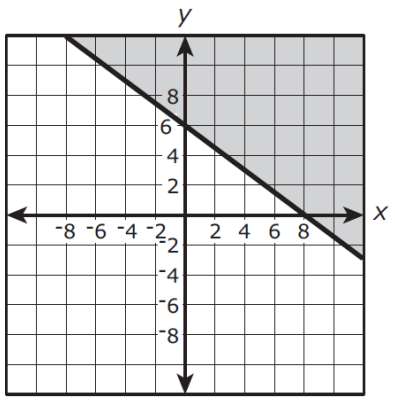
Arkansas Council of Teachers of Mathematics
2015 Algebra I State Exam

For questions 1 through 25, mark your answer choice on the answer sheet provided. After completing items 1 through 25, answer each of the tiebreaker items in sequential order (do #1 first, followed by #2, and #3 last). Be sure that your name is printed on each of the tiebreakers.

1. Which is a graph of the solution set for the inequality $3x - 4y \leq 24$?

a.



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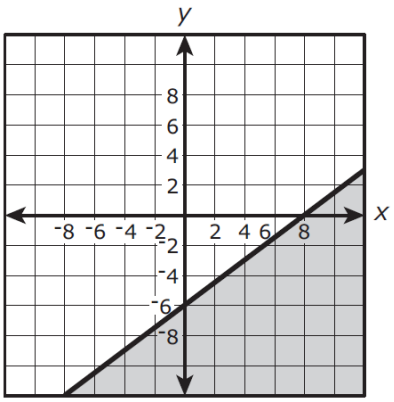

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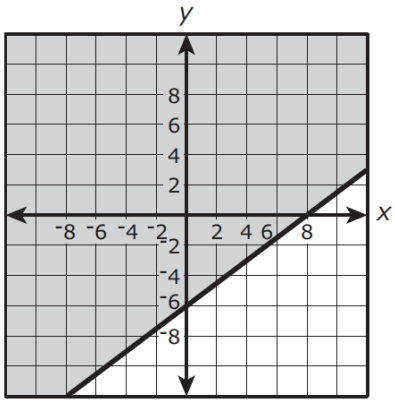

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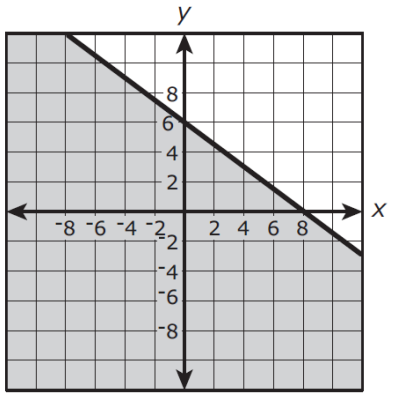


2. The point (3, 8) lies on the function $f(x) = 2^x$, what are the coordinates of the point $(3, y)$ if $y = 2^x$ is changed to $y = 3(2^{x+2})$?

   a. (3, 24)
   b. (3, 26)
   c. (3, 48)
   d. (3, 96)

3. Determine the interval of *x* for which *f(x) > g(x)* when $f(x) = 399x + 3500$ and $g(x) = 3^x$.

   a. [-8.77, 8.02]
   b. (-8.77, 8.02)
   c. (-∞, 8.02)
   a. [8.02, ∞)

4. Combined estimates for Etosha National Park and the Northwestern Population are listed in the table below.

Year	Estimated Number of Elephants
1998	3,218
2000	3,628
2002	3,721
2004	3,571

The elephant population in northwestern Namibia and Etosha National Park can be predicted by the expression $2{,}649(1.045)^b$, where b is the number of years since 1995. What does the value of 2,649 represent?

a. The predicted increase in the number of elephants in the region each year.
b. The predicted number of elephants in the region in 1995.
c. The year when the elephant population is predicted to stop increasing.
d. The percentage the elephant population is predicted to increase each year.

5. Juan is constructing a table of values that satisfies the definition of a function.

Input	-13	20	0	-4	11	-1	17	
Output	-15	-11	-9	-2	-1	5	5	13

Which number can be placed in the empty cell so that the table of values satisfies the definition of a function?

a. -5
b. -1
c. 0
d. 11

6. Caroline knows the height and the required volume of a cone-shaped vase she's designing.

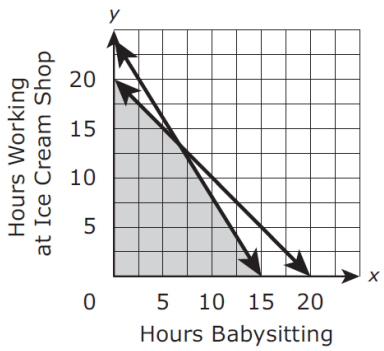
$$V = \frac{1}{3}\pi r^2 h$$

Which formula can she use to determine the radius of the vase?

a. $r = \sqrt{\frac{V}{3\pi h}}$
b. $r = \sqrt{\frac{3V}{\pi h}}$
c. $r = \frac{\sqrt{3V}}{\pi h}$
d. $r = \pm\sqrt{\frac{3V}{\pi h}}$

7. Hannah would like to earn at least $120 per month. She babysits for $5 per hour and works at the ice cream shop for $8 per hour. Hannah cannot work more than 20 hours per month. Let *x* represent the number of hours Hannah babysits and y represent the number of hours Hannah works at the ice cream shop. Which graph represents the number of hours that Hannah can work in order to earn at least $120 and not work more than 20 hours per month?

a.



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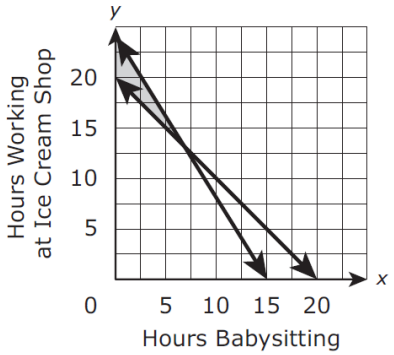

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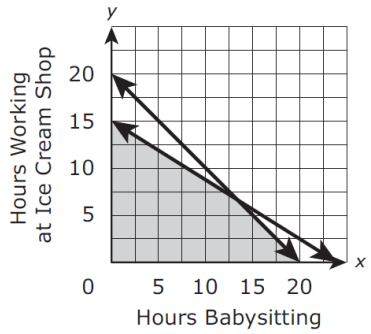

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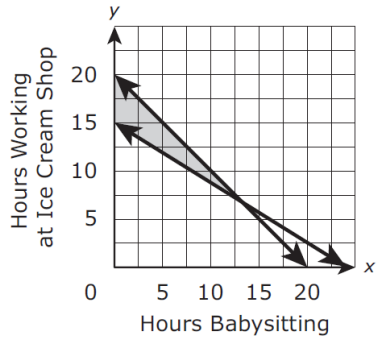


8. Given the domain (-∞, ∞) and *a* is a real number, identify the function that will have a non-real solution.

   a. $f(a) = \sqrt{-a^2}$
   b. $f(a) = \sqrt{a^2}$
   c. $f(a) = \sqrt[3]{-a^2}$
   d. $f(a) = \sqrt[3]{a^2}$

9. If the graphs of $2y + x + 3 = 0$ and $3y + ax + 2 = 0$ meet at right angles, what is the value of a?

   a. 1
   b. -6
   c. 5
   d. 2

10. Gene has a 22 cm by 28 cm piece of paper. He determines the area of the paper to be 616 cm^2 he then folds the paper in half and measures the sides of the paper again, he continues to fold the paper in half and record the area. The table below shows the area after each fold. Identify the model for the area of the paper as a function of the number of folds. Note: He could only fold the paper 6 times.

Folds (x)	0	1	2	3	4	5	6
Area (cm^2) f(x)	616	308	154	77	38.5	19.25	9.625

a. $f(x) = 616(2)^x$
b. $f(x) = 308\left(\frac{1}{2}\right)^x$
c. $f(x) = 616\left(\frac{1}{2}\right)^x$
d. $f(x) = 308(2)^x$

11. A 2014 study analyzed what percentage of residents in California were born in-state and what percentage were born out of state from 1900 until 2012. The two-way table of column relative frequencies below shows the results of the study. California's total population was approximately 31 million in 2012.

	California 1930	California 2012
Born in California	0.35	0.55
Born in a U.S. state other than California	0.46	0.17
Foreign Born	0.19	0.28
Column Total	1.00	1.00

Approximately how many 2012 California residents were born in California?

a. 5 million
b. 11 million
c. 17 million
d. Not enough information

12. Given that *a* and *b* are real numbers, and $|a| \cdot b = a \cdot |b|$. Which of the following must be true about *a* and *b*'s relationship?

a. $a = b$
b. $a = 0 \; or \; b = 0$
c. $ab \geq 0$
d. $ab \leq 0$

13. The Global Well-Being Index measures adult individuals' perceptions of well being in several categories. The table below shows data on social well-being and global region from a study conducted across 135 countries in 2013.

	The Americas	Sub-Saharan Africa
Thriving socially	125	62
Not thriving socially	73	210

According to the study, what is the probability that an individual is thriving socially?

a. 0.27
b. 0.40
b. 0.59
c. 0.60

14. The paired data below consist of the temperatures on randomly chosen days and the amount a plant grew (in millimeters).

Temperature, x	62	76	50	51	71	46	51	44	79
Growth, y	36	39	50	13	33	33	17	6	16

What statement can be made about the correlation coefficient?

a. Strong positive correlation
b. No correlation
c. Weak positive correlation
d. Strong negative correlation

15. Given the equation $x^2 - 6x - k$, which of the following values of k will result in exactly one solution when solved for x?

a. -9
b. -3
c. 5
d. 9

16. The sum of the first three terms of an arithmetic sequence is 120. Which of the following values cannot be the first term of this arithmetic sequence?

a. 20
b. 27
c. 39
d. 44

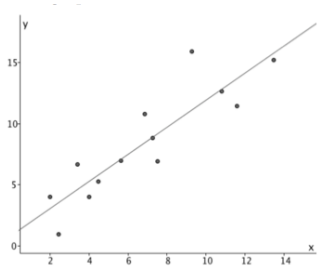
17. The information in the chart gives the salary of a person for the stated years.

Year, x	Salary, y
1990, 0	$ 23,500
1991, 1	24,500
1992, 2	25,200
1993, 3	26,600
1994, 4	27,200

Which of the following linear functions best models this data?

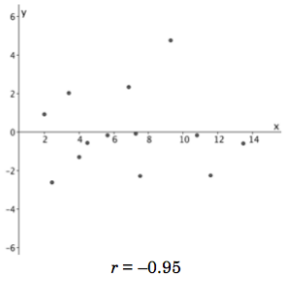
a. $y = -1295x + 23{,}500$
b. $y = 1050x + 23{,}500$
c. $y = 28.7x + 23{,}500$
d. $y = 1050x$

18. A scatter plot was constructed and a linear regression line was drawn on the graph below.



Which **residual plot** and correlation coefficient best model the regression curve's fit to the data?

a.



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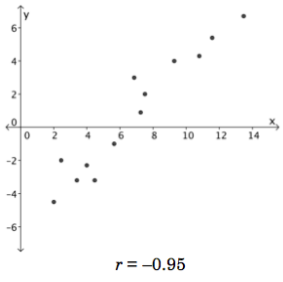

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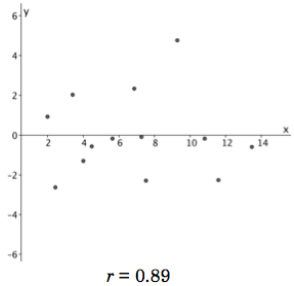

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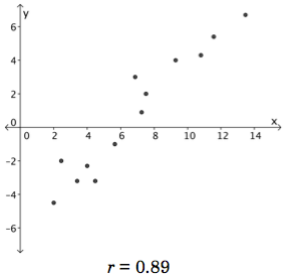

19. Samuel recently learned how to make origami paper cranes. He makes 5 cranes on the first day. Each day thereafter, the amount he makes will be 3 more than the previous day. After two months (61 days) of making cranes every day, how many total will Samuel have made?

    a. 488
    b. 1464
    c. 5795
    d. 11,713

20. Lucy accumulated $8.75 in coins over the course of a month. When separating her change, she noticed that she had twice as many nickels as pennies, one less dime than nickels, and three more quarters than nickels. How many quarters did she have?

    a. 18
    b. 19
    c. 23
    d. 35

21. Which is an example of the product of a rational number and irrational number being irrational?

    a. $3 \cdot \sqrt[3]{64}$
    b. $\sqrt[3]{8} \cdot 8\pi$
    c. $\sqrt{40} \cdot \sqrt{111}$
    d. $\sqrt{300} \cdot \sqrt{300}$

22. If $f(x)$ is a polynomial function with a degree of 13 and $g(x)$ is a linear function with a slope of π, which function will cross the y-axis more times?

    a. $f(x)$ crosses the y-axis more.
    b. $g(x)$ crosses the y-axis more.
    c. Neither $f(x)$ nor $g(x)$ cross the y-axis.
    d. Both $f(x)$ and $g(x)$ cross the y-axis an equal number of times

23. Which of the following functions will eventually surpass the others as x increases towards positive infinity?

    a. $f(x) = x^{100}$
    b. $g(x) = 100^x$
    c. $h(x) = 100x$
    d. $k(x) = x^{100}+100x$

24. Using the graph of $f(x) = x^2$, the following translations are made:

    (1) Reflect the graph of *f(x)* over the x-axis,
    (2) vertical translation up by $\frac{3}{5}$ units,
    (3) and horizontal translation left by 2 units.

    Which of the following functions, *g(x)*, would be the result?

    a. $g(x) = (x-2)^2 + \frac{3}{5}$
    b. $g(x) = -(x+2)^2 - \frac{3}{5}$
    c. $g(x) = -(x+2)^2 + \frac{3}{5}$
    d. $g(x) = (-x-2)^2 - \frac{3}{5}$

25. After 2.5 hours of driving at a constant speed, you have traveled 175 miles. If you increase your speed by 5%, how far will you travel in the next 2.5 hours? If needed, round your answer to the hundredth decimal place.

    a. 166.25 miles
    b. 166.75 miles
    c. 183.25 miles
    d. 183.75 miles

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Tiebreaker #1

Arkansas Tech University has formed a blue ribbon committee to determine the parking needs on campus. They have decided that when the campus population reaches 14,000 students they will need to upgrade the parking facilities and increase the classroom and dormitory facilities. The committee has the student population for the following terms.

Year, x	2006, 1	2008, 3	2010, 5	2012, 7	2014, 9
Number of Students	7,038	7,492	9,515	10,950	12,002

a. Use above data, with x = 0, construct a line of best fit. Write the equation in the space below.

b. Determine the fall semester in which the student population will reach or exceed 14,000 students.

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Tiebreaker #2

David wants to build the largest possible rectangular open box from a piece of 4' by 8' aluminum sheet. The box is to be constructed by cutting a square notch of length x out of each corner. Then, the aluminum sheet will be folded at the edges and the seams wielded.

A. State the domain of the volume function and justify your answer.

B. Write a function $V(x)$ that can be used to determine the volume of the box.

C. Find the dimensions of the box that maximize the volume.

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Tiebreaker #3

Marsha needs to buy t-shirts with the league's logo for her Community softball league. There are three companies that she is considering.

Sarah's Shirts	Mike's Custom Sports	K&K's Sporting Goods
		
$17 per shirt and an additional $400 for a custom logo	$26 per shirt and an additional $175 for a custom logo	$40 per shirt and no additional fee for custom logos

A. Write a linear model for buying x number of shirts from each company.

B. Sketch a graph representing the cost for each linear model from part 1. Show on the graph how many shirts must be purchased for Sarah's shirts to be the cheapest option.

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Multiple Choice Answers

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

Tie Breakers

1. a. $f(x) = 669.3x + 6052.9$
   b. In 2017 (year 12) there will be more than 14,000 students.

2. a. domain: $0 < x < 2$
   b. $V(x) = (x)(4 - 2x)(8 - 2x)$ or $4x^3 - 24x^2 + 32x$
   c. 0.85ft. x 2.3ft. x 6.3ft.

3. a. Sarah's: $f(x) = 17x + 400$
      Mike's: $g(x) = 26x + 175$
      K&K's: $h(x) = 40x$
   b. x > 25