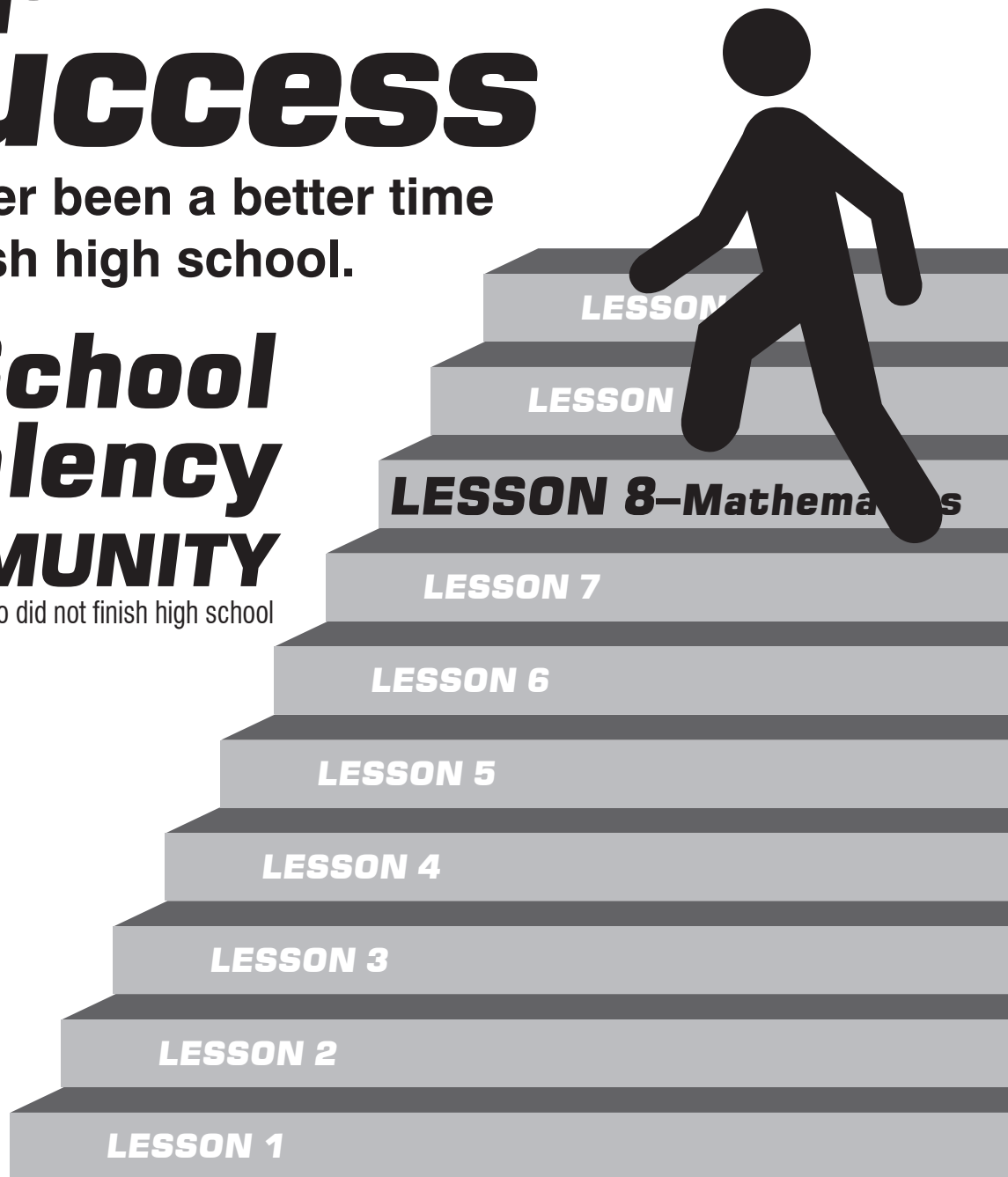


Steps to Success

There's never been a better time to finish high school.

High School Equivalency in the **COMMUNITY**

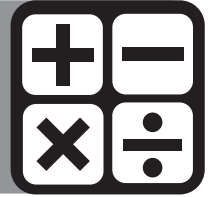
a 'Mail-In' program for adults who did not finish high school



**Eighth Step—
END IN
SIGHT!**

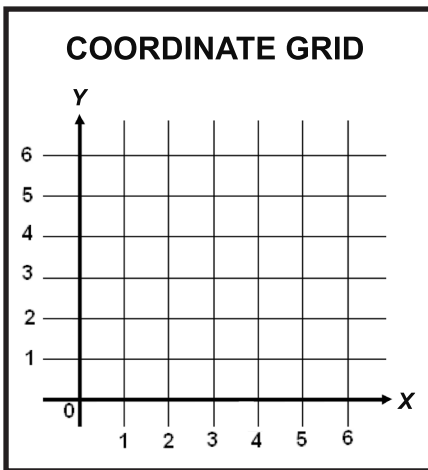
LESSON 8

Mathematical Reasoning



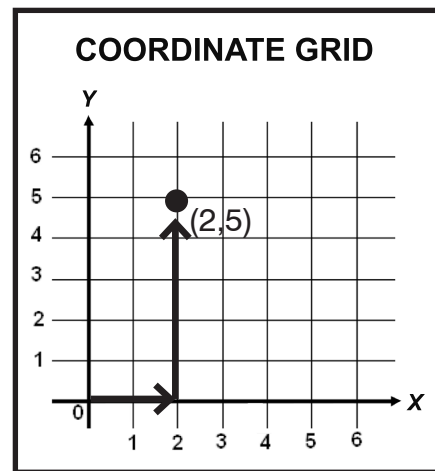
Coordinate Grid Graphing

Coordinate graphing sounds very dramatic but it is actually just a visual method for showing relationships between numbers. The relationships are shown on a coordinate grid. A **coordinate grid** has two perpendicular lines, or **axes**, labeled like number lines. The **horizontal axis** is called the **x-axis**. The **vertical axis** is called the **y-axis**. The point where the x-axis and y-axis intersect is called the **origin**.

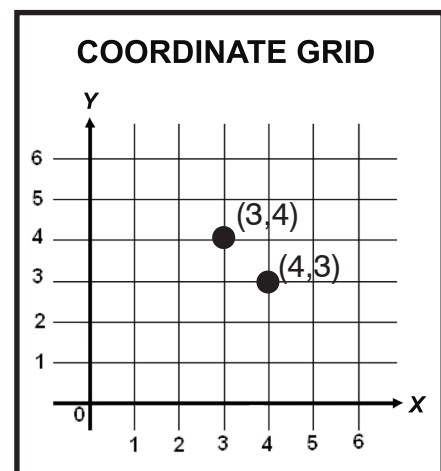


The numbers on a coordinate grid are used to locate points. Each point can be identified by an **ordered pair** of numbers; that is, a number on the x-axis called an **x-coordinate**, and a number on the y-axis called a **y-coordinate**. Ordered pairs are written in parentheses (x-coordinate, y-coordinate). The origin is located at (0,0). Note that there is no space after the comma.

The location of (2,5) is shown on the coordinate grid below. The x-coordinate is 2. The y-coordinate is 5. To locate (2,5), move 2 units to the right on the x-axis and 5 units up on the y-axis.

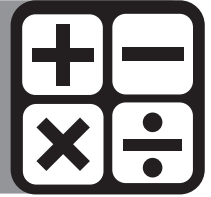


The order in which you write x- and y-coordinates in an ordered pair is very important. The x-coordinate always comes first, followed by the y-coordinate. As you can see in the coordinate grid below, the ordered pairs (3, 4) and (4, 3) refer to two different points!



LESSON 8

Mathematical Reasoning



ASSIGNMENT 1

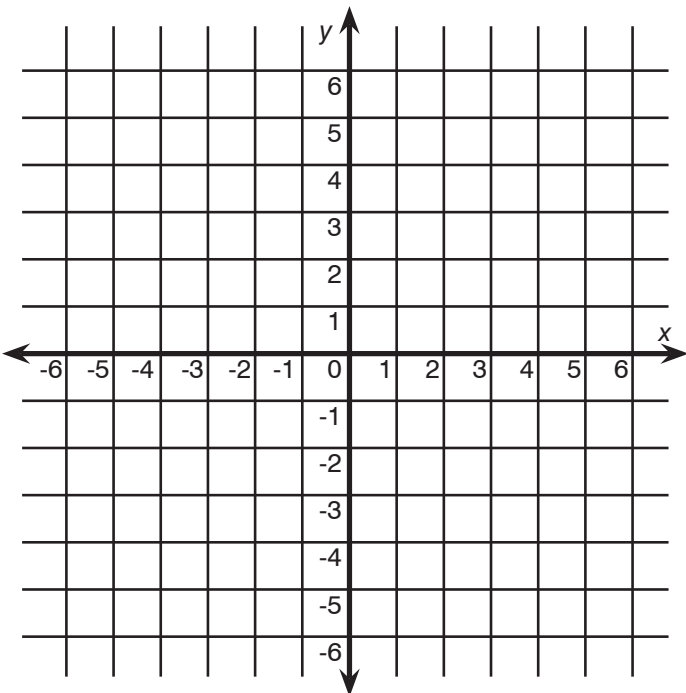
DIRECTIONS

A. Graph the following set of ordered pairs.

1. (3,-2)
2. (2,3)
3. (-5,5)
4. (-4,4)
5. (-5,0)

x	y
3	-2
2	3
-5	5
-4	4
-5	0
0	0

TABLE OF VALUES



B. What do you call the point located at (0,0)?

ASSIGNMENT 2

Relations and Functions

Vocabulary to Know

Domain	Function
Range	Relation
Inverse	Vertical line test

Noah has worked hard to create a recycling club at his school after noticing how many recyclable items were being thrown away. In order to determine how many recycling bins the school needed, Noah researched the containers and found that they each hold about 50 bottles. The club members then collected data about how many bottles they typically would recycle in a week.

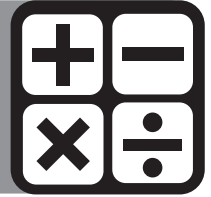
In this lesson, we'll look at values such as those below, which represent a relation, and learn how to determine if the relation is a function. We'll also see how to find the inverse of a relation.

The table shows recycling data that Noah collected. It is an example of a relation. A **relation** is a rule that gives an **output** for every valid **input**. The first set of numbers—the number of bottles collected—and the second set of numbers—how many recycle bins are needed—have a relationship to one another.

	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5
Number of bottles collected	48	55	62	36	150
Number of bins needed	1	2	2	1	3

LESSON 8

Mathematical Reasoning

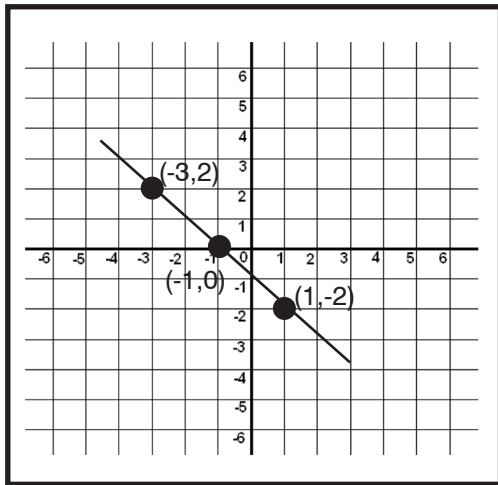


Every relation can be written as a set of ordered pairs. For example, the ordered pairs below represent the recycling data seen in the table.

(48,1), (55,2), (62,2), (36,1), (150,3)

In fact, a relation can be represented multiple ways.

COORDINATE GRID-GRAPH



MAPPING DIAGRAM

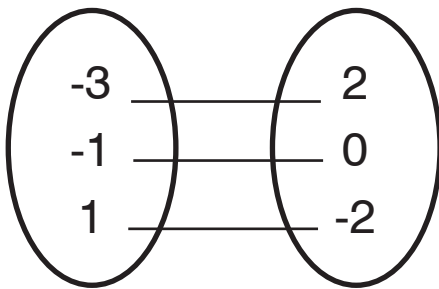


TABLE OF VALUES

x	y
-3	2
-1	0
1	-2

ORDERED PAIRS

(-3,2)
(-1,0)
(1,-2)

AN EQUATION

$$y = 2x + 4$$

WORDS

We can also describe a function in words: **y** is equal to three times **x** minus one. A real life example could be: Keisha sells programs at football games. For each program she sells, she earns \$3. Her cost to produce each program is \$1. Her profit is described by the function, profit (**y**) is equal to three times the number of programs she sells (**x**) minus the one dollar production cost.

$$y = 3x - 1$$

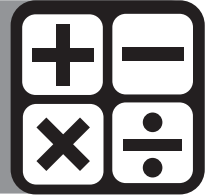
The **domain** of a relation is the set of **inputs**, or the **x-coordinates** of the ordered pairs. The **range** of a relation is the set of **outputs**, or the **y-coordinates** of the ordered pairs. When you list the domain and range of a relation, the values are typically listed in order from least to greatest and should not be repeated.

EXAMPLE: (-3,2)

Domain Input x	Range Output y
-3	2

LESSON 8

Mathematical Reasoning



DIRECTIONS

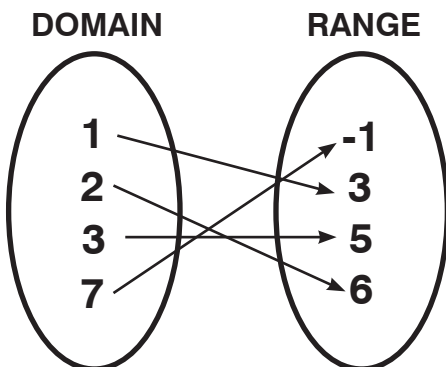
Complete the table using the given ordered pairs. Identify the domain and range for each relation.

1. (-1,0)
2. (1,-2)
3. (1,3)
4. (4,5)
5. (3,3)
6. (5,6)
7. (7,0)

	Domain x	Range y
1.		
2.		
3.		
4.		
5.		
6.		
7.		

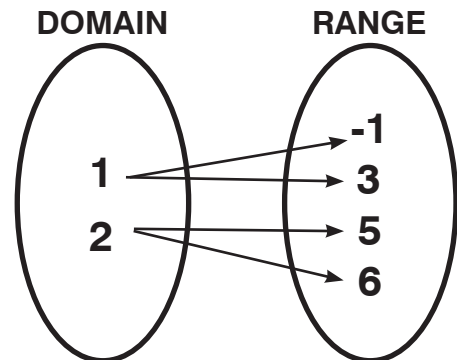
Look at the following mapping diagrams. Is each relation below also a function?

A function is a special type of relation where each input has *exactly one* output. In other words, each value in the domain is assigned to exactly one value in the range.

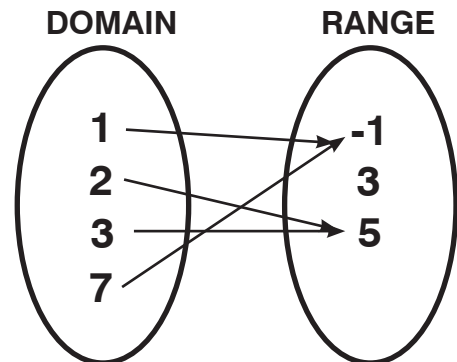


YES, THIS RELATION IS A FUNCTION.

Each value in the domain (the input) is mapped to exactly one value in the range (the output).



NO, THIS RELATION IS NOT A FUNCTION.
Both values in the domain are mapped to more than one value in the range. The number 1 maps to both -1 and 3. The number 2 maps to both 5 and 6.

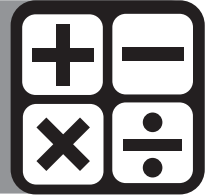


YES, THIS RELATION IS A FUNCTION.

While two different numbers in the domain, 2 and 3, map to 5, it still meets the definition that each input (domain) maps to exactly one output (range).

LESSON 8

Mathematical Reasoning



DIRECTIONS

Look at the following Tables of Value.
Is each relation a function?
Circle Yes or No.

8. Yes
No

x	y
1	2
2	3
1	4
3	3

9. Yes
No

x	y
1	2
2	4
3	4

ASSIGNMENT 3

The following table shows the number of blocks for 6 NBA teams during the 2010-2011 postseason.

DIRECTIONS

Identify the domain and range. Then determine if the relation is a function.

NBA TEAM	OWN BLOCKS	OPPONENTS' BLOCKS
Oklahoma City	7.6	5.2
New York	6.8	5.0
Chicago	6.6	6.4
Miami	6	4.2

1. List the values for the domain. Use a comma to separate each value.

2. List the values for the range. Use a comma to separate each value.

3. Does this data represent a function?

- A. Yes, each input has exactly one output.
- B. No, one of the inputs is assigned to more than one output.
- C. No, one of the outputs is assigned to more than one input.

KEY POINT

If a value in the domain repeats, then the relation is not a function.

DIRECTIONS

Read the questions. Choose the correct answer or fill in the blank.

4. In the following relation, identify the domain and range.

$\{(2,-4), (-2,4), (2,5), (5,-1), (-1,5)\}$

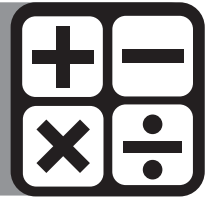
- A. domain: $\{-4, -1, 4, 5\}$
range: $\{-2, -1, 2, 5\}$
- B. domain: $\{-2, -1, 2, 5\}$
range: $\{-4, -1, 4, 5\}$
- C. domain: $\{-2, -1, 2, 2, 5\}$
range: $\{-4, -1, 4, 5, 5\}$

5. Is the relation a function? Select the best answer.

- A. Yes, the relation is a function.
- B. No, the relation is not a function. The domain values of -1 and 2 are both assigned to 5.
- C. No, the relation is not a function. The domain value of 2 is assigned to both -4 and 5.

LESSON 8

Mathematical Reasoning



Josiah bought a new car for \$25,000. He did some research and found that the value of his car would depreciate at an average rate of \$3,750 per year. The table shows data about the value of his car over the next 4 years.

# of years owned	0	1	2	3	4
Value of Car	\$25,000	\$21,250	\$17,500	\$13,750	\$10,000

6. What is the domain and range of this relation? Use a comma to separate each value in the domain and range.

6a. Domain: {_____}

6b. Range: {_____}

6c. Is this relation a function?

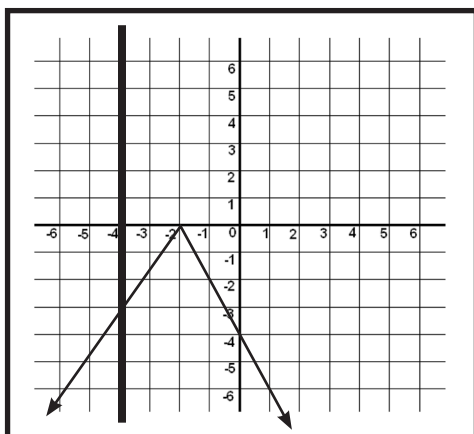
Yes _____ or No _____

ASSIGNMENT 4

The Vertical Line Test

Let's look at how to check a graph using a vertical line to see if a relation is a function.

To check a graph using the vertical line test, ask yourself, "If I drew a vertical line anywhere on this graph, would the line pass through more than one point on the graph?"



Would any vertical line on the graph pass through more than one point?

Yes _____ or No _____

If you chose **No**, you are **correct**.

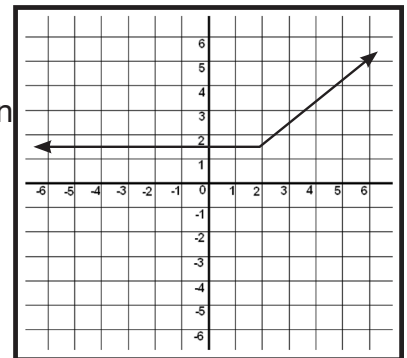
You could not draw a vertical any place on the graph where the vertical line would pass through more than one point.

DIRECTIONS

Determine whether or not the following relations are functions. Circle the correct response.

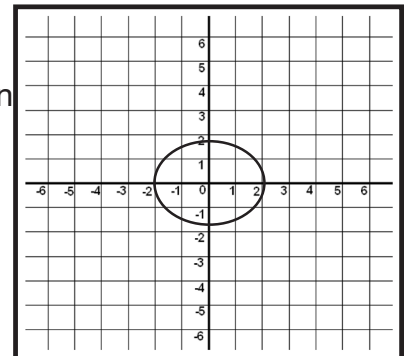
1.

- A. A function
B. Not a function



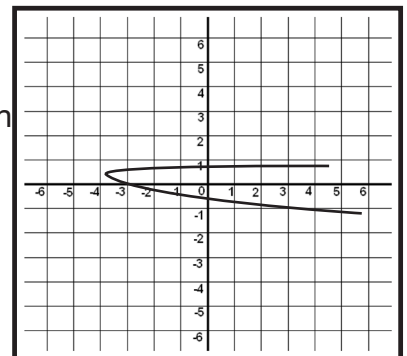
2.

- A. A function
B. Not a function



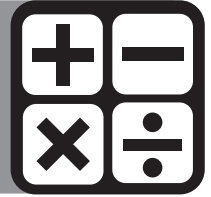
3.

- A. A function
B. Not a function

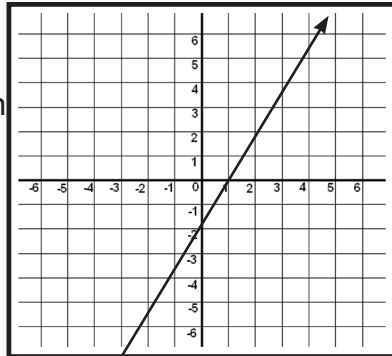


LESSON 8

Mathematical Reasoning



4.
A. A function
B. Not a function



Are all lines function? All lines that can be written in slope-intercept form, $y = mx + b$, are functions. Vertical lines are not functions since they do not pass the vertical line test.

ASSIGNMENT 5

Inverse of a Relation

The inverse of a relation reverses the mapping of the domain to the range. That means, if a relation maps a domain value a to range value b , the **inverse relation** “reverses” the mapping and maps b back to a . In other words, *if (a, b) is an ordered pair in a relation, the (b, a) is an ordered pair in the inverse of the relation.*

EXAMPLE:

<p>RELATION $\{(-3,6), (4,0), (0,-2), (7,5)\}$</p> <p>INVERSE OF RELATION $\{(6,-3), (0,4), (-2,0), (5,7)\}$</p>
--

To find the inverse of the relation, switch the x - and y -coordinates.

DIRECTIONS

Complete the following. Use the table to complete the assignment.

The relation in the table shows several equivalent temperatures in degrees Celsius and degrees Fahrenheit.

Temperature (C)	0	10	25	35
Temperature (F)	32	50	77	95

1. Identify the domain and range of the relation.

Domain (x) _____

Range (y) _____

2. List the values in order from least to greatest and use a comma to separate each value.

Domain (x) _____

Range (y) _____

3. Now, write the inverse of the relation as a set of ordered pairs.

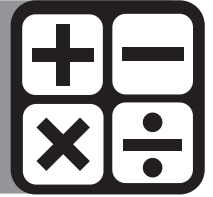
Inverse:

{(_____) , (_____) ,
(_____) , (_____) }

Did you notice that the domain of the relation became the range of the inverse, and range of the relation became the domain of the inverse?

LESSON 8

Mathematical Reasoning



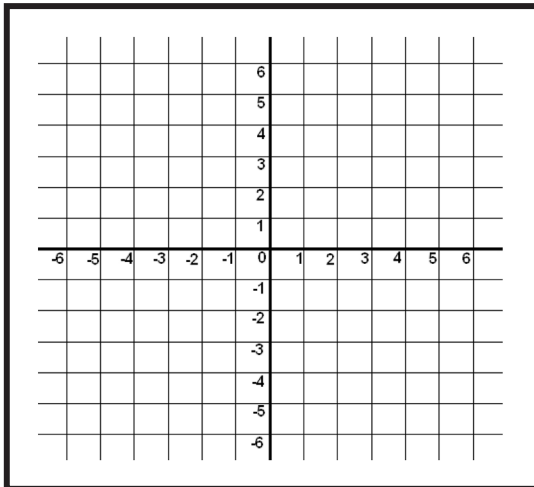
DIRECTIONS

Complete the following.

4. Write the inverse of the relation (ordered pairs).

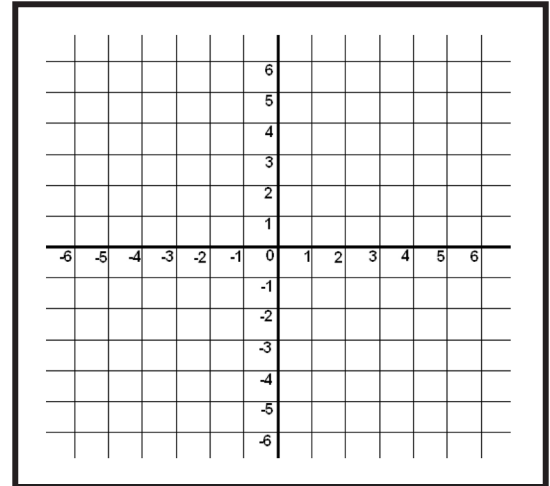
Relation	Inverse
$(-6,0)$	
$(-3,-2)$	
$(0,-3)$	
$(1,4)$	
$(2,1)$	
$(5,-2)$	

5. Graph the *RELATION* found in #4.



6. Is the relation a function? _____

7. Graph the *INVERSE* found in #4.



8. Is the inverse of the relation a function?

ASSIGNMENT 6

Vocabulary to Know

Domain	Function
Range	Relation
Inverse	Vertical line test

DIRECTIONS

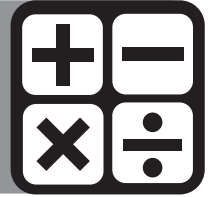
Write the definitions for the *Vocabulary to Know*.

1. Domain _____

2. Range _____

LESSON 8

Mathematical Reasoning



3. Inverse _____

4. Function _____

5. Relation _____

6. Vertical-line test _____

ASSIGNMENT 7

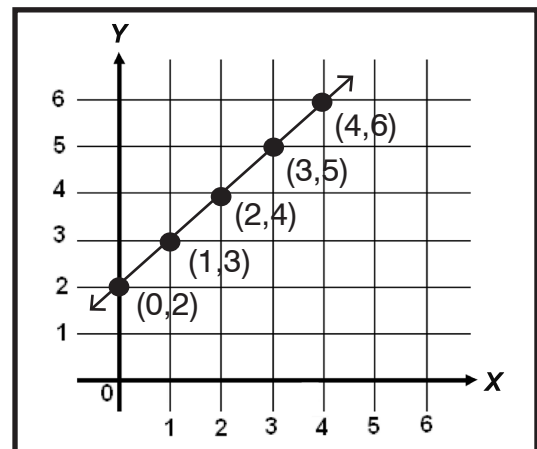
Graphing Equations

The function table below shows the x- and y-coordinates for five ordered pairs. You can describe the relationship between the x- and y-coordinates for each of these ordered pairs with this rule: the x-coordinate plus two equals the y-coordinate. You can also describe this relationship with the algebraic equation

$$x + 2 = y$$

x-coordinate	$x+2=y$	y-coordinate	ordered pair
0	$0+2=2$	2	(0,2)
1	$1+2=3$	3	(1,3)
2	$2+2=4$	4	(2,4)
3	$3+2=5$	5	(3,5)
4	$4+2=6$	6	(4,6)

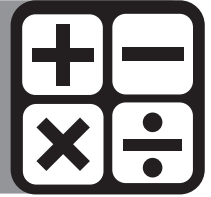
To graph the equation $x + 2 = y$, each ordered pair is located on a coordinate grid, and then the points are connected. Notice that the graph forms a straight line. The arrows indicate that the line goes on in both directions.



The graph for any simple addition, subtraction, multiplication, or division equation forms a straight line. Any line whose set of ordered pairs creates a straight line is a **linear equation**.

LESSON 8

Mathematical Reasoning



Linear Equations

A **linear equation** is an equation whose graph is a straight line. If you are given the equation $y=x$, you can find the solutions for the equation by creating a table of values. The table will give you the ordered pairs that you a plot to see the graph.

EXAMPLE:

1. Choose numbers to substitute for the letter x

Graph $y=x$	
x	y
-2	
-1	
0	
1	
2	

2. Now solve for y by substituting in the numbers you have chosen for x .

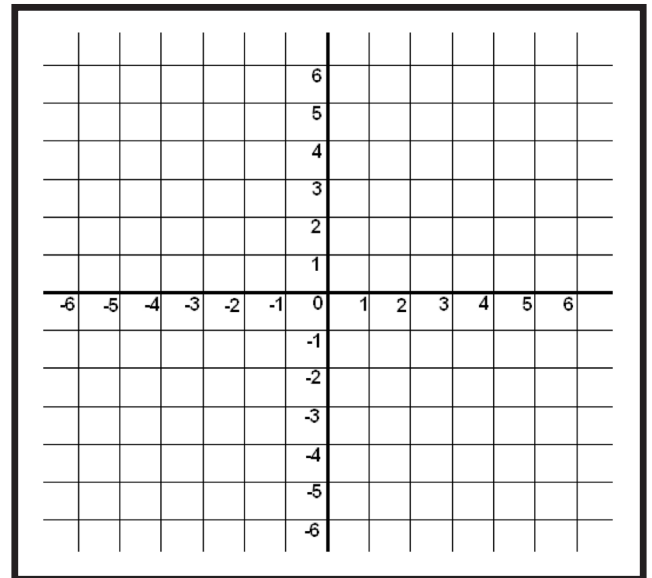
x	y
-2	-2
-1	
0	
1	
2	

3. Continue to substitute in until you have completed the table.

x	y
-2	-2
-1	-1
0	0
1	1
2	2

4. Now, graph the equation by plotting the points.

$\{(-2,-2), (-1,-1), (0,0), (1,1), (2,2)\}$



DIRECTIONS

Complete the following.

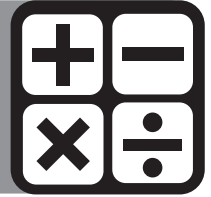
5. Complete the table of values for the equation $y = 2x$.

Graph $y = 2x$

x	y

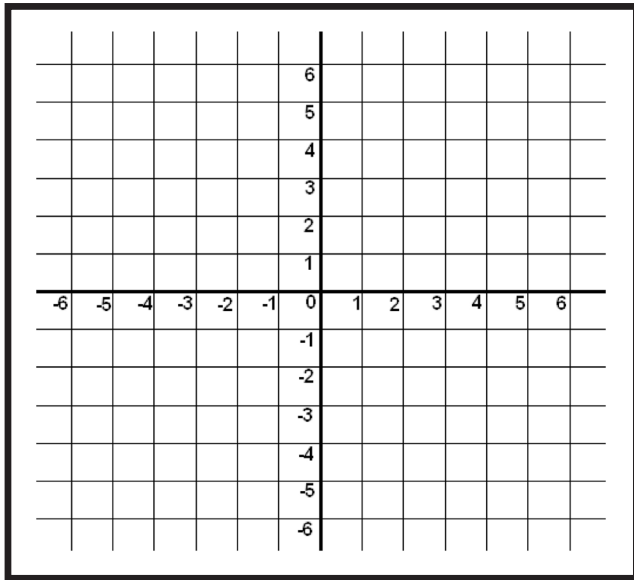
LESSON 8

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6. Now, graph the equation by plotting the points.

Graph $y=2x$



ASSIGNMENT 8

Function Notation

$$f(x) = 3x + 4$$

$f(x)$ is the same as y : $y = 3x + 4$ is the same as $f(x) = 3(x) + 4$.

$f(x)$ is often used since it makes it easier to see what happens as we put in different inputs for x .

$$f(x) = 3(x) + 4$$

You would read this as the function of x equals three times x plus 4. You must understand that the function of x is y . The value of x determines the value of y .

If $x = 0$, substitute 0 for x

$$f(0) = 3(0) + 4$$

Now Solve. $f(0) = 4$

Remember the function of x equals (is) y . So, the function of $x(0)$ is $y(4)$.

x is 0 then y is 4

$(0,4)$ is an ordered pair for the equation

$$f(x) = 3(x) + 4$$

NOW YOU TRY!

DIRECTIONS
Complete the following.

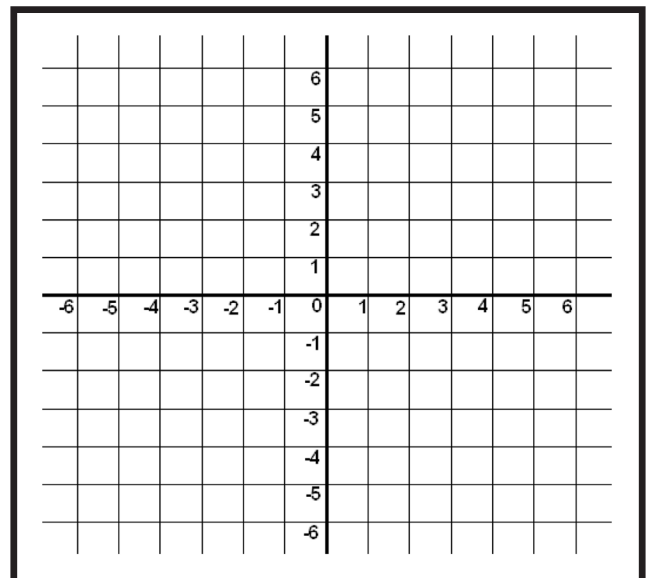
- Complete the Table of Values for the equation $f(x) = 3(x) - 1$. Remember you can choose the numbers for x and that will determine the value of y .

x	y

- Write your ordered pairs on the lines below.

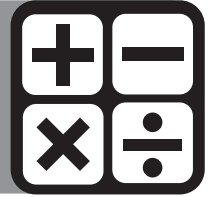
- _____
- _____
- _____
- _____

- Graph the line.



LESSON 8

Mathematical Reasoning



ASSIGNMENT 9

Here are some to practice:

The average lifespan of American women has been tracked, and the model for the data is $y=0.2t + 73$, where $t=0$ corresponds to 1960. Explain the meaning of the slope and the **y-intercept**.

What is the slope? It is $m=0.2$. This value tells me that, for every increase of 1 in my input variable t (that is, for every increase of one year), the value of my output variable y will increase by 0.2.

What is the meaning of the slope?

The slope tells me that every year, the average lifespan of American women increased by 0.2 years, or about 2.4 months.

When $t=0$, what is the value of y ? Looking at the equation, I see that $y=73$.

What is the meaning of this y-value?

The intercept value tells me that, in 1960 (when they started counting), the average lifespan of an American woman was 73 years.

1. The equation for the speed (not the height) of a ball which is thrown straight up in the air is given by $v=128 - 32t$, where v is the velocity (in feet per second) and t is the number of seconds after the ball is thrown. With what initial velocity was the ball thrown? What is the meaning of the slope?

2. Fisherman in the Finger Lakes Region have been recording the dead fish they encounter while fishing the region. The Department of Environmental Conservation monitors the pollution index for the Finger Lakes Region. The model for the number of fish deaths “ y ” for a given pollution index “ x ” is $y=9.607x + 111.958$. What is the meaning of the slope? What is the meaning of the **y-intercept**?

References

www.sascurriculumpathways.com
www.abspd.appstate.edu/testing-resources
www.ged.com

