Name _____ Date _____

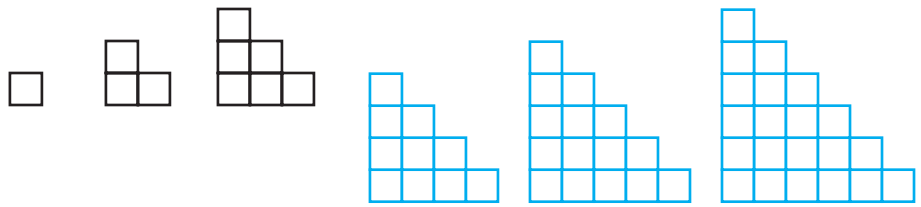
Patterns: They're Grrrrrowing!

Exploring and Analyzing Patterns

Problem Set

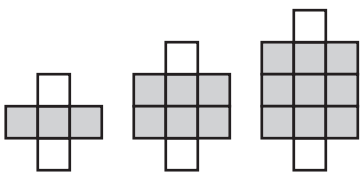
Draw the next three terms for each pattern shown.

1. Pattern 1 Pattern 2 Pattern 3 Pattern 4 Pattern 5 Pattern 6

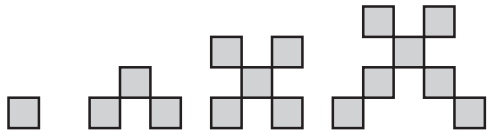


2. Pattern 1 Pattern 2 Pattern 3

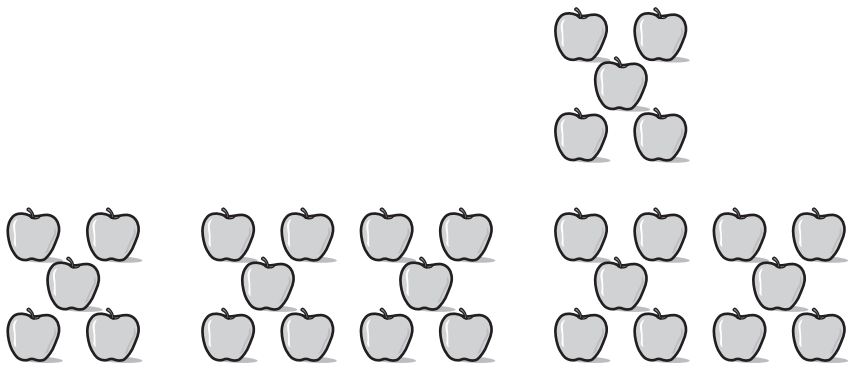
3. Pattern 1 Pattern 2 Pattern 3



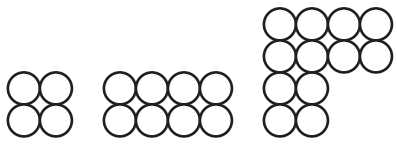
4. Pattern 1 Pattern 2 Pattern 3 Pattern 4



5. Pattern 1 Pattern 2 Pattern 3



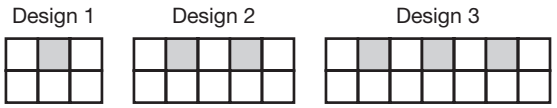
6. Pattern 1 Pattern 2 Pattern 3



Name _____ Date _____

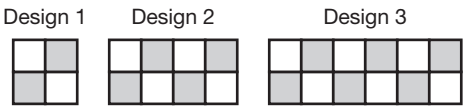
Answer the question for each pattern.

7. How many white tiles will be in Design 5 of the pattern? Explain your reasoning.



There will be 17 white tiles in Design 5 of the pattern. For every new design in the pattern, there are 3 white tiles added. So there will be 11 + 3 + 3 or 17 white tiles in Design 5.

8. How many shaded tiles will be in Design 5 of the pattern? Explain your reasoning.



9. Gregory has a vegetable garden. This year, he gives two tomato plants to friends. Next year, those two friends each give away two tomato plants. The following year, those four friends give away two tomato plants. How many tomato plants have been given away? Show your work.

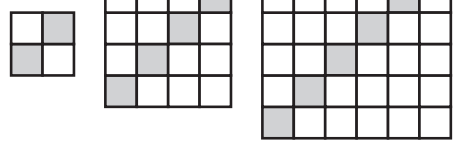
Time (years)	Number of Tomato Plants Given Away Per Year	Cumulative Total Number of Plants Given Away
1		
2		
3		

10. Charlene has a flourishing spider plant. She cuts three small pieces of the plant, called babies. She moves each baby into its own pot with soil. After one month, she is able to cut three babies off each of the original babies. She continues this pattern. How many baby plants will she have started after 5 months? Show your work.

Time (months)	Number of Baby Spider Plants
1	
2	
3	
4	
5	

11. How many white squares will be in Design 6 of the pattern? Explain your reasoning.

Design 1 Design 2 Design 3



Name _____ Date _____

12. Archie is playing an online game with friends. Each round of the game, he earns four times his current point total. The first three rounds are shown in the table. How many points does Archie have in round 6? Show your work.

Round	Number of Points
1	1
2	4
3	16

Determine the next number in each sequence. Explain your reasoning.

13. 6, 13, 27, 55, . . .

The next number in the sequence is 111. Each number in the sequence after the first number is two times the previous number plus one. So the next number would be $2 \cdot 55 + 1$ or 111.

14. 3, 5, 9, 17, . . .

15. 1, 4, 7, 10, . . .

16. 1, 5, 9, 13, . . .

17. 3, 8, 18, 38, . . .

18. 5, 8, 14, 26, . . .

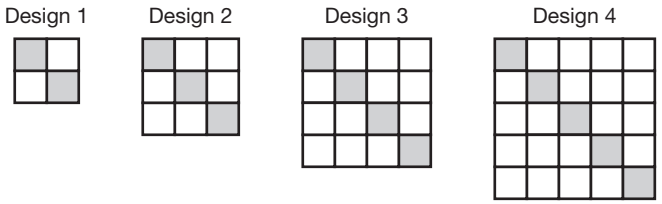
Name _____ Date _____

Are They Saying the Same Thing?
Using Patterns to Generate Algebraic Expressions

Problem Set

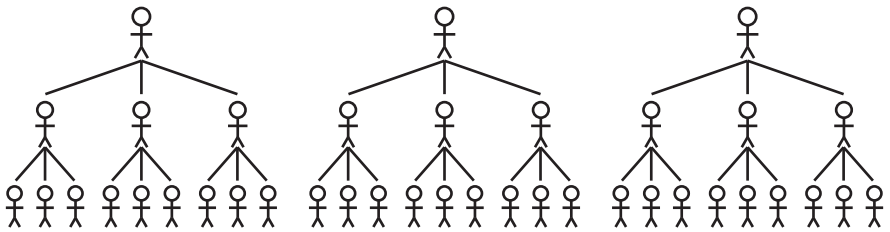
Write an expression to represent each pattern.

1. Renetta is creating a design for a craft project. Write an expression to represent the number of shaded squares in each piece of the design.



The number of shaded squares in each design is one more than the design number. So, the expression is $n + 1$.

2. Three candidates for the student government each tell three other people that the election will be held next Tuesday. Those three people each tell three more people. Write an expression to model the number of people who hear the about the election being held next Tuesday.



3. Charlie watches as a pattern develops. He starts with 3 guppy fish in his fish tank. The next month, he finds 6 guppy fish in his tank. The following month, he finds 11 guppy fish in his fish tank. Write an expression to model the pattern of guppy fish in Charlie's fish tank. Show your work.

4. After 1 minute, a file Portia is downloading from the internet is at 0 kilobytes downloaded. After 2 minutes, the file is at 7 kilobytes downloaded. After 3 minutes, the file is at 26 kilobytes downloaded. After 4 minutes, the file is at 63 kilobytes downloaded. Write an expression to model the amount of the file downloaded. Explain your reasoning.

5. A library receives book donations over the course of the year. The number of books received each month is listed in the table. Write an expression to model the number of books received by the library. Explain your reasoning.

Time (months)	Number of Books Received
1	2
2	11
3	26
4	47
5	74

6. A website begins its first week with 3 subscribers. The number of subscribers each week is listed in the table. Write an expression to model the number of subscribers at the website each week.

Time (weeks)	Number of Subscribers
1	3
2	17
3	55
4	129
5	251

Name _____ Date _____

Determine whether the two expressions are equivalent. Explain your reasoning.

7. $6n + 8$ and $2(3n + 4)$

The expressions are equivalent.

Use the distributive property and combine like terms.

$2(3n + 4) = 6n + 8$.

8. $(n^2 + 4n) - n^2$ and $4n$

9. $3x + 5$ and $2(x + 3)$

10. $15 - 6x$ and $15(1 - 6x)$

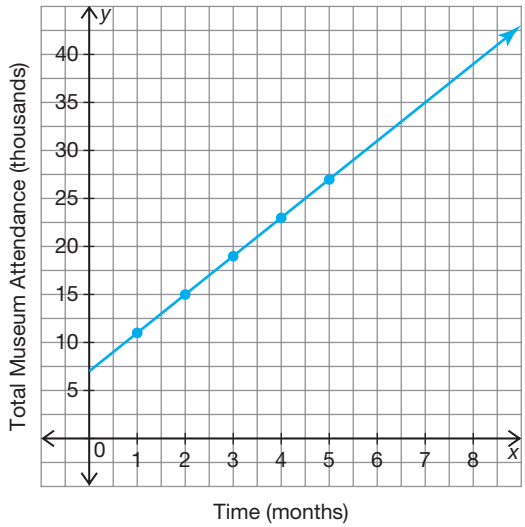
11. $(y + y + 2 + y) + 3y$ and $6y + 2$

12. $8y - 3 + 10y$ and $3(6y - 1)$

Represent each pattern as an expression and as a graph. Then identify whether the pattern is linear, exponential, or quadratic. Explain your reasoning.

13. The table lists the number of people who attended a museum (in thousands) over the course of several months.

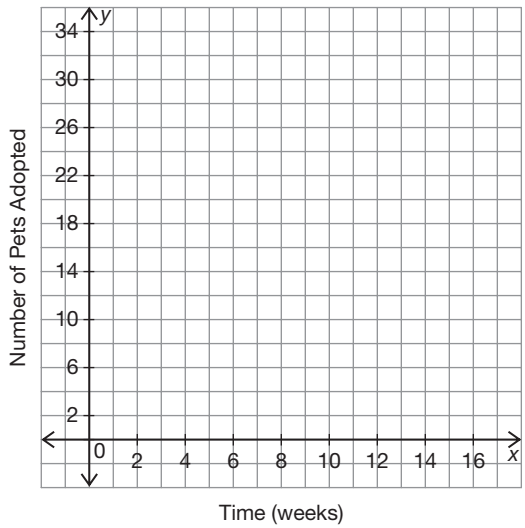
Time (months)	Total Museum Attendance (thousands)
1	11
2	15
3	19
4	23
5	27



The number of people who attended the museum is four times the number of months plus 7. So, an expression to represent the pattern is $4x + 7$. The pattern is linear.

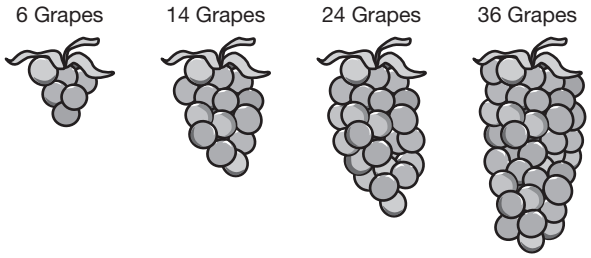
14. A local pet shelter is able to see many of their pets adopted. The table lists the number of pets that have been adopted over several weeks.

Time (weeks)	Number of Pets Adopted
1	8
2	11
3	16
4	23
5	32

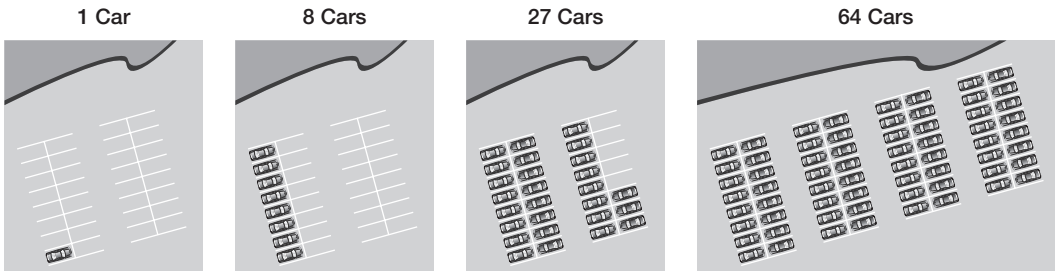


Name _____ Date _____

15. Emilio is looking at bunches of grapes at the market. He starts to notice a pattern in the number of grapes in each bunch. Write an expression for the number of grapes in each bunch.

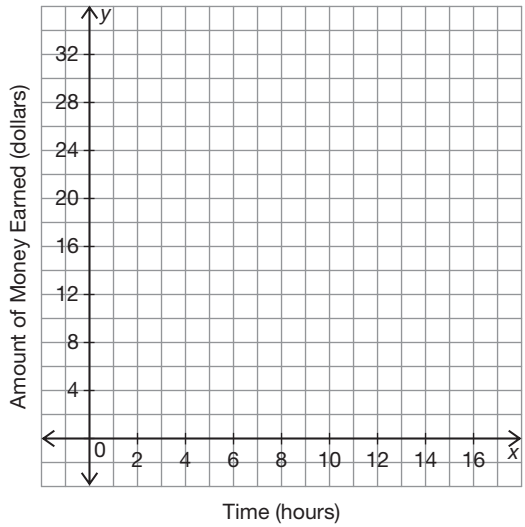


16. Nolan takes a photo of a parking lot every two hours. He counts the number of cars in each photo. The number of cars increases in each photo. Write an expression for the number of cars in the parking lot.



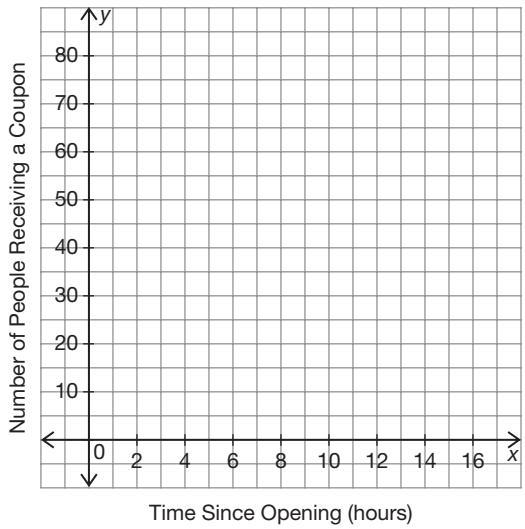
17. The school swim team holds a car wash to earn money for an upcoming trip. The table lists the number of hours that the car wash runs and the amount of money earned during the car wash.

Time (hours)	Amount of Money Earned (in dollars)
1	20
2	22
3	24
4	26
5	28



18. A store had a grand opening sale. During the sale, each person entering the store received a coupon for 10% off their entire purchase. The table lists the number of people who received a coupon.

Time Since Opening (hours)	Number of People Receiving a Coupon
1	3
2	12
3	27
4	48
5	75



Name _____ Date _____

Are All Functions Created Equal?

Comparing Multiple Representations of Functions

Vocabulary

Write a definition for each term in your own words.

1. relation

2. function

3. function notation

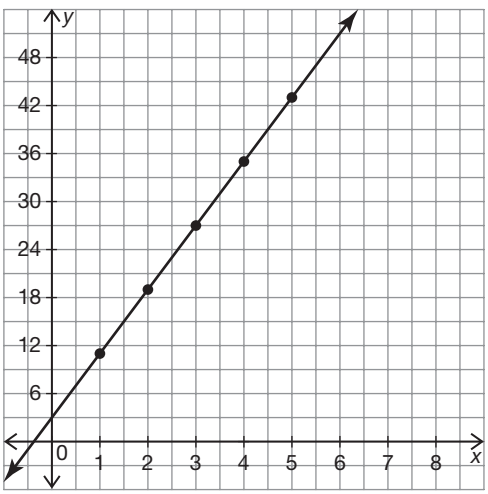
Problem Set

Determine whether the functions are equivalent.

1.

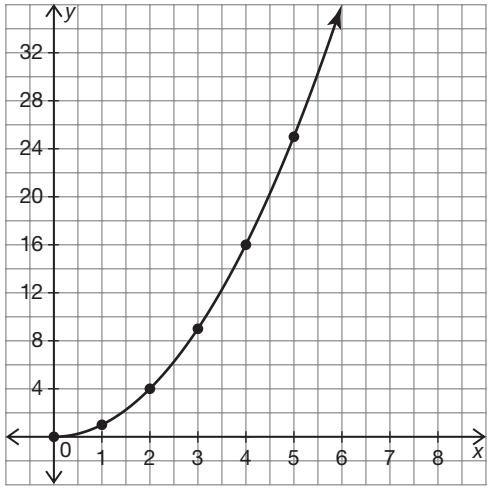
Input	Output
1	11
2	19
3	27
4	35
5	43

The functions are equivalent because the same outputs are matched to each input.

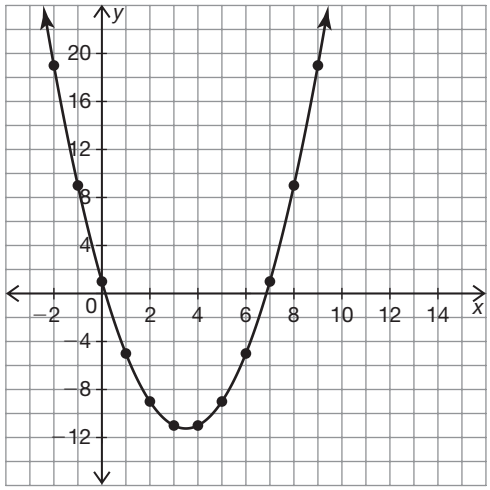


2.

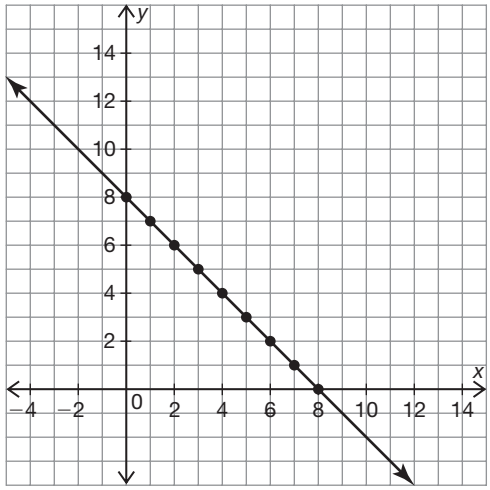
Input	Output
1	1
2	4
3	9
4	16
5	25



3. $y = x^2 - 7x + 1$



4. $y = 5(x - 1) + 4$

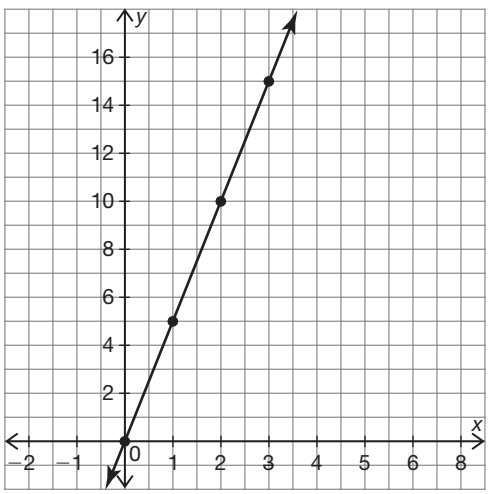


Name _____ Date _____

5. $f(x) = 3(x + 1)$

Input	Output
1	3
2	6
3	9
4	12
5	15

6. Alton is selling a few handmade toys at a community sale. After the first hour, Alton has earned $5. After the second hour, he has earned $10 and after the third hour, he has earned $15.

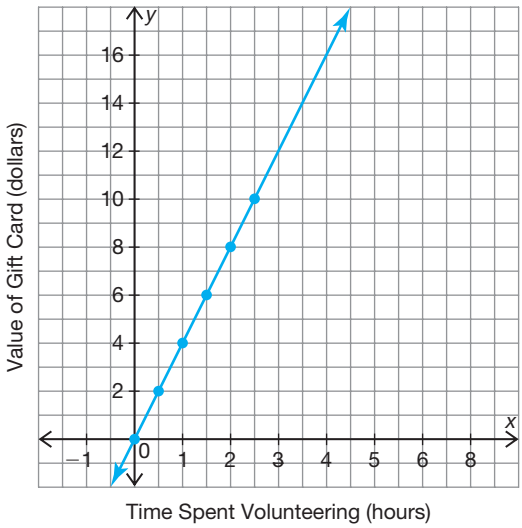


Model each scenario using a table, a graph, and a function.

7. A local arts festival has 150 vendors and 75 volunteers. Each volunteer receives a T-shirt and earns \$2 for each hour spent volunteering towards a gift card for the festival. Model the value of a gift card that a volunteer can earn.

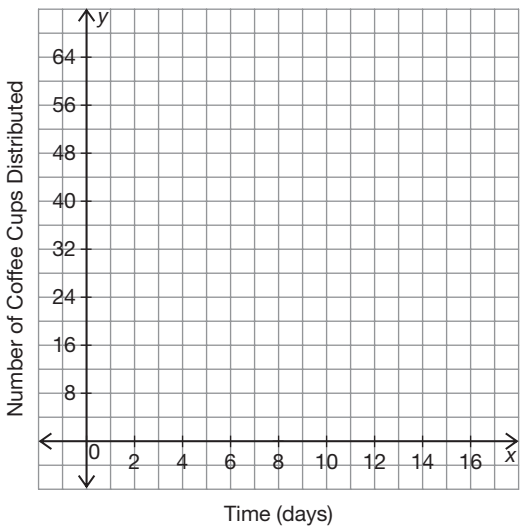
The function $f(x) = 2x$ represents the amount that a volunteer can earn.

Time Spent Volunteering (hours)	Value of Gift Card (dollars)
1	2
2	4
3	6
4	8
5	10



8. A public broadcasting station distributes 16 coffee cups each day of their fundraising drive to individuals who donate at least \$75. During the fundraising drive, 12 people decline the coffee cup. Model the number of coffee cups that are distributed.

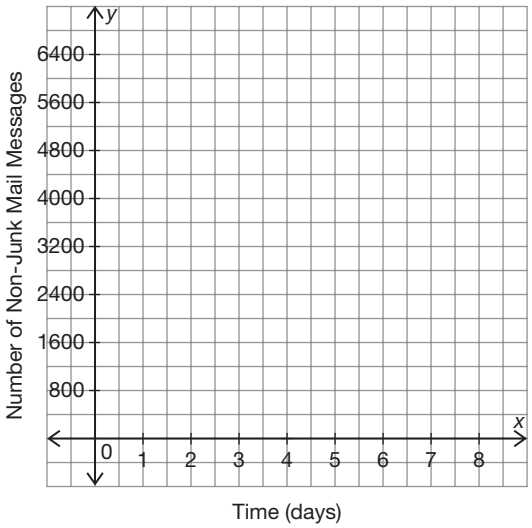
Time (days)	Number of Coffee Cups Distributed



Name _____ Date _____

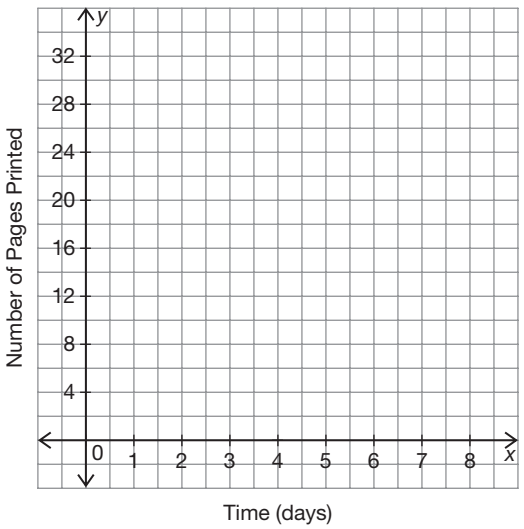
9. The school receives 2000 e-mail messages each day. Of those messages, 1250 are junk mail messages. Model the number of e-mail messages received by the school that are not junk mail.

Time (days)	Number of Non-Junk Mail Messages Received



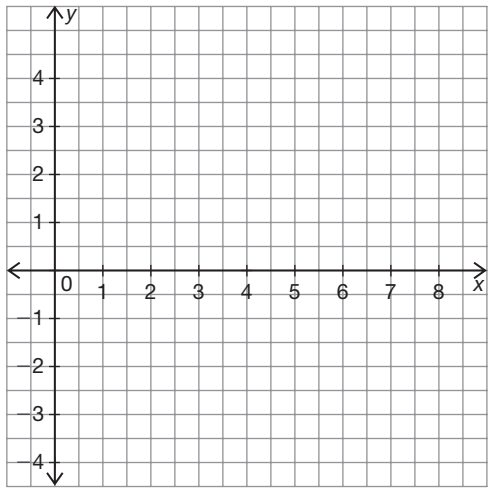
10. In order to cover the cost of paper, the computer lab institutes a new policy stating that students are only permitted to print 100 sheets of paper before incurring a cost. The policy is retroactive to the start of the current school year. After they have printed 100 sheets of paper, they must pay $0.50 per sheet of paper. Before the policy was created, one student had already printed a 5-page paper. He continues to print 4 pages per day. Model the number of pages this student prints.

Time (days)	Number of Pages Printed



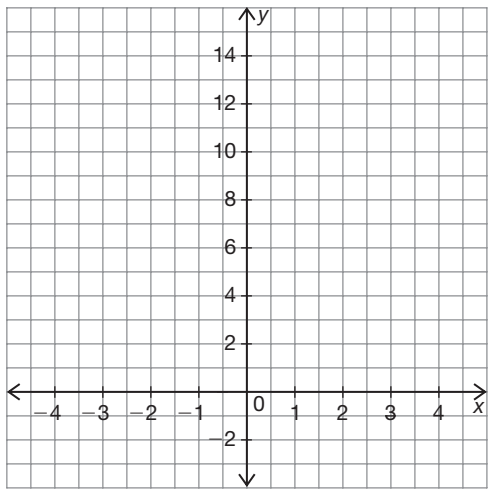
11. The opposite of x squared plus 5

x	$f(x)$



12. The cube of x plus 5

x	$f(x)$



Name _____ Date _____

Write an expression that represents each scenario. Then answer the question.

13. Tommy is purchasing items from an online store. The store charges $6 shipping and handling for each package. Write an expression to represent the total shipping costs. How much will Tommy pay in shipping and handling for 2 packages?

An expression to represent the total shipping costs is $6x$.

$6x = 6(2)$

$= 12$

The cost for 2 packages is $12.

14. A library has 45 books in their young adult science fiction collection. During a collection drive, the library collects 9 new young adult science fiction books per day. How many total young adult science fiction books will the library have after 1 week?

15. A group of friends is planning a trip to the movie theater. The cost of one ticket for a movie is $8.50. The cost for each person to purchase snacks at the theater is $5. How much will a group of 8 friends pay to purchase movie tickets and snacks at the theater?

Number of Friends	Total Cost of Ticket and Snacks (dollars)
2	27
3	40.5
4	54
5	67.5
6	81

16. A bookstore advertises a book signing by calling each of the 12 members of their book club. Each member of the book club calls two additional people. The table lists the number of people who receive a call. How many people will receive a call in the 4th round of calls?

Round of Calls	Number of People Who Receive a Call
1	12
2	24
3	48

17. A photographer takes 46 photos per hour during a soccer game. How many photos does the photographer take if the game lasts 3.5 hours?

18. The high school choir hosts a concert for the community. The members of the choir sell tickets for the concert. Each member of the choir sells 3 tickets. Tickets are also sold at the door before the concert. A total of 125 tickets are sold at the door. How many total tickets are sold if there are 18 members of the choir?

Name _____ Date _____

Determine whether the expressions are equivalent.

19. $(5x + 3) + 3x^2 - 2$ and $(5x + 1) + 3x^2$

$(5x + 3) + 3x^2 - 2$ $(5x + 1) + 3x^2$

$3x^2 + 5x + 1$ $3x^2 + 5x + 1$

The expressions are equivalent.

20. $3x^2 + (x - 2)(x + 1)$ and $(2x - 2)(2x + 1)$

21. $(2x + 1)^2 - 2x(x - 3)$ and $6x^2 + 6x + 2 - (2x - 1)^2$

22. $(7x^2 + 1) - (3x - 1)(x + 4)$ and $2x(x - 3) + 2x^2 - 5x + 5$

23. $6x(x + 1)$ and $6x^2 + 6$

24. $8x(2x + 1) + 8x^2$ and $8x(3x + 1)$

Name _____ Date _____

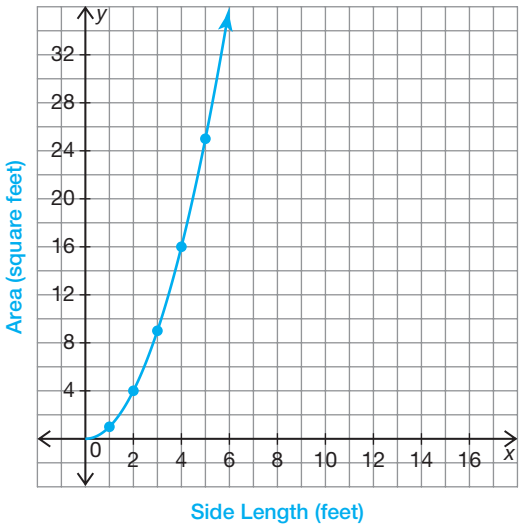
Water Under the Bridge
Modeling with Functions

Problem Set

Complete each table, then graph the function. Label the axes.

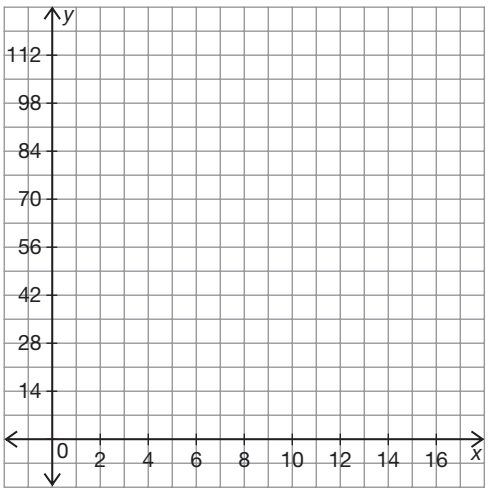
1. The area of a square is the side length squared.

Side Length (feet)	Area (square feet)
1	1
2	4
3	9
4	16
5	25



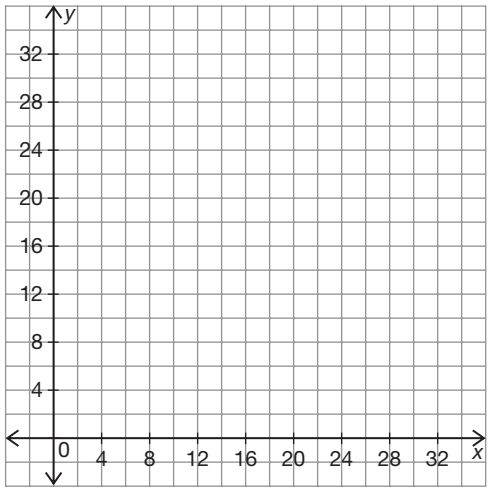
2. The volume of a cube is the side length cubed.

Side Length (inches)	Volume (cubic inches)
	1
	8
3	
4	
5	



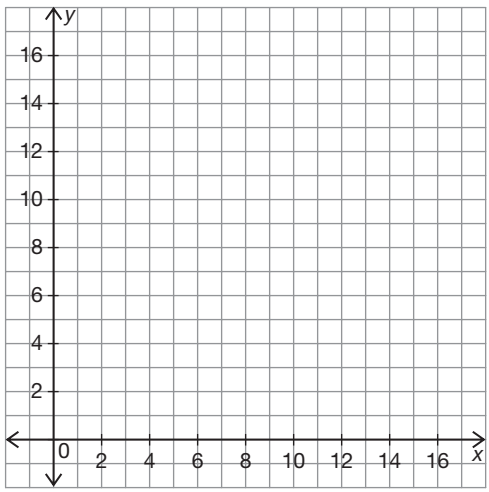
3. Malcolm plants a vegetable garden in the spring. The number of plants that grow is 4 less than the number of seeds. The table lists the number of seeds he planted and the number of plants that grew from those seeds.

Number of Seeds Planted	Number of Plants That Grow
	1
	6
15	
20	
25	



4. Shayla spends 3 hours studying for each quiz in her math class. She also spends 2 hours working on a project. The table lists the amount of time she spends studying for quizzes or working on a project for class.

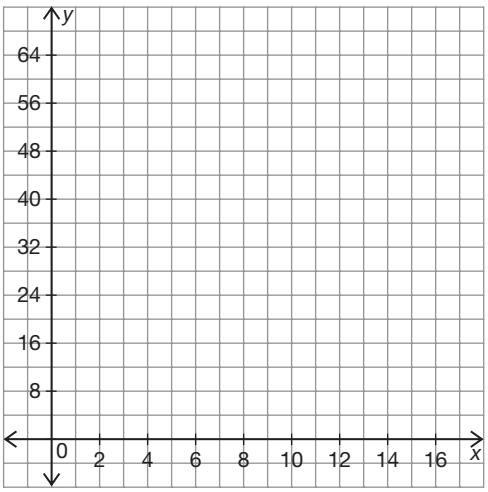
Number of Quizzes	Total Time Spent (hours)
	5
	8
3	
4	
5	



Name _____ Date _____

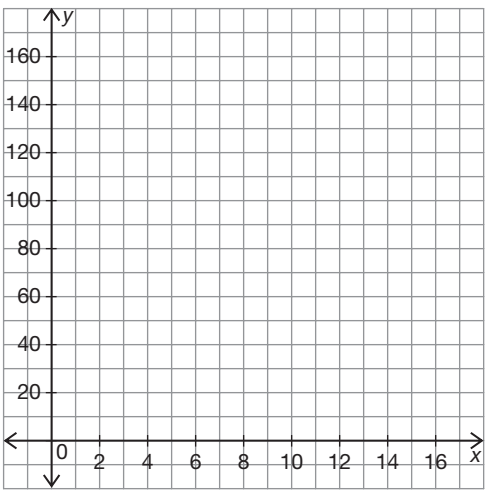
5. The photography club tracks the number of photos its members have published in the school paper over the course of one year. The total number of photos published can be represented by the expression, $2m^2 - 5$. The table lists the total number of photos published.

Time Since Start of Year (months)	Total Number of Photos Published
	3
	13
4	
5	
6	



6. An editor for the school newspaper keeps track of the number of words per article that are written by the newspaper staff. The total number of words per article can be modeled by the expression $4x^2 + 50$. The table lists the total number of words used per article since the beginning of the year.

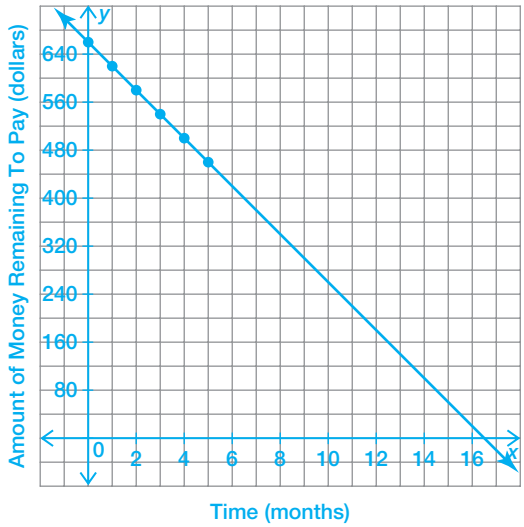
Time Since Start of Year (months)	Total Number of Words Per Article
	54
	66
3	
4	
5	



Define a function to represent each problem situation. Then graph the function and answer each question.

7. Latashia used a store's layaway program to purchase a laptop computer. Every month, Latashia makes a payment on the computer. The table shows the number of months that have passed and the amount of money she has remaining to pay. How much money is remaining to pay after the 5th month?

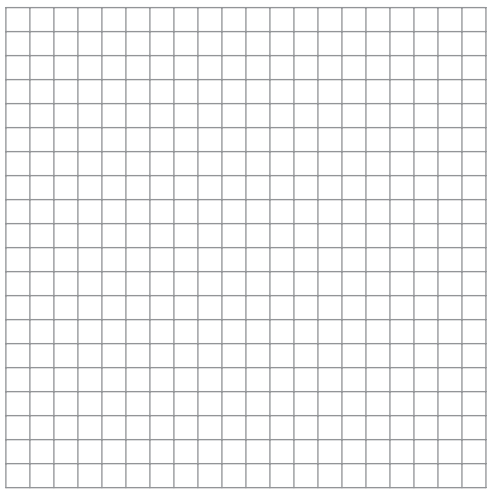
Time (months)	Amount of Money Remaining to Pay (dollars)
1	620
2	580
3	540
4	500
5	460



The amount of money left to pay can be represented by the function $f(x) = 660 - 40x$. The amount of money left to pay after 5 months is $460.

8. Deloise wasn't feeling well, but went to work sick on Monday. When she gets there, she realizes that Jayme is also sick. On Tuesday, 4 other employees were sick. On Wednesday, 8 employees were sick. The pattern continued for 5 days. The table lists the number of sick employees. How many employees are sick on the 5th day?

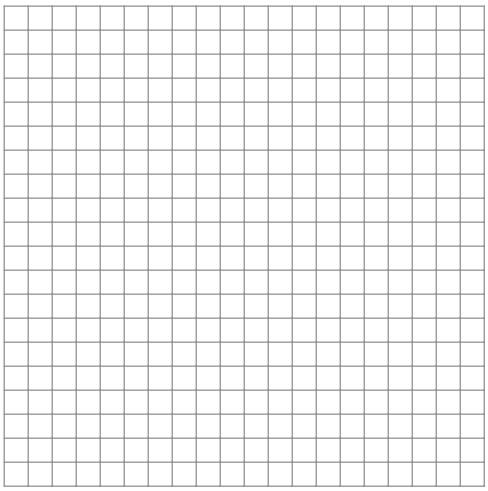
Time Since Sunday (days)	Number of Sick Employees
1	2
2	4
3	8
4	16
5	



Name _____ Date _____

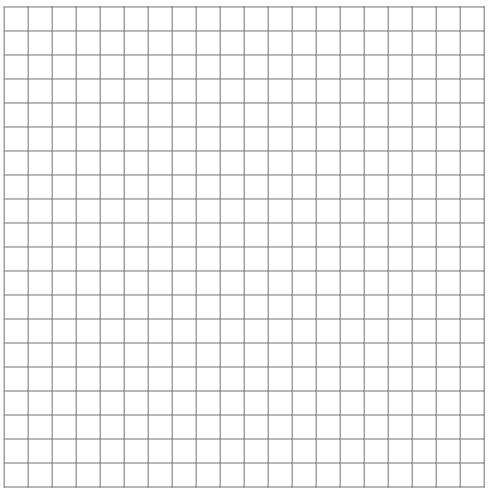
9. An airline has a flight crew that travels a jet airline across the United States. The jet carries 180 passengers plus the 9 crewmembers. The table lists the number of passengers and crew who traveled with the airline over several flights. How many passengers and crew traveled with the airline after 4 flights?

Number of Flights	Number of People Traveling
1	189
2	369
3	549
4	
5	909



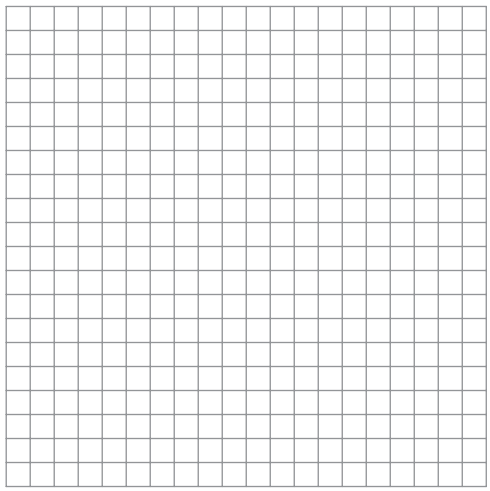
10. Garry is cooking appetizers to prepare for a party. For each appetizer, Garry needs 20 minutes to prepare. The table lists the amount of preparation time Garry will need for different numbers of appetizers. How many minutes of preparation time does Garry need for 5 appetizers?

Number of Appetizers	Amount of Preparation Time (minutes)
1	20
2	40
3	60
4	80
5	



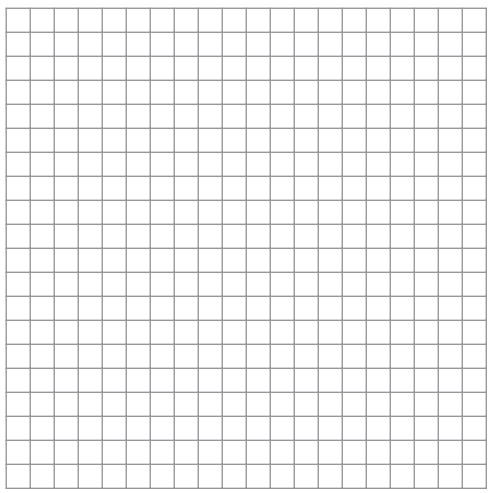
11. A company uses shipping boxes that are cubes. They have a variety of sizes to accommodate all of the different items that are shipped. The volume of a box with a side length of 1 foot is 1 cubic foot. The volume of a box with a side length of 2 feet is 8 cubic feet. What is the volume of a box with a side length of 5 feet?

Side Length (feet)	Volume (cubic feet)
1	1
2	8
3	27
4	64
5	



12. Toby is looking at frames to help decide the size of his next art project. He needs to consider both the side length of the frame and the area of the art project. A 1-inch frame results in an area of 1 square inch for the art project. A 2-inch frame results in an area of 4 square inches for the art project. The table lists the side lengths of the frames and the areas of the frames. What is the area of a frame with a side length of 5 inches?

Side Length (inches)	Area (square inches)
1	1
2	4
3	9
4	16
5	



Name _____ Date _____

I've Created a Monster, $m(x)$
Analyzing Graphs to Build New Functions

Vocabulary

Write the term that best completes each statement.

1. A _____ is a mathematical expression involving the sum of powers in one or more variables multiplied by coefficients.

2. The _____ of a polynomial is the greatest variable exponent in the expression.

3. The _____ states that if the product of two or more factors is equal to zero, then at least one factor must be equal to zero.

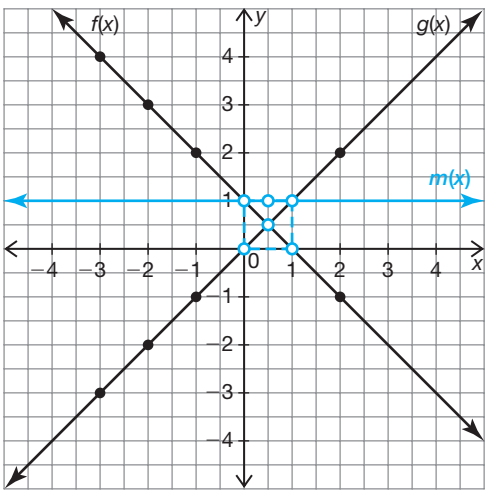
Problem Set

Predict the function family of $m(x)$ and sketch the graph of $m(x)$ using key points.

1. $m(x) = f(x) + g(x)$

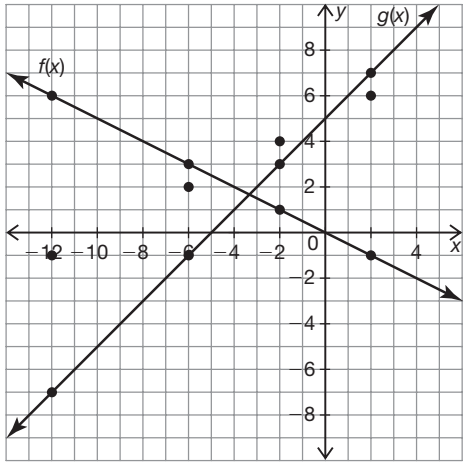
   $f(x) = -x + 1$; $g(x) = x$

   The function $m(x)$ will belong to the linear function family.



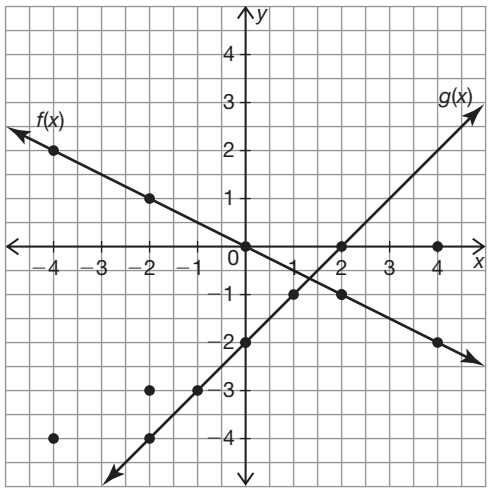
2. $m(x) = f(x) + g(x)$

$f(x) = -\frac{1}{2}x$; $g(x) = x + 5$



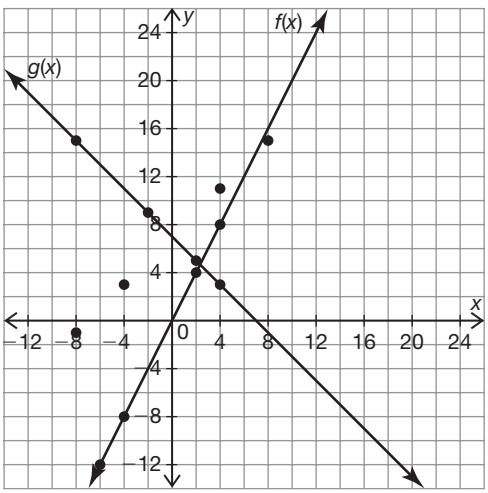
3. $m(x) = f(x) + g(x)$

$f(x) = -\frac{1}{2}x$; $g(x) = x - 2$



4. $m(x) = f(x) + g(x)$

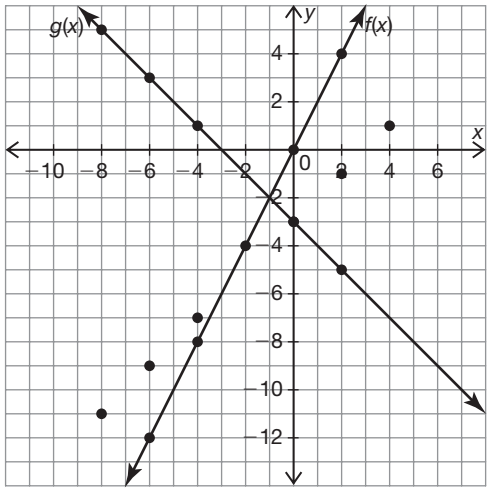
$f(x) = 2x$; $g(x) = -x + 7$



Name _____ Date _____

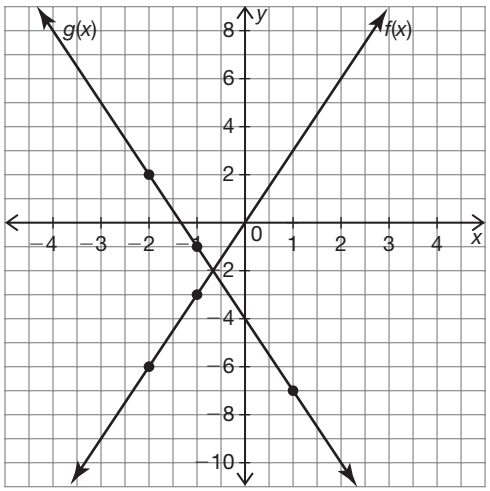
5. $m(x) = f(x) + g(x)$

$f(x) = 2x$; $g(x) = -x - 3$



6. $m(x) = f(x) + g(x)$

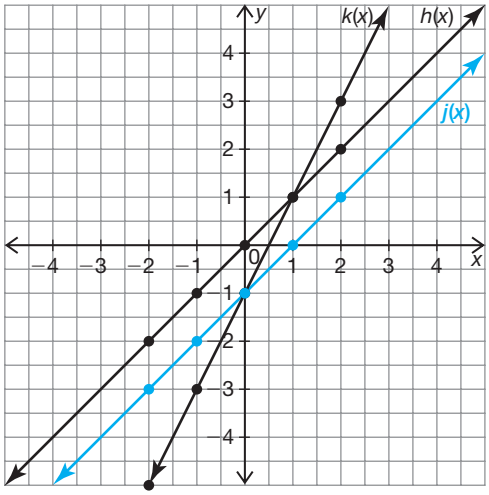
$f(x) = 3x$; $g(x) = -3x - 4$



Draw the function $j(x)$ with outputs such that $k(x) = h(x) + j(x)$. Then complete the table of values to verify that $h(x) + j(x) = k(x)$.

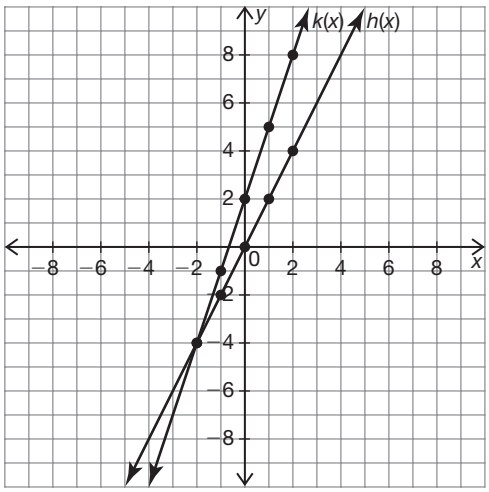
7.

x	$h(x)$	$j(x)$	$k(x) = h(x) + j(x)$
−2	−2	−3	−5
−1	−1	−2	−3
0	0	−1	−1
1	1	0	1
2	2	1	3



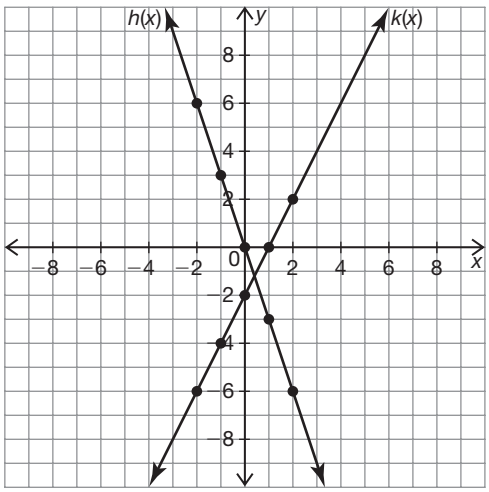
8.

x	$h(x)$	$j(x)$	$k(x) = h(x) + j(x)$
−2			
−1			
0			
1			
2			



9.

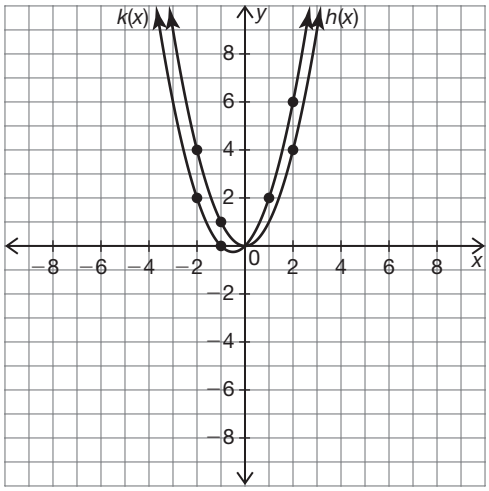
x	$h(x)$	$j(x)$	$k(x) = h(x) + j(x)$
−2			
−1			
0			
1			
2			



Name _____ Date _____

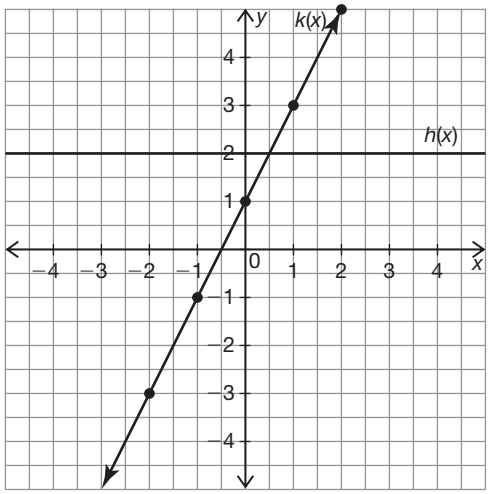
10.

x	$h(x)$	$j(x)$	$k(x) = h(x) + j(x)$
−2			
−1			
0			
1			
2			



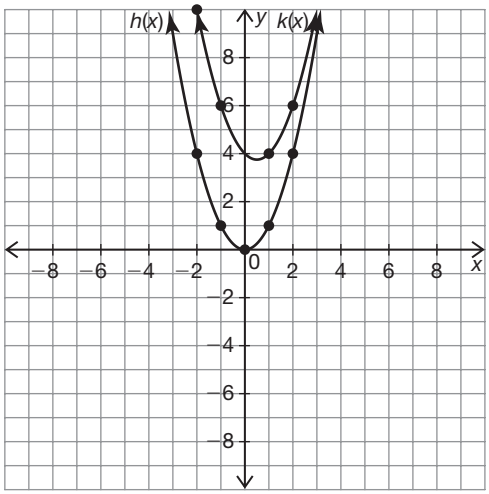
11.

x	$h(x)$	$j(x)$	$k(x) = h(x) + j(x)$
−2			
−1			
0			
1			
2			



12.

x	$h(x)$	$j(x)$	$k(x) = h(x) + j(x)$
−2			
−1			
0			
1			
2			



Algebraically show that $h(x) + j(x)$ is equivalent to $k(x)$.

13. $h(x) = 2x - 3$; $j(x) = -4x + 6$; $k(x) = -2x + 3$

$$h(x) + j(x) = k(x)$$
$$2x - 3 + (-4x + 6) = -2x + 3$$
$$-2x + 3 = -2x + 3$$

14. $h(x) = 15 - x$; $j(x) = \frac{1}{2}x + 1$; $k(x) = 16 - \frac{1}{2}x$

15. $h(x) = -3x + 5$; $j(x) = -5x - 7$; $k(x) = -8x - 2$

16. $h(x) = -x - 12$; $j(x) = -6x - 21$; $k(x) = -7x - 33$

17. $h(x) = \frac{1}{2}x + 9$; $j(x) = \frac{1}{2}x + 6$; $k(x) = x + 15$

18. $h(x) = -12x - 1$; $j(x) = -7x + 11$; $k(x) = -19x + 10$