

TEST NAME: **BF.1**  
TEST ID: **439382**  
GRADE: **09**  
SUBJECT: **Mathematics**  
TEST CATEGORY: **My Classroom**

Student: \_\_\_\_\_

Class: \_\_\_\_\_

Date: \_\_\_\_\_

Read the passage - 'Going to a Baseball Game' - and answer the question below:

**Going to a Baseball Game**

Going to a Baseball Game

Chris is a big fan of the baseball team in the city where she lives, and she loves to go to the games with her family. Chris and her dad are planning a trip to a game for four people. He asked her to determine how much it will cost for their tickets and snacks at the game. Chris's dad thinks they may go to several games this year.

They chose the section of the park where they wanted to sit, and Chris found the prices for seats in that section. She found three ways to buy the tickets.

- Individual game tickets for the section they chose are \$30 per ticket.
- The cost of a 21-game package of tickets for one seat in their section is \$20 per game.
- A package of 10 tickets costs \$200, and they can be used in any combination of single tickets per game or multiple tickets per game in their section.

Chris thinks they will each want a hot dog and a soft drink, and two people can share a bag of peanuts. This table shows the cost of those items at the game.

<b>FOOD COSTS</b>	
<b>Food Item</b>	<b>Cost</b>
Hot dog	\$6.00
Soft drink	\$4.50
Peanuts	\$5.00

An additional cost will be the \$20 charge at the parking lot.

1. Read "Going to a Baseball Game" and answer the question.

Which expression represents the difference between purchasing 4 "individual game tickets" for  $x$  games and using 4 tickets per game from a "package of 10 tickets" plan for  $x$  games?

A.  $D(x) = 4\left(\frac{20}{x}\right) - 4\left(\frac{30}{x}\right)$

B.  $D(x) = 4\left(\frac{30}{x}\right) - 4\left(\frac{20}{x}\right)$

C.  $D(x) = 4(20x) - 4(30x)$

D.  $D(x) = 4(30x) - 4(20x)$

Read the passage - 'Flagstone Pathways' - and answer the question below:

### Flagstone Pathways

#### Flagstone Pathways

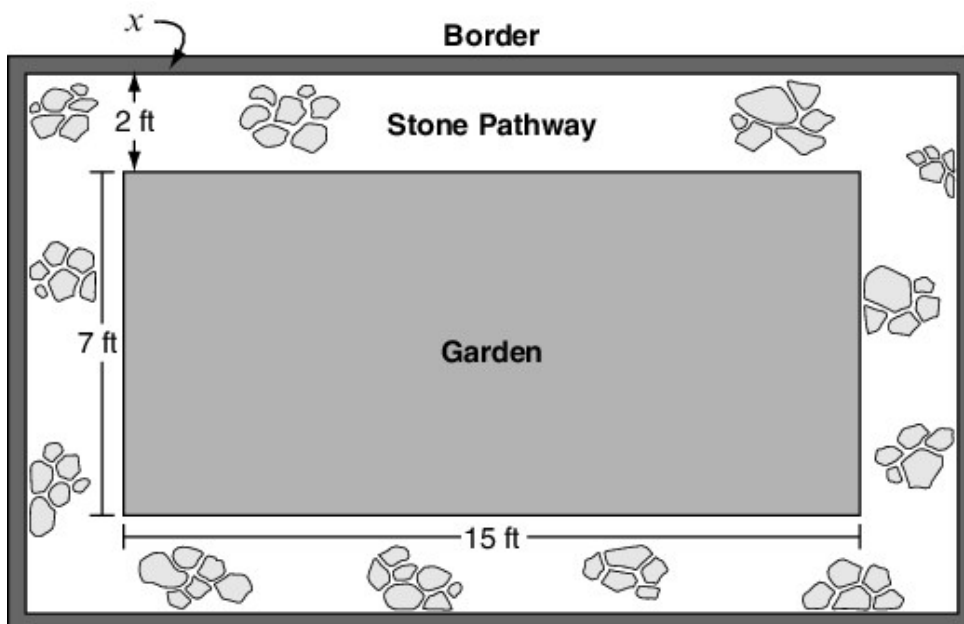
Bill's Landscaping is a local company that offers several services for families in the area, such as planning and building gardens; constructing pathways in yards, gardens, and pools; and maintaining landscaped areas.

Bill's Landscaping would like to be sure that the price it is charging per square foot of flagstone pathway is competitive in the local landscaping market and yields the maximum profit. Currently, the company charges \$18 per square foot of pathway laid. At this price, it brings in about 2,400 square feet of pathway work from customers each month.

However, the owners are thinking of decreasing the price charged per square foot to be more competitive. Using information about the local landscaping market, they have determined that for every \$1 decrease in price per square foot, the amount of work brought in by customer requests for flagstone pathways will increase by 200 square feet monthly.

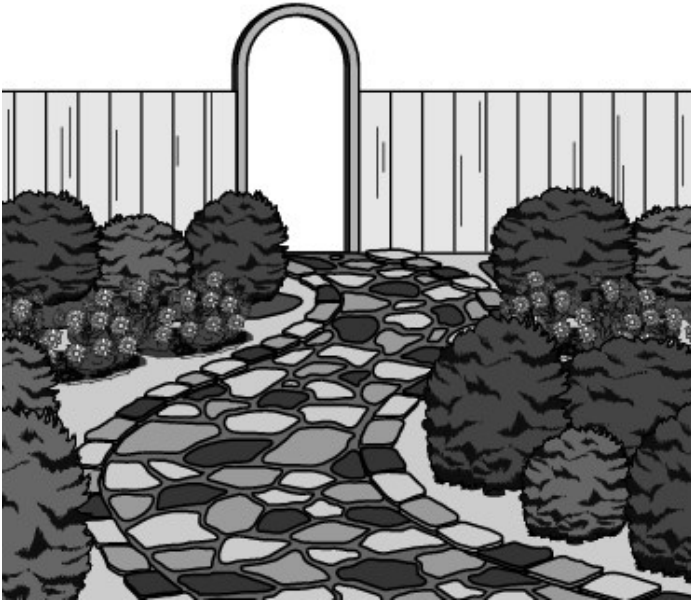
The Johnsons, a family living in the area, are considering hiring a company to help them build a garden. The garden will be rectangular in shape and will be surrounded by a stone pathway of uniform width throughout.

The Johnsons have heard that Bill's Landscaping is the most reliable company around but can be expensive at times. They must take this into consideration when determining the width (overall area) of the pathway. Mr. Johnson thinks that the walkable portion of the pathway should be at least 2 feet (ft) in width. Mrs. Johnson would like to have a decorative border around the pathway that will increase the width slightly. The diagram below shows the Johnsons' vision for the garden, where  $x$  represents the width of the decorative border that Mrs. Johnson would like to have.



The Johnsons are not the only family in the community that is hiring a

landscaping company to help with constructing garden pathways. Recently, there has been a lot of interest in stone pathways, particularly using flagstone, in garden and backyard areas. Flagstone is a flat stone slab that comes in several different natural colors and is often irregularly shaped, although it can also be square or rectangular. The stone is used to make natural-looking pathways in backyards and other landscaping projects. The picture below shows a typical flagstone pathway.



The Johnsons have heard about the possible decrease in prices at Bill's Landscaping. They hope that this reduction in prices will allow them to hire Bill's to construct a flagstone pathway around their garden and still have enough in their budget to include a decorative border.

2. Read “Flagstone Pathways” and answer the questions.

In order for Bill’s Landscaping Company to determine the price at which its profits for flagstone pathways will be maximized, the owners must first come up with a function to represent the total monthly revenue brought in by the pathways,  $R(x)$ , in terms of the amount of pathway work per month in square feet,  $x$ . Then, they must also determine a function to represent the monthly profits from building flagstone pathways,  $P(x)$ . The general format for these functions is shown below.

$$R(x) = \text{price} \times \text{number of units sold}$$

$$P(x) = \text{revenue} - \text{cost}$$

Part A. The price function is part of the revenue function. It is a linear function with an equation of the form  $y = mx + b$ , in which  $y$  is the price per unit and  $x$  is the number of units sold at that price. Using the information in the passage about the current price per square foot and the number of square feet sold when the price is decreased, write a price function,  $g(x)$ , to represent the relationship between the price and the number of square feet of pathway work brought in from customers each month at Bill’s Landscaping Company.

Part B. Using the general format for a revenue function and  $g(x)$ , write a function,  $R(x)$ , to represent the revenue for Bill’s Landscaping Company in terms of the number of square feet of work brought in monthly,  $x$ .

Part C. The total monthly costs for Bill’s Landscaping Company to build flagstone pathways can be determined using a linear function. This cost function can be represented by an equation of the form  $y = mx + b$ , in which  $y$  is the total monthly cost in dollars and  $x$  is the number of square feet of pathway work done. For building flagstone pathways, Bill’s Landscaping Company has fixed costs of \$12,000 per month and variable costs (that depend on the number of square feet of work done) of \$3 per square foot. Write the cost function,  $c(x)$ , to represent the total monthly costs for Bill’s Landscaping Company to build flagstone pathways.

Part D. Using the information above, write a profit function,  $P(x)$ , that represents the monthly profit that Bill’s Landscaping Company makes from building flagstone pathways in terms of the number of square feet of work brought in monthly,  $x$ . What will be the maximum profit that Bill’s Landscaping Company can make on flagstone pathways per month?

Use words, numbers, and/or pictures to show your work.

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3. The first term of a sequence is 13. Each term in the sequence is 12 more than the previous term. Which explicit equation can be used to determine the  $n$ th term in the sequence?
- A.  $a_n = n + 12$
  - B.  $a_n = 12n + 1$
  - C.  $a_n = 12n + 13$
  - D.  $a_n = 13n$
4. Which of the following expressions represents the sequence 1, 3, 5, 7, ... written explicitly for  $n = 1, 2, 3, \dots$ ?
- A.  $n + 1$
  - B.  $n + 2$
  - C.  $2n - 1$
  - D.  $2n + 1$
5. The number of cows a farmer has can be modeled by an arithmetic sequence. The 2nd, 5th and 7th terms in that sequence are 30, 39, and 45, respectively. How many cows did the farmer begin with?
- A. 21
  - B. 24
  - C. 27
  - D. 30
6. A sequence is shown below.
- $-1.5, -1.25, -1, -0.75, \dots$
- Which explicit expression can be used to determine the value of the  $n$ th number in the sequence?
- A.  $a_n = 0.25n - 1.75$
  - B.  $a_n = n + 0.25$
  - C.  $a_n = n - 2.5$
  - D.  $a_n = -1.5n$

7. Albert deposits \$320 in a savings account at the beginning of the year. He deposits an additional \$60 every month. Write a recursive expression, where  $A_0 = 320$  and  $n \geq 1$ , that can be used to represent the amount,  $A_n$ , in Albert's account after  $n$  months.

8. A sequence is shown below.

-20, -17, -14, -11, -8, . . .

Which explicit equation could be used to determine the value of the  $n$ th term in the sequence?

- A.  $a_n = n + 3$
- B.  $a_n = 3n - 23$
- C.  $a_n = n - 23$
- D.  $a_n = -3n + 23$
9. A plane is at a height of 30,000 feet above the ground when it begins to descend at a rate of 1,500 feet per minute. If  $H_0 = 30000$  and  $n \geq 1$ , write a recursive formula that can be used to determine the height of the plane above the ground after  $n$  number of minutes.
10. A 20-gram sample of uranium is decaying at a constant rate. After 5 days there are 19.6 grams of the uranium remaining. After 10 days there are 19.2 grams remaining. **About** how much of the sample remains after 30 days?
- A. 2.4 grams
- B. 5.9 grams
- C. 16.8 grams
- D. 17.7 grams

11. An athlete is training to run a marathon. She plans to run 2 miles the first week. She increases the distance by 8% each week. Which function models how far she will run in the  $n$ th week?

A.  $t(n) = 1.08(2)^n$

B.  $t(n) = 2(1.08)^n$

C.  $t(n) = 1.08(2)^{n-1}$

D.  $t(n) = 2(1.08)^{n-1}$

12. The function  $f(x) = p \cdot q^x$  is an exponential growth function with an asymptote of  $y = 0$ . The function  $g(x) = 17 + r \cdot s^{-x}$  is an exponential decay function with an asymptote of  $y = 17$ . The graphs of  $f$  and  $g$  intersect at the points  $(-2, 1)$  and  $(2, 16)$ , and  $(g - f)(1) = 7$ . What is  $(g - f)(3)$ ?

A.  $-47.25$

B.  $-15.5$

C.  $-7$

D.  $-4.5$



13. A tank that was filled with water started leaking at time  $t_0$ . The table below shows the number of gallons left in the tank after different periods of time.

Time (in hours)	Volume (in gallons)
4	526
6	519
12	498
20	470

**Part A.** How can you determine the rate at which the water is leaking? Find the rate and determine whether or not it is constant.

**Part B.** How much water was in the tank at  $t_0$ ? Use this information and the rate from part A to write an equation for  $t_n$  giving the volume of water in the tank  $n$  hours after it started leaking.

Use words, numbers, and/or pictures to show your work.

14. Sarah purchased a manufacturing machine worth \$30,000 for her factory. The value of the machine decreases every year by \$1,250. Which explicit equation represents the value,  $v$ , of the machine  $t$  years after the purchase?
- A.  $v = 30,000t - 1,250$
  - B.  $v = 30,000 - 1,250t$
  - C.  $v = 30,000 - 1,250 - t$
  - D.  $v = 30,000 - 1,250 + t$
15. The sum of the interior angles of a three-sided polygon is  $180^\circ$ . The sum of the interior angles of a four-sided polygon is  $360^\circ$ . The sum of the interior angles of a five-sided polygon is  $540^\circ$ . What is the sum of the interior angles of a polygon with 12 sides?
- A.  $1,440^\circ$
  - B.  $1,620^\circ$
  - C.  $1,800^\circ$
  - D.  $2,160^\circ$

16. A theater has 22 seats in the first row, 25 seats in the second row, 28 seats in the third row, and so on. How many seats are in the fifteenth row?
- A. 64 seats
  - B. 67 seats
  - C. 350 seats
  - D. 375 seats

17. Joe wants to sell his old car and an old set of furniture. He decides to assess their value by writing functions to represent their values after  $x$  years.

Part A. He bought the car for \$10,000 and it has depreciated at a rate of 6% every year. Write an explicit function to determine the value of the car after  $x$  number of years.

Part B: Write a recursive formula for the value of the car after  $x$  number of years. Make sure to define the variables used and the domain for the formula.

Part C. The value of the furniture over a period of 3 years is listed below.

Number of Years after Purchase	Furniture Value (in dollars)
3	4500
5	3500
8	2000

Write an explicit function for the value of the furniture for  $x$  number of years.

Part D. Write a recursive formula for the value of the furniture after  $x$  number of years. Make sure to define the variables used and the domain for the formula.

Use words, numbers, and/or pictures to show your work.

18. Which context **best** matches the recursive equation  $\text{NEXT} = \text{NOW} + 5$ ?

- A the population of sea bass in 5 year's time
- B the speed of a bike traveling at 5 miles per hour
- C the number of students at a basketball game, increasing by 5 students every minute
- D the time it takes a person to run a marathon, decreasing by 5 minutes each marathon

19. A population of rabbits doubles in size every 6 months. There were initially 5 rabbits in the population. How many rabbits will be in the population after 4 years?

- A 400 rabbits
- B 1,280 rabbits
- C 2,540 rabbits
- D 5,000 rabbits

20. Mr. Alvarez invested an initial amount of \$3,000 in an account that earns 1.1% interest compounded annually. Which recursive function describes the value of the account,  $A_n$ ?

- A  $A_1 = 1.1$   
 $A_n = 3,000 + A_{n-1}$
- B  $A_1 = 1.1$   
 $A_n = 3,000 \cdot A_{n-1}$
- C  $A_1 = 3,000$   
 $A_n = 1.011 + A_{n-1}$
- D  $A_1 = 3,000$   
 $A_n = 1.011 \cdot A_{n-1}$

21. The Rodriguez family plans to build a pyramid of firewood for use in the fireplace. At the very top of the pyramid (the first row), they have only one piece of wood. In the next row they have three pieces of wood and they continue by placing two more pieces of wood in each succeeding row. If each piece of wood is \$1.50, which explicit function expresses the cost,  $C(n)$ , of the firewood as a function of the number of rows in the pyramid,  $n$ ?
- A.  $C(n) = 1.50(2n - 1)$
  - B.  $C(n) = 2n - 1$
  - C.  $C(n) = 1.50n^2$
  - D.  $C(n) = n^2$
22. A student is creating an art project that requires a 180-degree angle to be cut in half. Each of those angles are then cut in half. This is repeated a total of 9 times. What is the smallest **approximate** angle measure created?
- A.  $0.35^\circ$
  - B.  $0.70^\circ$
  - C.  $20^\circ$
  - D.  $90^\circ$
23. What is the 4th term in the sequence modeled by the recursive formula  $\text{NEXT} = 2 \cdot \text{NOW} + 5$  if the first term is equal to 5?
- A. 15
  - B. 35
  - C. 60
  - D. 75

24. Jessie deposited \$6,000 in a savings account. The amount in the account after 1, 2, and 3 years is shown below.

\$6,240, \$6,480, \$6,720, ...

Which expression represents the total amount in her account at the end of  $t$  years?

- A.  $6000 + 240t$
  - B.  $6240 + 240t$
  - C.  $6000t + 240$
  - D.  $6240t + 240$
25. Four friends attempted to write the explicit expression for the  $n$ th term of the sequence 2, 5, 10, 17, ...

Name	Function
Austin	$(n + 1)^2 + 1$
Kaylee	$3n - 1$
Noah	$n^2 + 1$
Zoey	$7n - 11$

If  $n$  represents the set of counting numbers, who wrote the **correct** expression?

- A. Austin
  - B. Kaylee
  - C. Noah
  - D. Zoey
26. The formula NEXT = NOW - 7 models a sequence. The first term of the sequence is 5. What is the fourth term in the sequence?
- A. -9
  - B. -16
  - C. -17
  - D. -21

27. A walker starts walking 2 miles daily. She increases her daily walking distance by 0.5 mile each week. Which equation represents her daily walking distance the  $n$ th week?

- A.  $a_n = 2n + 0.5$
- B.  $a_n = 2n - 1.5$
- C.  $a_n = 0.5n + 2$
- D.  $a_n = 0.5n + 1.5$

28. John purchased a TV on sale for \$1,500 using his store credit card. The annual interest rate is 12% and is compounded monthly. The monthly payments are \$375. Which recursive equation expresses the remaining amount to be paid off as a function of the number of months,  $n$ , where  $a_{n-1}$  is the balance from the previous month?

- A.  $a_n = 1.01a_{n-1} - 375$
- B.  $a_n = 1.12a_{n-1} + 375$
- C.  $a_n = 1.12a_{n-1} - 375n$
- D.  $a_n = 1.01a_{n-1} + 375n$

29. **Predicting the Value?**

The table below shows the value of a car during the first 8 years after its purchase. In this task you will be asked to write a linear, quadratic, and exponential function that models the relationship seen in this table. At the end of the task you will evaluate which of these functions is the best fit for the data.

Years Since Purchase	Value of Car (in dollars)
0	32,000
1	26,000
2	18,500
3	14,000
4	9,500
5	7,000
6	5,000
7	4,200
8	3,000

Part A. Linear function: Use the values from 1 year after purchase and 7 years after purchase to write an explicit formula and a recursive formula

that model the value of the car over time, assuming that the value of the car decreases linearly. Round the parameters to the nearest thousandth.

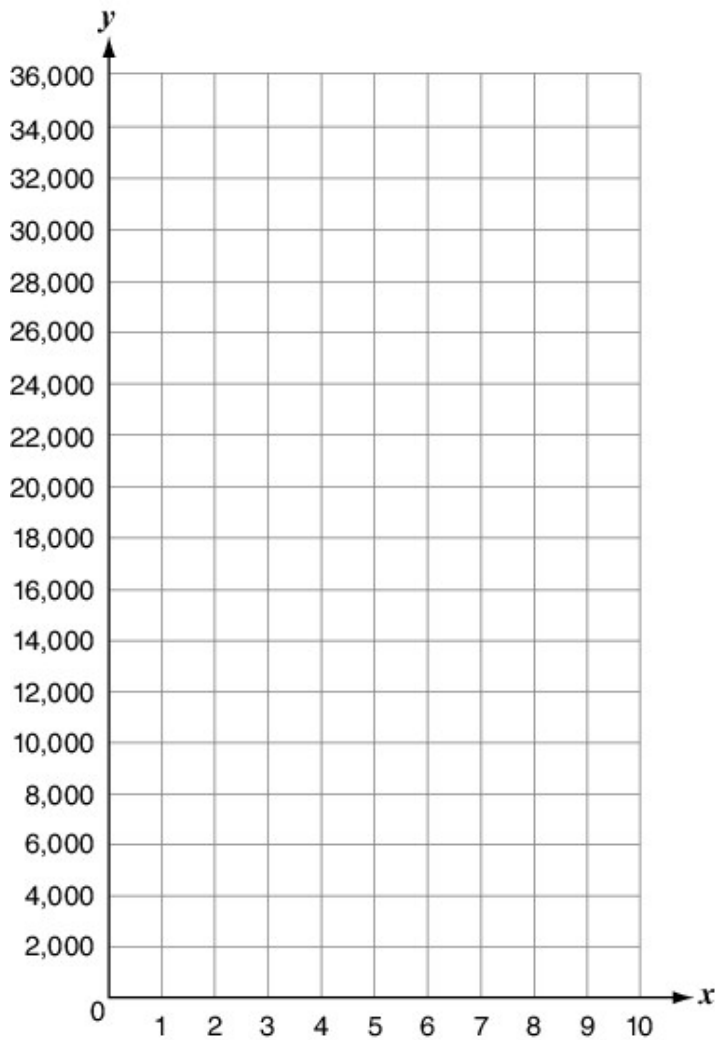
Part B. Quadratic function: Use the values from 1 year, 4 years, and 7 years after purchase to create a quadratic function of  $x$  that models the value of the car over time. Round the parameters to the nearest thousandth.

Part C. Exponential function: Use the values from 1 year after purchase and 7 years after purchase to write an explicit formula and a recursive formula that model the value of the car over time, assuming that the value of the car decreases exponentially. Round the parameters to the nearest thousandth.

Part D. Copy and complete the table below using the values predicted by each of your modeling functions. Round values to the nearest whole dollar.

Years Since Purchase	Value of Car (in dollars)	Linear Model Predicted Value (in dollars)	Quadratic Model Predicted Value (in dollars)	Exponential Model Predicted Value (in dollars)
0	32,000			
1	26,000			
2	18,500			
3	14,000			
4	9,500			
5	7,000			
6	5,000			
7	4,200			
8	3,000			
9	?			
10	?			

Part E. Create a scatter plot that shows the **true** values of the car on the axis below. Plot the lines generated by your three prediction functions (linear, quadratic, and exponential) on the same axis.



Part F. Which model do you think is the **best** predictor of the car's value in years 9 and 10? Explain why this is a better fit than the other two models.

30. The first four terms of a sequence are shown below.

1, 4, 7, 10

Which formula can be used to determine the  $n$ th term in the sequence?

- A.  $a_n = 3n - 2$
- B.  $a_n = 3n + 1$
- C.  $a_n = n - 3$
- D.  $a_n = n + 3$



31. A culture of bacteria in a lab doubles every 3 hours. If there are initially 500 bacteria before they begin to multiply, what explicit expression determines the number of bacteria after  $n$  number of hours?
32. The population of a city in 2009 is 100 million. If the population of the city increases exponentially and the projected population in 2015 is 231 million, which equation describes the approximate relationship between the population of the city,  $P$ , and the number of years,  $t$ , since 2009?
- A.  $P = 100(1.15)^t$
- B.  $P = 231(1.15)^t$
- C.  $P = 100(1.22)^t$
- D.  $P = 231(1.22)^t$

33. The table below shows the sum of the interior angles of several polygons.

Number of Sides	Sum of Angles
3	180
4	360
5	540

What is the sum of the interior angles of a polygon with 10 sides?

- A.  $900^\circ$
- B.  $1,080^\circ$
- C.  $1,440^\circ$
- D.  $1,800^\circ$
34. Ryan is considering the purchase of a new truck. He is faced with the decision to lease or buy.
- If he leases the truck, he will pay \$369 each month.
  - If he buys the truck now, he will pay \$16,893 and the value of the truck will depreciate by 17% each year.

Write a composition of two functions that represents the difference between the depreciated value of the truck and the cost of leasing it in terms of time ( $t$ ) in years.

35. Kerry makes dolls to sell. The profit she makes every month depends on the number of dolls she sells times the difference between the price she charges for each doll and the cost of materials for each doll.

Part A. Use the following variables to write a function to represent Kerry's monthly profit.

$a$  = the price Kerry charges for one doll  
 $b$  = the cost of materials for one doll  
 $x$  = the number of dolls Kerry sells  
 $f(x)$  = the profit Kerry makes

Part B. Kerry has found that if she drops the price, she sells more dolls every month. Suppose that a 5% drop in price results in a 10% increase in the number of dolls she sells. Using the same variables as above, write a function,  $g(x)$ , to show the profit Kerry would make by dropping the price by 5%.

Part C. The cost of materials for one doll is \$8. Suppose Kerry was originally charging \$25 per doll and selling 20 dolls per month. Using these values, what would her monthly profit be?

Part D. Let  $t$  be the number of times she drops the price by 5%, with a resulting increase of 10% in sales. What would her profit be if she dropped the price three times, and how does this compare to her current profit? Round to the nearest dollar.

Use words, numbers, and/or pictures to show your work.

36. If  $f(x) = x - 1$  and  $g(x) = x^2$ , what is the value of  $f(g(x))$ ?

- A.  $x^2 - 1$   
B.  $x^3 - 1$   
C.  $x^2 - 2x + 1$   
D.  $x^2 + x - 1$

37. The account balance of Robin's savings account  $t$  years after it was opened can be modeled by the function  $A(t) = 4,200(1.09)^t$ . Which function models the amount of interest he has earned after  $t$  years?

A.  $I(t) = 4200(1.09)^t - 4200$

B.  $I(t) = 4200(1.09)^t + 4200$

C.  $I(t) = 4200(1.09)^t - (1.09)^t$

D.  $I(t) = 4200(1.09)^t + (1.09)^t$

38. Two functions are defined below.

$$f(x) = e^{2x} + 5e^x + 6 \text{ and } g(x) = 3e^x - 5$$

If  $h(x) = f(x) - g(x)$ , which expression represents  $h(x)$ ?

A.  $h(x) = e^{2x} + 2e^x + 11$

B.  $h(x) = e^{2x} + 2e^x + 1$

C.  $h(x) = 3e^{2x} + 11$

D.  $h(x) = 3e^{2x} + 1$

39. Part A. Let  $f(x) = 2x^2 - x$  and  $g(x) = \sqrt{x} - 9$ . Find  $(f+g)(x)$ ,  $(f-g)(4)$ ,  $(f \cdot g)(4)$ , and  $\left(\frac{f}{g}\right)(4)$ .

Part B. Let  $f(x) = 2x + 3$  and  $g(x) = \sqrt{16 - x^2}$ . Find  $(f+g)(x)$ ,  $(f-g)(x)$ ,  $(f \cdot g)(x)$ , and  $\left(\frac{f}{g}\right)(x)$ , and give the domain of each.

Part C. Let  $f(x) = 2x - 2$  and  $g(x) = x^2 + x - 2$ . Find  $(f+g)(x)$ ,  $(f-g)(x)$ ,  $(f \cdot g)(x)$ , and  $\left(\frac{f}{g}\right)(x)$ , and give the domain of each. Simplify your answers when possible.

The functions below represent a company's monthly profit (in thousands of dollars) on two different items depending on  $x$ , the amount of money spent on advertising (in hundreds of thousands of dollars).

Profit function for item A:  $A(x) = -3x^2 + 30x + 72$

Profit function for item B:  $B(x) = -5x^2 + 15x + 50$

Use the two profit functions to answer the questions in parts D–F.

Part D. Write a function to represent the difference in the profit of item A and item B given that the same amount of money is spent on advertising for both items. Write your answer first in function notation, and then simplify. What is the domain for this function?

Part E. Write a function to represent the ratio of item B's profit to item A's profit given that the same amount of money is spent on advertising for both items. Write your answer first in function notation, and then simplify. What is the domain for this function?

Part F. If the profit of item A doubles and the profit of item B is cut in half, will the combined profit stay the same as the original combined profit? Use function combinations to show why or why not, and explain how you know.

40. If  $f(x) = \frac{x-1}{2x+3}$  and  $g(x) = \frac{x+5}{x-5}$ , which expression shows  $\left(\frac{f}{g}\right)(x)$ ?

A.  $\frac{x^2+4x-5}{2x^2-7x-15}$

B.  $\frac{2x^2-7x-15}{x^2+4x-5}$

C.  $\frac{2x^2+13x+15}{x^2-6x+5}$

D.  $\frac{x^2-6x+5}{2x^2+13x+15}$

41. A factory is built on a 100-acre plot of land. The function  $f(x) = 250000(1.06)^t$  represents the value of the land  $t$  years after the factory is built. Write a function that represents value of the land per acre  $t$  years after the factory is built.

42. Which function of  $g(x)$  makes the equation  $(g \cdot h)(x) = f(x)$  true, if

$$f(x) = \frac{16}{5x^2-6x} \text{ and } h(x) = \frac{10x+12}{x^3} ?$$

A.  $g(x) = \frac{32}{x^4}$

B.  $g(x) = \frac{8x^2}{25x^2-36}$

C.  $g(x) = \frac{x^4+32}{10x^2+12x}$

D.  $g(x) = \frac{25x^2-36}{8x^2}$

43. Sheila went to a store to buy granola bars. The store regularly sells granola bars for \$0.55 each but is running a sale.
- The function  $r(x) = 0.55x$  models the regular price to buy  $x$  granola bars.
  - The function  $s(x) = 0.10x$  models the amount of money that a person will save when purchasing  $x$  granola bars.
  - The function  $c(x) = 0.25$  models the amount of money that Sheila will save using a coupon when she buys  $x$  granola bars.

Which function,  $f(x)$ , models the final cost before taxes that Sheila will pay to buy  $x$  granola bars?

- A.  $f(x) = 0.65x - 0.25$
- B.  $f(x) = 0.45x - 0.25$
- C.  $f(x) = 0.45x + 0.25$
- D.  $f(x) = 0.20x$

44. Tectron is a firm that produces two types of refrigerators: large and small. The monthly profit earned, in thousands of dollars, on the large refrigerators is modeled by the function  $P(x) = -4x^2 + 16x - 7$ , where  $x$  is the change in selling price, in hundreds of dollars. The monthly profit earned on the small refrigerators is modeled by the function  $P'(x) = -3x^2 + 18x - 10$ .

Which function can be used to model the total monthly profit earned by the firm?

- A.  $k(x) = -7x^2 + 34x - 17$
- B.  $k(x) = -7x^4 + 34x^2 - 17$
- C.  $k(x) = -x^2 - 2x + 3$
- D.  $k(x) = -27x^3 - 17$

45. Cindy invested \$2,800. The function  $V(t) = 2,800(1.025)^t$  models the value of Cindy's investment after  $y$  months. The function  $S(t) = 10t$  models the amount of money that Cindy has saved in a safe at her house after  $t$  months. Which function  $C(t)$  models the combined value of the investment and money in the safe?

- A.  $C(t) = 2,810(1.025)^t$
- B.  $C(t) = 2,800(1.025)^{11t}$
- C.  $C(t) = (2,800 + 10t)(1.025)^t$
- D.  $C(t) = 2,800(1.025)^t + 10t$

46. The weekly revenue for Ms. McConnell's business can be estimated by the function  $R(n) = 30n$ . The weekly costs for her business can be estimated by the function  $C(n) = 12n + 1,500$ . Which function best represents the weekly profit for this business?

- A.  $P(n) = -18n - 1,500$
- B.  $P(n) = -18n + 1,500$
- C.  $P(n) = 18n - 1,500$
- D.  $P(n) = 18n + 1,500$

47. Greg is visiting a friend who lives 250 miles away. It snows during the first 100 miles of his trip, but after it stops snowing, Greg increases his driving speed by 15 mph for the last 150 miles. The function  $s(r) = \frac{100}{r}$  represents the time, in  $r$  hours, it takes Greg to travel the first part of the trip and the function  $n(r) = \frac{150}{r+15}$  represents the time, in  $r$  hours, it takes him to travel the second part of his trip. Which function represents the total time of Greg's trip?

- A.  $t(r) = \frac{5(50r+3)}{2r(r+15)}$
- B.  $t(r) = \frac{50(5r+30)}{r(r+15)}$
- C.  $t(r) = \frac{15,000}{r(r+15)}$
- D.  $t(r) = \frac{250}{2r+15}$

48. Define the two functions  $f(x), g(x)$ :

$$f(x) = 4(x-2)(x+2) \text{ and } g(x) = -(x-2)(x+5)$$

Which expression represents  $(f-g)(x)$ ?

- A.  $-5x^2 - 35x - 50$
- B.  $3x^2 - 3x - 6$
- C.  $5x^2 + 3x - 26$
- D.  $5x^2 - 13x - 10$

49. The function  $f(x) = 75x + 100$  models the amount of money that a mechanic earned working  $x$  hours in a week. The function  $g(x) = 70x + 200$  models the amount of money the mechanic earned  $x$  hours in another week. Which function,  $h(x)$ , models the total amount of money the mechanic earned the two weeks?

- A.  $h(x) = 445x$
- B.  $h(x) = 300x + 145$
- C.  $h(x) = 175x + 270$
- D.  $h(x) = 145x + 300$

50. Given the functions  $f(x) = \frac{1}{2x}$  and  $g(x) = \frac{4}{x^2}$ , which expression represents  $f(x) + g(x)$ ?

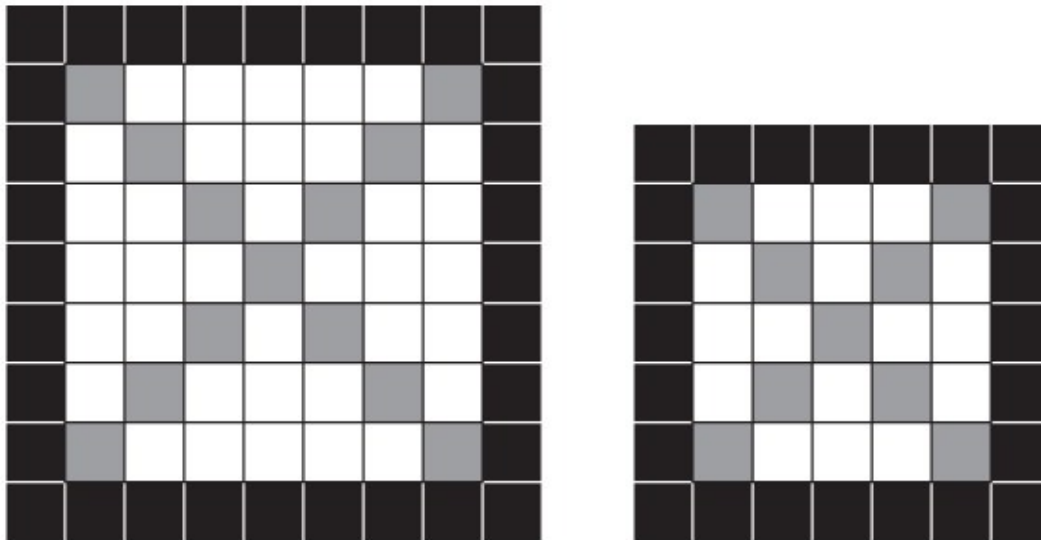
- A.  $\frac{9}{2x^2}$
- B.  $\frac{x+4}{2x^2}$
- C.  $\frac{x+8}{2x^2}$
- D.  $\frac{1+2x}{x^2}$

51. The profit of a company is found by subtracting its costs from its revenue. The costs of a certain company consist of a fixed weekly cost of \$3000 plus \$20 for each item it produces. The weekly revenue of the same company can be represented by the function  $R(x) = -x^2 + 800x$ , where  $x$  represents the number of items produced. Write a function,  $P(x)$ , to represent the company's weekly profit.



52. A rectangular room's length is three more than four times its width,  $w$ . An adjoining room has an area of  $144 \text{ ft}^2$ . Which function,  $f(w)$ , represents the total area of the two rooms?
- A.  $f(w) = 4w + 147$
  - B.  $f(w) = 7w + 144$
  - C.  $f(w) = 4w^2 + 3w + 12$
  - D.  $f(w) = 4w^2 + 3w + 144$

53. Sieji designs square mosaics. His pattern is made of white, gray, and black tiles. The pattern has a gray X design radiating from the center of the square and a black border. Examples of the pattern are shown below for a  $9 \times 9$  and a  $7 \times 7$  mosaic.



Sieji always uses the same pattern with an odd number of tiles in each row, but the number of tiles he uses changes based on the size of the mosaic.

Part A

Let  $x$  represent the number of tiles in a row. Find  $b(x)$ , the function representing the number of black tiles in a mosaic, and  $w(x)$ , the function representing the number of white tiles in a mosaic. Add the two functions to find the total number of black and white tiles Sieji would use for a mosaic of size  $x$ .

Part B

Find the total number of tiles in a mosaic of size  $x$ . Subtract two functions to find the number of gray tiles Sieji would use for a mosaic of size  $x$ .

Part C

Create a new pattern and describe it as the sum or difference of two functions. Define both functions, as well as their sum or difference.

54. On average, graduates of College A earn a salary of \$25,000 plus \$1,500 for every year after completing their degrees and pay \$1,050 minus \$100 for every year after completing their degrees to pay for their student loans.

Which function represents  $y(t)$ , the difference between the average salary graduates of College A earn and the average amount of money they pay for their student loans  $t$  years after completing their degrees?

- A.  $y(t) = 25,350t$
- B.  $y(t) = 25,000 + 350t$
- C.  $y(t) = 26,000 + 950t$
- D.  $y(t) = 23,950 + 1,600t$

55. If  $m(x) = \frac{x+6}{x-6}$  and  $n(x) = \frac{2x+5}{-x+5}$ , what is the value of  $(mn)(-2)$ ?

- A.  $\frac{1}{14}$
- B.  $-\frac{1}{14}$
- C.  $-\frac{2}{7}$
- D.  $-\frac{43}{41}$

56. Given the functions  $f(x) = 3x^2 - 5x + 2$  and  $g(x) = -4x^2 + 3$ , what is  $f(x) - g(x)$ ?

- A.  $-x^2 + 5$
- B.  $-x^2 - 5x + 5$
- C.  $7x^2 - 1$
- D.  $7x^2 - 5x - 1$

57. A scientist observes the growth of two types of bacteria, A and B. He notes that every hour, the number of bacteria A doubles while the number of bacteria B increases by 500. The scientist begins the experiment with  $x$  number of bacteria A and  $x$  number of bacteria B. Which function models the total number of bacteria after 3 hours?
- A.  $f(x) = 7x + 500$
- B.  $f(x) = 9x + 500$
- C.  $f(x) = 7x + 1500$
- D.  $f(x) = 9x + 1500$
58. A scientist collected two samples of bacteria, A and B, each of which has an initial population of 10,000. He observed that the population of bacteria A decreased exponentially by 10% each hour and the population of bacteria B increased linearly by 3,000 each hour. Write a function,  $f(x)$ , that models the total populations of bacterias A and B after  $x$  hours.
59. The function  $p(w) = -25w^2 + 300w$  represents the daily profit of a store depending on the number of workers,  $w$ . Which expression represents the daily profit per worker?
- A.  $-25w^3 + 300w^2$
- B.  $-25w + 300w$
- C.  $-25w^2 + 300$
- D.  $-25w + 300$
60. The function  $C(x) = 200 + 3.3x$  models the cost for a company to produce  $x$  units of a product. The function  $R(x) = 25x$  models the revenue the company earns if they sell  $x$  units of the product. Which function,  $P(x)$ , models the profit the company earns if they sell  $x$  units of the product? (Profit = Revenue - Cost)
- A.  $P(x) = 28.3x - 200$
- B.  $P(x) = 21.7x - 200$
- C.  $P(x) = 200 - 21.7x$
- D.  $P(x) = 28.3x + 200$

61. The function  $f(x) = k^x$  is an exponential function with base  $k$ , where  $k$  is a positive number other than 1. Which expression can be rewritten as the product of a constant function and an exponential function?
- A.  $a(x) = 2^x + 3$
  - B.  $b(x) = 2^x + 3^x$
  - C.  $c(x) = 2^x + 2^{2x}$
  - D.  $d(x) = 2^x + 2^{x+1}$
62. The function  $f(x) = 9.75x + 62$  models the amount of money that Hector earned working  $x$  hours in a week. The function  $g(x) = 7.5x + 84$  models the amount of money that Carl earned working  $x$  hours in the same week. Which function,  $h(x)$ , models the difference in Hector's and Carl's earnings?
- A.  $h(x) = 17.25x - 22$
  - B.  $h(x) = 17.25x + 146$
  - C.  $h(x) = 2.25x - 22$
  - D.  $h(x) = 2.25x + 146$
63. A family wants to carpet two rooms in their home. The area of the first room can be represented by the function  $f(x) = 2x^2 - 7x - 30$ . The area of the second room can be represented by the function  $g(x) = 6x^2 - 11x - 10$ . What function,  $h(x)$ , shows the combined total area?
- A.  $h(x) = 8x^2 + 18x + 40$
  - B.  $h(x) = 8x^2 - 18x - 40$
  - C.  $h(x) = 8x^2 + 4x - 20$
  - D.  $h(x) = 8x^2 - 4x + 20$

64. The ingredients for a particular kind of European chocolates cost \$12 per box. The foil wrappers cost \$0.05 per piece of chocolate. The box has  $x$  pieces of chocolates in it. Which function represents the total cost per piece of chocolate?

A.  $c(x) = \frac{12}{x} + 0.05$

B.  $c(x) = \frac{(12 + 0.05)}{x}$

C.  $c(x) = 12x + 0.05$

D.  $c(x) = (12 + 0.05)x$

65. Suppose that two types of bacteria which coexist grow at different rates.

- The function  $f(x) = 2(5)^x$  models the amount of the first type of bacteria present after  $x$  hours.
- The function  $s(x) = 3x + 2$  models the amount of the second type of bacteria present after  $x$  hours.

Which function,  $T(x)$ , models the total amount of bacteria present after  $x$  hours?

A.  $T(x) = 2(5)^x + 3x + 2$

B.  $T(x) = 2(5)^x(3x + 2)$

C.  $T(x) = (6x + 4)(5)^x$

D.  $T(x) = 2(3x + 7)^x$

66. If  $f(x) = x^2 + 2x - 4$  and  $g(x) = -4x + 1$ , what is  $(g - f)(x)$ ?

A.  $x^2 + 6x - 5$

B.  $x^2 - 2x - 3$

C.  $x^2 - 6x + 5$

D.  $-x^2 - 6x + 5$

67. Alisha designs bracelets and sells them at the local farmers' market. She sells her bracelets for \$9.95 each. The revenue from selling  $x$  bracelets is represented by  $G(x) = 9.95x$ . Alisha has to pay a \$50 fee in order to sell at the farmers' market. The cost to produce  $x$  bracelets is represented by  $F(x) = 50 + 1.25x$ . Which function represents Alisha's profit,  $P(x)$ , as a function of the number of bracelets sold,  $x$ ?

- A.  $P(x) = 8.70x - 50$
- B.  $P(x) = 8.70x + 50$
- C.  $P(x) = -8.70x - 50$
- D.  $P(x) = -8.70x + 50$

68. **Putting Functions Together**

Angela has a jewelry-making business. She uses functions to make calculations related to her business.

Part A. Once Angela gets her materials set up, she can make  $p$  pins in one hour. Due to the set-up time, she can make only  $p - 2$  pins in the first hour. Write a function to find  $f(t)$ , the number of pins Angela can make in  $t$  hours, including the set-up time.

Part B. Out of every 10 pins that Angela makes, she donates one pin to a shelter and sells the rest. Write a function to find  $g(t)$ , the number of pins that Angela will have to sell after  $t$  hours of work.

Part C. If Angela wanted to work for 6 hours and have 36 pins to sell, what would  $p$  have to be? Show your work.

Part D. The materials to make one bracelet cost \$2, and Angela sells the finished bracelets for \$10 each. However, if someone buys 2 bracelets, she charges \$9.50 each. If a person buys 3 bracelets, they are \$9 each. Four bracelets cost \$8.50 each, and so on.

Write a function  $c(x)$  to give the cost of materials for  $x$  bracelets.

Write a function  $a(x)$  to give the total amount she charges for  $x$  bracelets.

Part E. Use the functions in Part C to explain how the profit Angela will make on  $x$  bracelets can be found. Then, determine the profit function in terms of  $x$  using  $c(x)$  and  $a(x)$ .

Part F. Angela participated in a craft fair to sell her jewelry. The cost of materials for one necklace is \$4 and she normally sells them for \$12 each, but during the craft fair, she decided to drop the price by 5% each hour to try to sell the remaining necklaces. Combine functions to find  $p(t)$ , the amount of profit she would make on a necklace sold after  $t$  hours at the craft fair.



69. A pipe is filling a tank of water. The volume in liters that it can fill in  $t$  hours is given by the function  $V(t) = 30t$ . After the tank is filled with 50 liters of water, another pipe starts filling the tank at a rate modeled by the function  $V'(t) = 40t$  along with the first pipe. Which function represents the volume of the tank after  $t$  hours, where  $t = 0$  represents the time when the second pipe begins?

A.  $V''(t) = 70t$

B.  $V''(t) = 120t$

C.  $V''(t) = 30t + 90$

D.  $V''(t) = 70t + 50$

70. A ball is dropped out of a window of a building. The ball's height in feet can be represented by the function  $h(t) = -16t^2 + 48$ , where  $t$  is the time in seconds. If the height at which the ball is dropped is increased by 20 feet, what is the resulting function?

A.  $h(t) = 4t^2 + 48$

B.  $h(t) = -16t^2 + 68$

C.  $h(t) = -36t^2 + 48$

D.  $h(t) = -16t^2 + 20t + 48$