - 4y &= 3a\end{aligned}$$

- A. 2  
B. 6  
C. 8  
D. 18  
E. 24
7. The price of an item is first marked down 20% and then up 20%. Express as a percentage the overall change in the price of the item.
- A. 0%  
B. +4%  
C. -4%  
D. +10%  
E. -10%
8. The equation of line  $l$  is  $6x + 5y = 18$ , and the equation of line  $q$  is  $-5x - 6y = -15$ . Which statement about the two lines is true?
- A. Lines  $l$  and  $q$  have the same  $y$  – intercept.  
B. Lines  $l$  and  $q$  are parallel.  
C. Lines  $l$  and  $q$  are perpendicular.  
D. Lines  $l$  and  $q$  have the same  $x$  – intercept.  
E. None of the statements are true.

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9. When is this statement true?

The opposite of a number is less than the original number.

- A. This statement is never true.  
B. This statement is always true.  
C. This statement is true for positive numbers.  
D. This statement is true for negative numbers.
10. The cost to rent a construction crane is \$750 per day plus \$250 per hour of use. What is the maximum number of hours the crane can be used each day if the rental cost is not to exceed \$2500 per day?
- A. 2.5  
B. 3.7  
C. 7.0  
D. 13.0
11. Marta is buying a car from her sister for \$12,294. After making an initial payment of \$1,200, she agrees to pay \$258 per month for  $n$  months. Which equation can Marta use to determine the number of months,  $n$ , it will take her to finish paying for the car?
- A.  $1,200n + 258 = 12,294$   
B.  $1,200 + 258n = 12,294$   
C.  $\frac{(1,200 + 258)}{n} = 12,294$   
D.  $\frac{(1,200 - 258)}{n} = 12,294$
12. An object that is thrown straight downward with initial velocity  $v_0$  travels a distance  $s(t) = v_0t + \frac{1}{2}at^2$ , where  $t$  represents time and  $a$  represents acceleration. If Ramón is standing on a balcony 84 feet above the ground and throws a penny straight down with an initial velocity of 10 feet per second, in how many seconds will it reach the ground? Assume a constant acceleration of  $32\frac{ft}{sec^2}$ .
- A. 2 seconds  
B. 3 seconds  
C. 6 seconds  
D. 8 seconds

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13. One pipe can fill a tank in 20 minutes, while another takes 30 minutes to fill the same tank. How long would it take to fill the tank using both pipes simultaneously?
- A. 50 min
  - B. 25 min
  - C. 15 min
  - D. 12 min
14. Which statement *best* explains why there is no real solution to the quadratic equation  $2x^2 + x + 7 = 0$ ?
- A. The value of the discriminant is positive.
  - B. The value of the discriminant is equal to 0.
  - C. The value of the discriminant is negative.
  - D. The value of the discriminant is not a perfect square.
15. Tiffany bought 4 shirts and 3 pairs of jeans for \$109.85. Brittany bought 6 shirts and 1 pair of jeans for \$94.95. Each shirt costs the same amount. Each pair of jeans costs the same amount. If Marie wants to buy 2 shirts and 2 pairs of jeans, how much would she spend?
- A) \$32.45
  - B) \$52.40
  - C) \$64.90
  - D) \$79.80
16. Given  $X = \begin{bmatrix} 2 & 3 & 1 \\ -1 & 5 & 4 \end{bmatrix}$  and  $Y = \begin{bmatrix} 6 & 0 & -2 \\ 4 & 1 & 5 \end{bmatrix}$ . What is  $2Y - 3X$ ?
- A)  $\begin{bmatrix} 18 & 9 & -1 \\ 5 & 17 & 22 \end{bmatrix}$
  - B)  $\begin{bmatrix} 6 & -9 & -7 \\ 11 & -13 & 2 \end{bmatrix}$
  - C)  $\begin{bmatrix} -14 & 6 & 8 \\ -14 & 7 & -7 \end{bmatrix}$
  - D)  $\begin{bmatrix} 6 & -9 & -7 \\ 11 & -13 & -2 \end{bmatrix}$
17. Which equation is equivalent to  $3[7x - 4(x - 3)] + 1 = 16$ ?
- A.  $9x - 2 = 16$
  - B.  $9x + 37 = 16$
  - C.  $17x - 2 = 16$
  - D.  $17x + 13 = 16$

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18. The distance from Earth to Pluto is approximately  $4.3 \times 10^{12}$  meters. The diameter of Earth is approximately  $1.2 \times 10^7$  meters. Approximately how many times the diameter of Earth is the distance from Earth to Pluto?

- A. 0.28                      B. 3.60                      C.  $2.8 \times 10^4$                       D.  $3.6 \times 10^5$

19. What is the product of the values for  $a$  and  $b$  in the following equation?

$$\frac{x^{2y+2}}{x^{4y-3}} x^{ay-b} = x^{4y+4}$$

- A. 5                      B. 8                      C. -6                      D. 16                      E. 6

20. What is the sum of the roots of the following equation  $2x^2 - 5x - 3 = 0$ ?

- A. -2                      B. -1                      C.  $\frac{1}{2}$                       D.  $\frac{3}{2}$                       E.  $\frac{5}{2}$

21. The balance,  $B_{n+1}$ , in Mr. Smith's savings account at the end of a year is calculated by the equation  $B_{n+1} = (1.065)B_n$ , where  $B_n$  is the balance at the end of the previous year. Mr. Smith made a deposit to open the account 4 years ago. He has not made any additional deposits or withdrawals since. The balance at the end of 2 years was \$1,701.34. What is the balance at the end of 4 years?

- A. \$1922.51  
B. \$1929.70  
C. \$2143.69  
D. \$2188.72

22. If  $k$  is an integer, which of the following must be odd?

- I.  $k + 1$   
II.  $k^2 + 1$   
III.  $2k + 1$

- A. I only  
B. II only  
C. I and II only  
D. II and III only  
E. III only

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23.  $\frac{x^2+8x+16}{x+3} \div \frac{2x+8}{x^2-9} =$

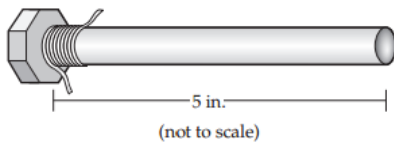
A.  $\frac{2(x+4)^2}{(x-3)(x+3)^2}$

B.  $\frac{2(x+3)(x-3)}{x+4}$

C.  $\frac{(x+4)(x-3)}{2}$

D.  $\frac{(x+4)(x-3)^2}{2(x+3)}$

24. Jenny is making an electromagnet by wrapping wire around an iron bolt, as shown in the picture below.



The wire is 0.1 inch in diameter so each wrap is 0.1 inch wide. If Jenny makes one wrap every 3 seconds, how many seconds will it take to wrap the 5-inch bolt?

- A. 16.7 seconds  
B. 30.0 seconds  
C. 150.0 seconds  
D. 166.7 seconds
25. Find the solution set for  $x$  in terms of  $a$  and  $b$ , where  $a > 0$ ,  $b > 0$ ,  $b \neq 2$

$$|2x - a| = |bx + 2|$$

A.  $\left\{ \frac{a+2}{2+b}, \frac{a+2}{2-b}, \frac{a-2}{2+b}, \frac{a-2}{2-b} \right\}$

B.  $\left\{ \frac{a+2}{2+b}, \frac{a+2}{2-b}, \frac{a-2}{2-b} \right\}$

C.  $\left\{ \frac{a+2}{2+b}, \frac{a-2}{2+b}, \frac{a-2}{2-b} \right\}$

D.  $\left\{ \frac{a+2}{2-b}, \frac{a-2}{2+b} \right\}$

- E. Each of the other answers are incorrect.

**Tie-Breaker Questions**

Name \_\_\_\_\_  
[Please Print]

School \_\_\_\_\_  
[Please Print]

**In each of the following you must show supporting work for your answers to receive credit. The questions will be used in the order given to resolve ties for 1<sup>st</sup>, 2<sup>nd</sup>, and/or 3<sup>rd</sup> place. Be sure that your name is printed on each of the tiebreaker pages.**

1. When a patient needs to receive medicine intravenously (directly into the blood stream), the doctor prescribes the medicine in milliliters per hour (mL/hr). A nurse then converts the mL/hr into a rate of drops per minute using  $1 \text{ mL} = 15 \text{ drops of medicine}$ . What is the total number of hours that 1000 mL of medicine will last if the patient receives the medicine at a rate of 40 drops per minute?

**Tie-Breaker Questions**

Name \_\_\_\_\_  
[Please Print]

School \_\_\_\_\_  
[Please Print]

2. The manager of a computer help center made a table to track customer calls. The table below shows the number of telephone calls and the duration of the calls in minutes ,  $t$ .

**Duration of Customer Calls**

Call Duration ( $t$ minutes)	Number of Calls
$0 < t < 4$	120
$4 \leq t < 8$	425
$8 \leq t < 12$	210
$12 \leq t < 16$	150
$16 \leq t < 20$	30
$20 \leq t < 24$	15

- A. Build a cumulative frequency histogram of the data above.
- B. What is the probability that a telephone call received during the one-day period lasted between 12 and 24 minutes?



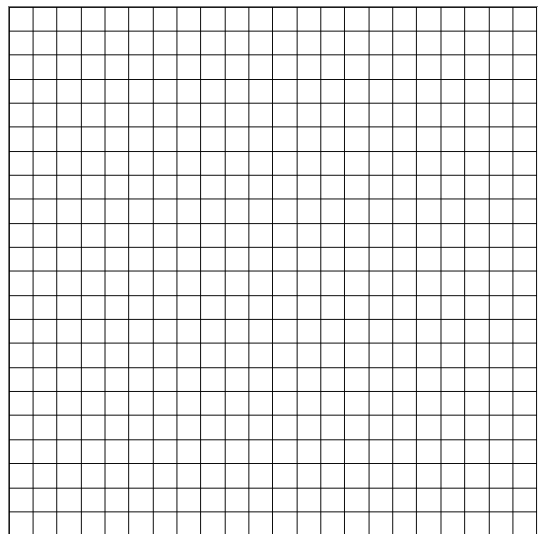
**Tie-Breaker Questions**

Name \_\_\_\_\_  
[Please Print]

School \_\_\_\_\_  
[Please Print]

3. The boys' soccer team is holding a fundraiser. They are selling cheese pizzas for \$12 and supreme pizzas for \$15. They would like to raise at least \$500. The boys estimate that at most they will be able to sell 120 pizzas.

- A) Write a system of inequalities to represent this situation.
- B) Graph each inequality on the grid and label the solution set.
- C) 20 cheese pizzas have been sold. Determine the range of the number of supreme pizzas that could be sold to reach the team's goal of \$500, keeping in mind that number of pizzas they will be able to sell.



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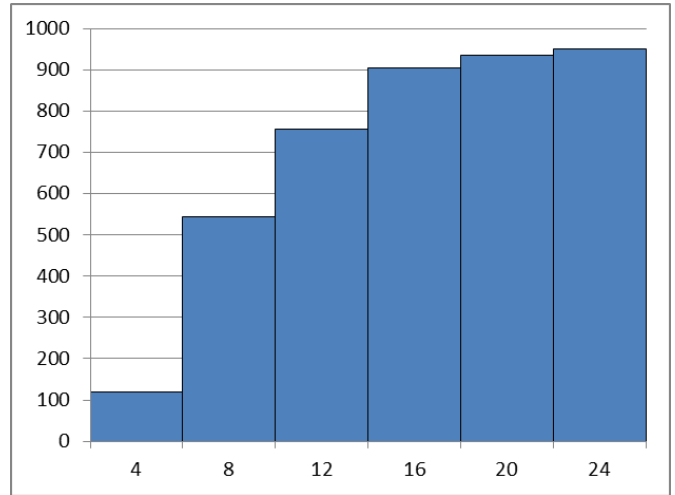
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#### Algebra 1 State Test Answer Key

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

Tie Breaker #1. Answer: 6.25 Hours

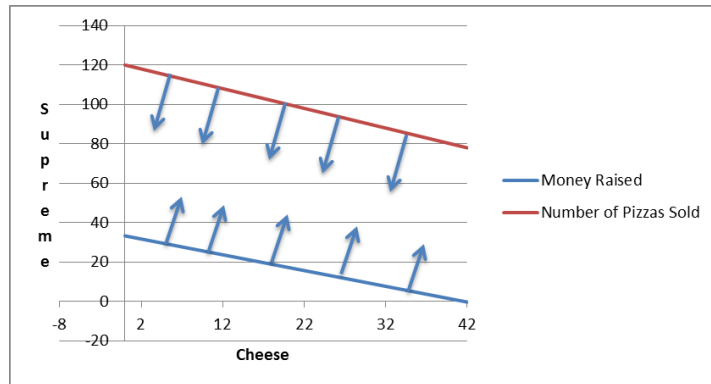
Tie Breaker #2. Answer:



Probability:  $195/950$  or approximately 0.20526

Tie Breaker #3. Answer:

A)  $12c + 15s \geq 500$  and  $c + s \leq 120$



- B)
- C) A range of  $[18, 100]$  supreme pizzas could be sold.