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 sequence order (do #1 first, followed by #2, then #3). Be sure that your name is printed on each of the tiebreaker pages.

1. Which system of inequalities best represents the graph shown below?



2. The data in the table show the cost of renting a bicycle, by the hour, including deposit.

Hours (h)	Cost in dollars (<i>c</i>)
2	15
5	30
8	45

Which of the following is the equation of a line that fits the data?

A.
$$c = 5h$$
 B. $c = \frac{1}{5}h + 5$ **C.** $c = 5h + 5$ **D.** $c = 5h - 5$

3. What is the fourth term of the sequence defined by $a_1 = 3xy^5$ and $a_n = \left(\frac{2x}{y}\right)a_{n-1}$?

A.
$$24x^3y^3$$
 B. $24x^4y^2$ **C.** $24x^2y^4$ **D.** $24x^5y$

- 4. Which is not an equivalent expression to $(12)^{\frac{1}{2}} \left(\frac{1}{7}\right)^{-2x}$?
 - A. $\frac{2(49^x)}{(3)^{-\frac{1}{2}}}$ B. $\frac{(49)^x}{(2\sqrt{3})^{-1}}$ C. $4\sqrt{3}(7)^{2x}$ D. $\sqrt{12}\left(\frac{1}{49}\right)^{-x}$
- 5. Leanne correctly solved the equation $x^2 + 4x = 6$ by completing the square. Which equation is part of her solution?

A.
$$(x + 2)^2 = 10$$
 B. $(x + 2)^2 = 8$ **C**. $(x + 4)^2 = 10$ **D**. $(x + 4)^2 = 22$

- 6. A car depreciates at a rate of 4.5% annually. Greg purchased a car for \$12,500. Which equation can be used to determine the value of the car, *V*, after 5 years?
 - A. $V = 12,500(0.55)^5$ B. $V = 12,500(1.45)^5$ D. $V = 12,500(0.955)^5$

Use the figure below to answer question 7.



- 7. If the perimeter of the triangle is $8x \frac{1}{2}$, what is the length of the third side?
- **A.** $3\frac{2}{3}x + 1$ **B.** $4\frac{1}{3}x + \frac{1}{2}$ **C.** $4\frac{1}{3}x 1\frac{1}{2}$ **D.** $12\frac{2}{3}x + \frac{1}{2}$
- 8. At the beginning of 2016, there were 19 male bunnies and 26 female bunnies in a lab. The bunnies were able to double in population every 9 months. In what year would there be about 9,000 bunnies?
- **A.** 2022 **B.** 2024 **C.** 2026 **D.** 2030
- 9. Which of the following expressions is equal to (x + 2) + (x 2)(2x + 1)?
- A. $2x^2 2x$ B. $2x^2 4x$ C. $2x^2 + x$ D. $4x^2 + 2x$
- 10. Given $x^2 + 5x + 6 = 0$, which one of the answers below is a correct step of solving this equation?

A.
$$(x-2)(x-3) = 0$$
B. $(x+2)(x+3) = 0$ C. $(x-1)(x-6) = 0$ D. $(x+1)(x+6) = 0$

- 11. The relationship between temperature in Celsius and Fahrenheit is represented as $C = \frac{5}{9}(F 32).$ Which of the following correctly solves for F?
- A. $F = \frac{5}{9}C + 32$ B. $F = \frac{5}{9}(C + 32)$ C. $F = \frac{9}{5}C + 32$ D. $F = \frac{9}{5}(C + 32)$
- 12. Solve the inequality: $|x 2| \le 5$
 - **A.** $x \ge -7$ **B.** $-7 \le x \le 3$ **C.** $-3 \le x \le 7$ **D.** $x \le 7$

- 13. Which quadrant will be completely shaded in the graph of the inequality $y \le 2x$?
 - A. Quadrant I B. Quadrant II C. Quadrant III D. Quadrant IV
- 14. An elevator's maximum capacity is 1,800 pounds. If a UPS deliverer weighs 183 pounds, and loads 45-pound boxes on the elevator with him, what is the maximum number of boxes the elevator can carry on one trip?
 - **A.** 30 boxes **B.** 35 boxes **C.** 36 boxes **D.** 44 boxes
- 15. A steamboat travels 8 miles per hour downstream but only 3 miles per hour upstream. It took the steamboat 50 more hours to go upstream than it did to go downstream. Since the distance downstream is equal to the distance upstream, how long did it take to complete the round trip?
 - **A.** 30 hours **B.** 60 hours **C.** 80 hours **D.** 110 hours
- 16. Two functions, y = |x 3| and x = 3y 24, are graphed on the same set of axes. Which statement is true about the solution to the system of equations?
 - A. The system has no solution.
 - **B.** The system has exactly one solution.
 - **C.** The system has exactly two solutions.
 - **D.** The system has infinitely many solutions.
- 17. What is the common ratio of the sequence $\frac{1}{64}a^5b^3$, $-\frac{3}{32}a^3b^4$, $\frac{9}{16}ab^5$, ...?

A.
$$-\frac{3b}{2a^2}$$
 B. $-\frac{6b}{a^2}$ **C.** $-\frac{3a^2}{b}$ **D.** $-\frac{6a^2}{b}$

18. What is the perimeter of the fifth square in this pattern?



- A. 256
 B. 80
 C. 400
 D. 60
- 19. An astronaut drops a rock off the edge of a cliff on the Moon. The distance, d(t), in meters, the rock travels after *t* seconds can be modeled by the function $d(t) = 0.8t^2$. What is the average speed, in meters per second, of the rock between 5 and 10 seconds after it was dropped?
 - A. 12 B. 20 C. 60 D. 80

- 20. Which set of ordered pairs represents y as a function of x?
 - A. $\{(-9, 2), (0, 6), (1, -2), (-3, 6)\}$
 - **B.** $\{(-1, 0), (4, 3), (-7, -3), (-1, -8)\}$
 - C. $\{(3, 2), (-4, -2), (3, 1), (-4, 1)\}$
 - **D.** $\{(5, 4), (2, 3), (1,1), (2, 4)\}$
- 21. The graph below shows a line of regression that represents Olivia's lunch budget based on the number of days her lunch money lasts.



If Olivia spends \$25 on lunch each school week, what should the increments of the y-scale be?



22. Angela is booking a room at an indoor banquet hall. The diagram below shows the dimensions of the room she wants.



Which of the following is most useful in planning for how many people to invite?

- A. Average volume needed per person
- **B.** Average area needed per person
- C. Average height of each person
- **D.** Average weight of each person

- 23. The Merkland Weather Bureau calculated that a total of 12 ¹/₂ inches of precipitation fell in Merkland in the past 30 days. The total is the sum of three measurements, each rounded to the nearest ¹/₄ inch. What is the least amount of rain that could have actually fallen in the past 30 days?
 - **A.** 11³/₄ in **B.** 12¹/₄ in **C.** 12 $\frac{1}{8}$ in **D.** 13 $\frac{1}{8}$ in
- 24. Edwin is planning to build a basement. He has not yet decided how long to make the walls, but he knows how he wants the lengths of the walls to relate to each other, as shown below (left). Which equation can Edwin use to analyze the area of the basemen depending on how long he chooses to make the western wall?



- 25. The manager electronically records the time it takes to check out a customer and the number of items scanned in each transaction. Suzanne plotted her data and found that the function y = 24.3x 13.3 models the data where x is the time in minutes and y is the number of items. What does the slope of the function represent in the context of the situation?
 - A. The average number of items in each transaction.
 - **B.** The average number of items Suzanne scans per minute.
 - C. The average time spent on a transaction.
 - **D.** The average time spent per item.

Name : _____

Open Response #1

Room	Mariah	Catherine
Bedroom 1	$4x^2 - 3x$	2 <i>x</i> ²
Bedroom 2	2x - 1	-2x + 4
Living Room	$x^2 - 16$	$x^2 + 16$
Kitchen	$-3x^2 + 4x$	3x + 4x
Bathroom	3x + 5	2x - 5
Total		

The table above shows the floor areas of Mariah and Catherine's apartments.

(a) How much larger is Mariah's apartment than Catherine's?

(b) What are the possible dimensions of Mariah's Living Room? What are some possible dimensions of Catherine's Bedroom 1?

Name : _____

Open Response #2

James Woods High School is throwing a senior prom party for the schools' high school seniors and their guests. The school decides to rent out a ballroom in a downtown hotel. The cost to rent the ballroom is \$1750.49. For the prom event, the school bought the following necessary items:

Item	Cost (\$)
Drinks	1100.39
Food	1236.12
Decorations	323.98
DJ rental	575
Security	823.44
Misc Supplies	236.17

The school invited all 580 seniors the school has, and each senior is allowed to bring up to two guests. By prom night, 471 seniors and 276 guests confirmed to attend the event.

- (a) What is per person unit cost of the items purchased to the number of total invitees confirmed to attend the party? Justify your answer.
- (b) What is the per person cost of the grand total amount the school spent putting together senior prom to the number of invitees who confirmed to attend senior prom? Justify your answer.
- (c) James Woods decides to sell tickets for prom. The ticket price for seniors is \$15 a person while the guests are \$22 a person. Out of the seniors and guests who confirmed to attend, 1/3 of the seniors and 25% of the guests actually attended the prom. How much revenue did the school make on prom night? Justify your answer.
- (d) Assuming all of the invitees confirmed to attend the event actually showed up to senior prom, did the school make a profit from senior prom? Justify your answer.

Name:_____

Open Response #3

1. The baseball team pitcher was asked to participate in a demonstration for his math class. He took a baseball to the edge of the roof of the school building and threw it up into the air at a slight angle so that the ball eventually fell all the way to the ground. The class determined that the motion of the ball from the time it was thrown could be modeled closely by the function

$$h(t) = -16t^2 + 64t + 80,$$

where h(t) represents the height of the ball in feet after t seconds.

- a. Determine whether the function has a maximum value or a minimum value. Explain your answer mathematically.
- b. Find the maximum or minimum value of the function. After how many seconds did the ball reach this value? Show your work.

- c. Evaluate h(0). What does this value tell you (in the context of this problem)?
- d. How long is the ball in the air? Explain your answer.
- e. State the domain of the function in interval notation, and explain the restrictions on the domain based on the context of the problem.

Answer Key

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

25. B

Room	Mariah	Catherine
Bedroom 1	$4x^2 - 3x$	$2x^2$
Bedroom 2	2x - 1	-2x + 4
Living Room	$x^2 - 16$	$x^2 + 16$
Kitchen	$-3x^2 + 4x$	3x + 4x
Bathroom	3x + 5	2x - 5
Total	$2x^2 + 6x - 12$	$3x^2 + 7x + 15$

Open Response #1

(2 points each for Total Mariah Room and Catherine's Room)

The table above shows the floor areas of Mariah and Catherine's apartments.

1. How much larger is Mariah's apartment than Catherine's?

 $-x^2 - x - 27$ (2 points)

2. What are the possible dimensions of Mariah's Living Room?

Length of 1 and width of $x^2 - 16$ Length of $x^2 - 16$ and width of 1 Length of x + 4 and width of x - 4Length of x - 4 and width of x + 4

(4 Points total)

Constructed Response Answer Open Response #2

James Woods High School is throwing a senior prom party for the schools' high school seniors and their guests. The school decides to rent out a ballroom in a downtown hotel. The cost to rent the ballroom is \$1750.49. For the prom event, the school bought the following necessary items:

Item	Cost (\$)
Drinks	1100.39
Food	1236.12
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DJ rental	575
Security	823.44
Misc Supplies	236.17

The school invited all 580 seniors the school has, and each senior is allowed to bring up to two guests. By prom night, 471 seniors and 276 guests confirmed to attend the event.

(a) What is per person unit cost of the items purchased to the number of total invitees confirmed to attend the party? Justify your answer.

(2 Points)

Total number of invitees confirmed: 747 Total cost of items: \$4295.10 Per person unit cost: \$5.75

(b) What is the per person cost of the grand total amount the school spent putting together senior prom to the number of invitees who confirmed to attend senior prom? Justify your answer.

(2 Points)

Cost of venue + *total cost of items* = \$1750.49 + \$4295.10 = \$6045.59 *Per person cost:* \$8.09

(c) James Woods decides to sell tickets for prom. The ticket price for seniors is \$15 a person while the guests are \$22 a person. Out of the seniors and guests who confirmed to attend, 1/3 of the seniors and 25% of the guests actually attended the prom. How much revenue did the school make on prom night? Justify your answer.

(3 Points)

Seniors = 471/3 = 157; Guests = .25(276) = 69Revenue from seniors = 157(\$15) = \$2355Revenue from guests = 69(\$22) = \$1518Total Revenue: \$3873

(d) Assuming all of the invitees confirmed to attend the event actually showed up to senior prom, did the school make a profit from senior prom? Justify your answer.

(3 Points)

Revenue from confirmed seniors = 471(\$15) = \$7065Revenue from confirmed guests = 276(\$22) = \$6072Profit = Total Revenue – Total Cost = \$13,137 - \$6045.59 = \$7091.41If all the confirmed invitees attend, then the school will make a profit of \$7091.41.

Open Response #3

The baseball team pitcher was asked to participate in a demonstration for his math class. He took a baseball to the edge of the roof of the school building and threw it up into the air at a slight angle so that the ball eventually fell all the way to the ground. The class determined that the motion of the ball from the time it was thrown could be modeled closely by the function

$$h(t) = -16t^2 + 64t + 80,$$

where h(t) represents the height of the ball in feet after t seconds.

 a. Determine whether the function has a maximum value or a minimum value. Explain your answer mathematically.
 (1 point)

The function has a maximum because the leading coefficient is negative, making the graph of the function open down.

b. Find the maximum or minimum value of the function. After how many seconds did the ball reach this value? Show how you found your answers.(2 Points)

To find the zeros of the function, we factor as follows:

 $-16(t^2 - 4t - 5) = -16(t - 5)(t + 1) = 0.$

So, t = -1 or 5. Therefore, the t-coordinate of the vertex is t = $\frac{-1+5}{2} = 2$.

If we substitute 2 for t into the original function, we find that the vertex is at (2, 144); this tells us that the maximum height is 144 ft., which occurs at 2 seconds.

c. Evaluate h(0). What does this value tell you? Explain in the context of the problem.
(2 Points)

h(0) = 80. This is the initial height, the height at which the ball was when it was thrown upward. The roof was 80 ft. high.

d. How long is the ball in the air? Explain your answer.(2 Points)

The ball is in the air for 5 seconds. When t = 0, the ball is released. When t = 5, the height is 0, which means the ball hits the ground 5 seconds after it is thrown.

e. State the domain of the function, and explain the restrictions on the domain based on the context of the problem.
(3 Points)

We consider the experiment over at the time the ball reaches the ground, so it must be less than or equal to 5. Additionally, the values for t as described in this context must be greater than or equal to 0 because time began when the ball was thrown. t: $\{0 \le t \le 5\}$