

Arkansas Council of Teachers of Mathematics
2017 Regional Exam for Algebra I

For questions 1- 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, then #3). Be sure that your name is printed on each of the tiebreaker pages.

1. For which value of a will the solution of $f(a)$ be irrational? $f(a) = a\sqrt{2}$

a. $\sqrt{2}$ b. $\sqrt{3}$ c. $\sqrt{8}$ d. $\frac{1}{\sqrt{2}}$

2. The first three terms in a geometric sequence are shown below. What is the sixth term in the sequence?

4, -6, 9, ...

a. -45.5625 b. -30.375 c. -18 d. 45.5625

3. Which shows the correct method for finding $\frac{a}{c} - \frac{b}{d}$?

a. $\frac{a-b}{c-d}$ b. $\frac{a-b}{cd}$ c. $\frac{ad-bc}{cd}$ d. $\frac{ac-bd}{cd}$

4. After getting his wisdom teeth pulled, Matt was prescribed 60mg of pain pills to be taken every 4 hours for 5 days. The pharmacy only has 30 mg pills. How many pills should Matt receive when filling the prescription?

a. 20 b. 30 c. 40 d. 60

5. Simplify $\frac{1}{3} \left(\frac{x^{-1}y^{-1}}{3x^2y^3} \right)^{-2}$

a. $\frac{1}{x^3y^4}$ b. $\frac{3}{x^4y^{12}}$ c. $\frac{x^6y^8}{9}$ d. $3x^6y^8$

6. Simplify $x + \left[\sqrt[3]{\frac{8x^3}{y^4} \left(\frac{5x}{z} * \frac{y(z-1)}{10} \right)} \right]^0 + 4x - 9$

a. $5x + \frac{x^2(z-1)}{yz} \sqrt[3]{y^2} - 9$ b. $5x - 9$ c. $5x - 8$ d. Cannot be simplified

7. Simplify $\frac{9x^2 - 39x + 36}{3x^2 - 27}$

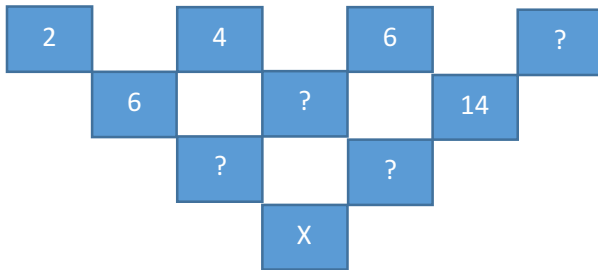
a. $\frac{3x-4}{x+3}$

b. $\frac{3x^2 - 13x + 12}{x^2 - 9}$

c. $\frac{(3x-4)(3x-9)}{(3x+9)(x-3)}$

d. $\frac{3x-4}{x-3}$

8. Which of the following could be a solution for X in the diagram below?



a.) 14

b. 40

c. 54

d. There is not enough information

9. Find $f(2)$ when $f(x) = \left(\frac{1}{a}\right)^{-x}$ for $0 < a < 1$.

a.) a^2

b. -2^x

c. $-\frac{1}{2}$

d. $-\frac{1}{a^2}$

10. What is the domain of $g(x) = \begin{cases} \frac{10}{(x-9)(x+9)} & \text{if } x \neq -1 \\ -1 & \text{if } x = -1 \end{cases}$

a. $\{x \in \mathfrak{R} \mid x \neq \pm 9\}$

b. $\{x \in \mathfrak{R} \mid x \neq -0.8 \text{ or } x \neq -1\}$

c. $\{x \in \mathfrak{R} \mid x \neq \pm 9 \text{ or } x \neq -1\}$

d. $\{x \in \mathfrak{R} \mid x \neq -1\}$

11. Order the following from least to greatest when $a = 3$ and $b = \frac{1}{2}$

$$a\pi \qquad 14b - 20\sqrt{4} \qquad 12b + \sqrt{36} \qquad 8ab - \frac{a}{b}$$

- a. $14b - 20\sqrt{4}$, $a\pi$, $8ab - \frac{a}{b}$, $12b + \sqrt{36}$
 b. $8ab - \frac{a}{b}$, $12b + \sqrt{36}$, $a\pi$, $14b - 20\sqrt{4}$
 c. $14b - 20\sqrt{4}$, $8ab - \frac{a}{b}$, $a\pi$, $12b + \sqrt{36}$
 d. $a\pi$, $12b + \sqrt{36}$, $8ab - \frac{a}{b}$, $14b - 20\sqrt{4}$
12. Which of the following equations is equivalent to $x^2 + 8x - 9 - (11x^2 - 4x + 7) = 0$
- a. $-10x^2 + 12x - 2 = 0$
 b. $10x^2 - 12x + 16 = 0$
 c. $-10x^2 + 4x - 2 = 0$
 d. $-10x^2 + 12x + 16 = 0$
13. Cherie likes to go rock climbing. One day, she starts at an altitude of 286 feet and begins climbing at a rate of 7 feet per minute. She then stops her climb at an altitude of 503 feet. Which equation could be solved to find the number of minutes, x , that Cherie spent climbing?
- a. $503 + 7x = 286$
 b. $286 - 7x = 503$
 c. $286x + 7 = 503$
 d. $286 + 7x = 503$
14. Which statement about the graph of the equation $f(x) = e^x$ is *not* true?
- a.) The graph of $f(x)$ is asymptotic to the x-axis.
 b.) The domain is the set of all real numbers.
 c.) The graph of $f(x)$ lies in Quadrants I and II
 d.) The graph of $f(x)$ passes through the point $(e, 1)$.
15. A student scored 83 and 91 on her first two quizzes. Write and solve a compound inequality to find the possible values for a third quiz score n that would give her an average between 85 and 90, inclusive.
- a. $73 \geq n \geq 94$
 b. $81 \geq n \geq 96$
 c. $73 \leq n \leq 94$
 d. $81 \leq n \leq 96$

16. Copacabana Beach in Rio de Janeiro is one of the most popular beaches in the world. $P(t)$ models the number of people at the beach, t hours past midnight on a specific day. **What does the statement $P(10) = N$ mean?**

- There was an equal number of people at the beach at 10:00 a.m. and at N hours past midnight.
- There were 10 people at the beach at N hours past midnight.
- There were N people at the beach at 10:00 a.m.
- There was no one at the beach at N hours past midnight.

17. Which function table does **not** show a linear relationship between x and y ?

a.

x	10	20	30	40	50
y	10	20	30	40	50

b.

x	10	20	30	40	50
y	20	30	40	50	60

c.

x	10	20	30	40	50
y	10	30	70	130	210

d.

x	10	20	30	40	50
y	1	2	3	4	5

18. Which of the following is the recursive formula for $f(n) = -11 + 22(n - 1)$?

- $f(n) = f(n - 1) + 22$
- $f(n) = f(n - 1) + 11$
- $f(n) = f(n - 1) - 22$
- $f(n) = f(n - 1) - 11$

19. The number of points scored by a basketball player in the first eight games of a season are shown below.

15, 35, 18, 30, 25, 21, 32, 16

What would happen to the data distribution if she scored 24, 22, 27, and 28 points in her next four games?

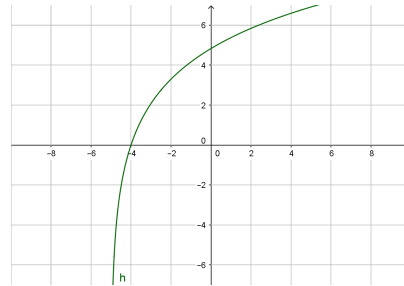
- The data distribution would become less peaked and more widely spread.
- The data distribution would become less peaked and the spread would be unchanged.
- The data distribution would become more peaked and less widely spread.
- The data distribution would become more peaked and more widely spread.

20. f is a function defined on all real numbers. Its formula is given below.
 g is a function defined on all integers between $[-2,2]$. Its values are given in the table below.
 h is a function defined on all real numbers greater than -5 . Its graph is given below.

Which function has no x -intercepts?

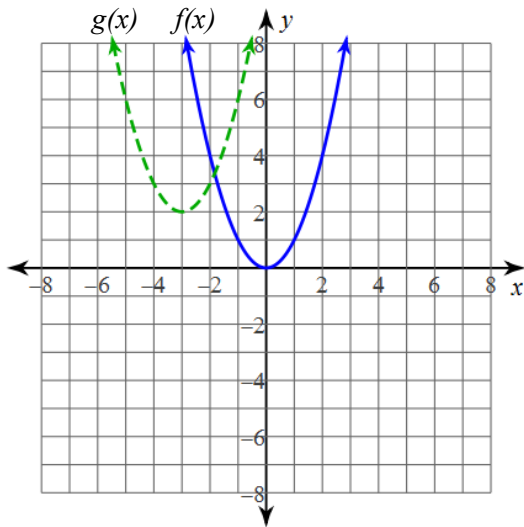
$$f(x) = x(x + 4)$$

x	-2	-1	0	1	2
$g(x)$	2	3	-1	-2	-3



- a. $f(x)$ b. $g(x)$ c. $h(x)$ d. All of the functions have at least one x -intercept.

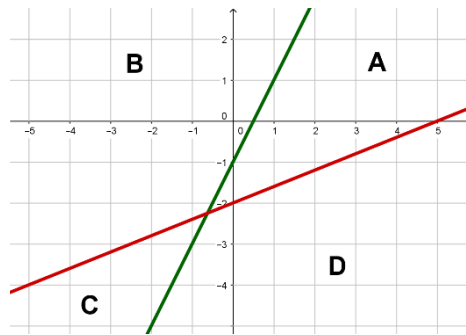
21. Write $g(x)$ in terms of $f(x)$.



- a. $g(x) = f(x + 3) + 2$
 b. $g(x) = f(x - 3) + 2$
 c. $g(x) = f(x + 2) + 3$
 d. None of these.
22. Which statement about the graph of the equation $f(x) = -\left(\frac{1}{a}\right)^{-x}$ is true for $0 < a < 1$?
- a.) $f(x)$ is an increasing function with a range of $(0, \infty)$.
 b.) $f(x)$ is a decreasing function with a range of $(0, \infty)$.
 c.) $f(x)$ is an increasing function with a range of $(-\infty, 0)$.
 d.) $f(x)$ is a decreasing function with a range of $(-\infty, 0)$.

23. Which region of the graph should be shaded to represent the solution to this system of inequalities?

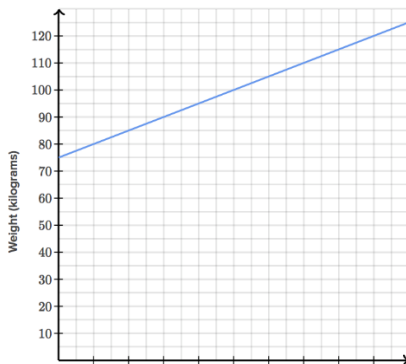
$$\begin{cases} 2x - 5y \geq 10 \\ 2x \leq y + 1 \end{cases}$$



- a. Region A
- b. Region B
- c. Region C
- d. Region D

24. Two young sumo wrestlers decided to go on a special diet to gain weight rapidly. They each gained weight at a constant rate.

The graph of the weight (in kilograms) of the first wrestler as a function of time (in months) is shown below.



Time (months)	Weight (kilograms)
3	95
4.5	101.75
6	108.5

The weight (in kilograms) of the second wrestler as a function of time (in months) is given in the table above.

Which wrestler weighed more at the beginning of the diet?

- a. The first wrestler.
- b. The second wrestler.
- c. The wrestlers weighed the same.
- d. There is not enough information.

25. Which of the two wrestlers from problem 24 gained weight faster?

- a. The first wrestler.
- b. The second wrestler.
- c. The wrestlers gained weight at the same rate.
- d. There is not enough information.

Tie Breaker Questions

Name: _____

Reminder: Attempt the tie-breaker questions in sequential order (Do #1 first, followed by #2, and then #3 last). Be sure that your name is printed on each of the tiebreaker pages.

1. **Part A.** Consider the linear function $f(x) = 5x + 20$. What is the domain and range of this function? Use interval notation.

Domain: _____ Range: _____

Part B. Now, suppose the function $G(x) = 5x + 20$ represents the relationship between study time and grade percentage (without bonus) on an exam. The variable x represents the number of hours spent studying for the exam and $G(x)$ represents the grade on the exam. Does this change the domain and/or range? If so, what is the domain and/or range implied by $G(x)$? Use interval notation.

Domain: _____ Range: _____

Justify your answers.

2. Tonya is an interior designer and creates custom furniture and décor for her customers. She has a client that needs a rectangular rug with an area of 21 square feet. The rug is 4 feet longer than it is wide.

Part A. Create an equation in terms of length that can be used to help Tonya determine the dimensions of the rug. What size should the rug be? Justify your answer.

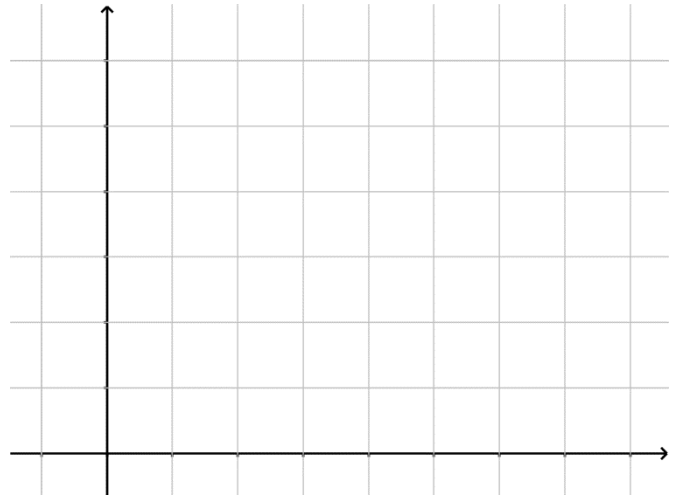
Part B. Tonya needs to make an alteration to the rug and adds a 1.5-foot border all the way around it. What are the dimensions and the area of the new, enlarged rug? Show all work.

Tie Breaker Questions

Name: _____

3. The power of personal computers has increased drastically as a result of the ability to place an increasing number of transistors on a single processor chip. The following table lists the number of transistors on some popular computer chips made by Intel.
- a. Let t be the year, where $t = 0$ corresponds to 1985, and y be the number of transistors (in millions). Use a graphing calculator to plot the data. Determine an appropriate scale and label axes.

Year	Chip	Transistors
1985	386	0.275
1989	486	1.2
1993	Pentium	3.1
1997	Pentium II	7.5
2000	Pentium 4	42
2005	Pentium D	291
2007	Penryn	820
2009	Nehalem	1900



- b. Create a linear $L(x)$, a quadratic $Q(x)$, and an exponential $E(x)$ regression function to model this data. Round to three decimal places when recording answers. Record any other information needed to determine the best fitting model for this data.
- c. Sketch and label these functions on the scatterplot from part a.
- d. Which function best models the data? Justify your answer.
- e. Use the best-fitting function from part d to predict the expected number of transistors on a chip in the year 2018.

Multiple Choice Answer Key:

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

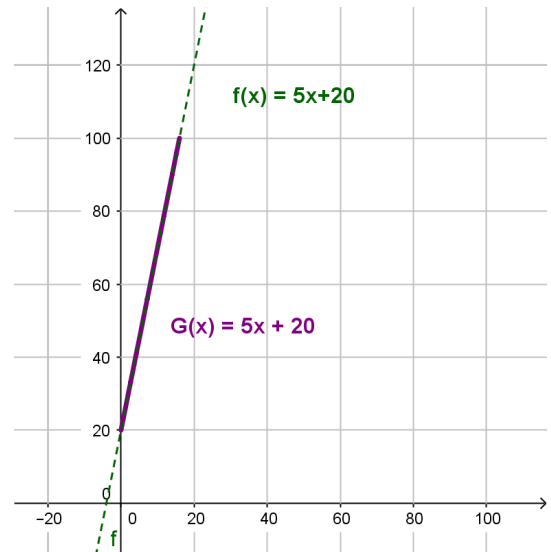
Tie Breaker Answer Key:

1. Part A. Domain: $(-\infty, \infty)$ Range: $(-\infty, \infty)$

Part B. Domain: $[0, 16]$ Range: $[20, 100]$

Since $G(x)$ is an application problem the domain and range are limited. The x variable represents time. Students will not be studying a negative number of hours, therefore $x \geq 0$.

Since $G(0) = 20$ and the highest percentage grade possible is 100, the range is limited to scores between 20 and 100 (according to the indicated model).



Since the function is linear and the maximum score is 100, when $G(x) = 100$, the x value is 16.

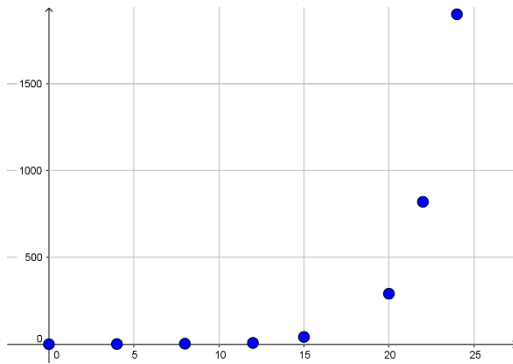
2. A. $A(L) = L(L - 4)$ or $A(L) = L^2 - 4L$

Tonya should create a rug with a length of 7 feet and a width of 3 feet.

B. The new rug will have a length of 10 feet and a width of 6 feet. The area of the new rug will be 60 square feet.

Tie Breaker Answer Key:

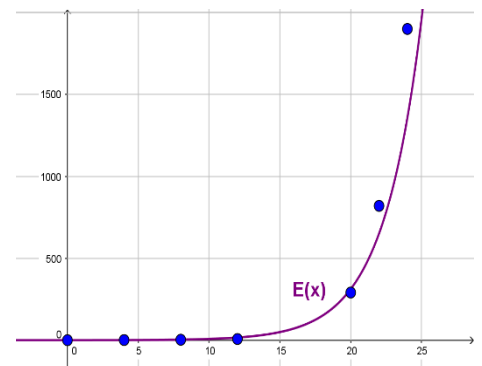
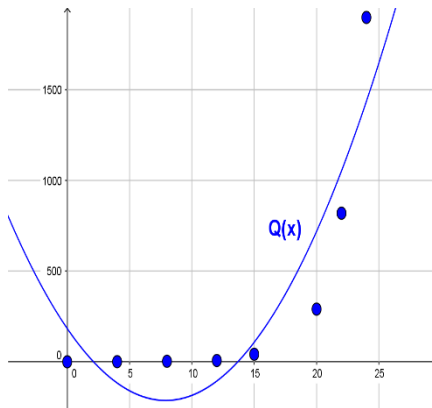
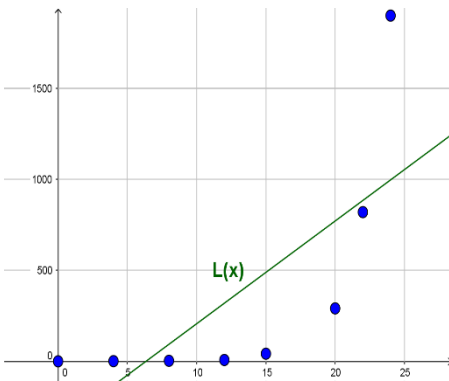
3. a.



Students may choose to draw the graph on a different scale.

b.	$L(x) = 56.474x - 358.083$	$r^2 = .5300$	$r = .7280$
	$Q(x) = 6.363x^2 - 100.475x + 183.600$	$R^2 = .8237$	
	$E(x) = 0.201(1.444)^x$	$r^2 = .9854$	$r = .9927$

c.



d. The function that best represents the scatterplot given is the exponential function.

The coefficient of determination for the exponential function is much closer to 1 compared to the other functions.

e. $x = 33$ corresponds to the year 2018

$E(33) = 37,060.684$ (Using the equation with the rounded values.)

$E(33) = 36,650.989$ (Using the regression equation.)

Provided the number of resistors placed on a single processor chip continues to grow at the same rate, we would expect there to be approximately 37,000 resistors on a chip in the year 2018.