Instructional Routines for Mathematics Intervention

The purpose of these mathematics instructional routines is to provide educators with materials to use when providing intervention to students who experience difficulty with mathematics. The routines address content included in the grades 2-8 Texas Essential Knowledge and Skills (TEKS). There are 23 modules that include routines and examples – each focused on different mathematical content. Each of the 23 modules include vocabulary cards and problem sets to use during instruction. These materials are intended to be implemented explicitly with the aim of improving mathematics outcomes for students.

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Instructional Routines for Mathematics Intervention

MODULE 20

Functions and Ordered Pairs

Module 20: Functions and Ordered Pairs
Mathematics Routines

A. Important Vocabulary with Definitions

Term	Definition
coordinate plane	A two-dimensional plane formed at the intersection of the *x*-axis and *y*-axis.
equation	A mathematical statement that two expressions are the same or equal; must have an equal sign.
expression	A combination of variables, numbers, and/or operations that represents a mathematical relationship; does not have an equal sign.
function	A relationship between two quantities in which every output corresponds to exactly one input.
function table	A table that displays a set of inputs and outputs in such a way that each input has a unique output.
input variable	The *x* of an equation; the information put in to find the output.
ordered pair	A pair of numbers used to locate a point on a coordinate plane.
origin	A point where the *x*-axis and *y*-axis intersect. The origin has the coordinates (0, 0).
output variable	The *y* of an equation; the information gained after the input is plugged into an equation.
quadrant	The *x*- and *y*-axes divide the coordinate plane into four regions called quadrants.
x-axis	The horizontal number line on a coordinate plane.
y-axis	The vertical number line on a coordinate plane.

B. Background Information

In this module, we focus primarily on functions. The secondary focus is ordered pairs and graphing related to functions. We include routines and examples for the following:

(1) Function Tables with Rules and Expressions
(2) Using the Rule in Function Tables
(3) Function Tables with Rules and Equations
(4) Function Tables and Ordered Pairs
(5) Graphing Ordered Pairs

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C. Routines and Examples

(1) Function Tables with Rules and Expressions

Routine

Materials:

- Module 20 Problem Sets
- Module 20 Vocabulary Cards
    - If necessary, review Vocabulary Cards before teaching

ROUTINE

Teacher	**Let's determine the rule for a function table and write an expression that represents the rule. First, let's talk about a function table. A function table has two columns** (for tables presented vertically)**/two rows** (for tables presented horizontally)**. What does a function table have?**
Students	Two columns/two rows.
Teacher	**And the columns/rows show *x* and *y*. What do the columns/rows show?**
Students	*x* and *y.*
Teacher	**We can use *x* and *y* to determine a rule about the relationship between *x* and *y*. What can we determine?**
Students	A rule about the relationship between *x* and *y.*
Teacher	**Using that rule, we can write an expression that represents the rule. What's an expression?**
Students	Numbers and operator symbols.
Teacher	**That's right. An expression is made of numbers and at least one operator symbol – like the plus sign, minus sign, multiplication symbol, or division symbol. An expression doesn't have an equal sign. Let's get started.** (Show function table.)
Teacher	**This is a function table. Tell me what you notice about the function table.**
Students	The information is organized in columns/rows. Each column/row represents *x* or *y*.
Teacher	**With this function table, first, we will determine the rule. That's the relationship between *x* and *y.* Look at the *x* column/row. What do you notice about the numbers in the *x* column/row?**
Students	(Comments on pattern.)
Teacher	**The numbers in the *x* column/row are …** (fill in information here about positive and negative numbers and other important aspects). **Now, look at the *y* column/row. What do you notice about the numbers in the *y* column/row?**
Students	(Comments on pattern.)
Teacher	**The numbers in the *y* column/row are …** (fill in information here about positive and negative numbers and other important aspects). **Now, let's look at the relationship between each pair of *x* and *y* values. Look carefully. Do you see**

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	any relationship between *x* and *y* that is the same for every pair of numbers in the function table?
Students	(Comments on rule.)
Teacher	**Let's test out that rule. You said that if we start with *x* and then add/subtract/multiply/divide __, then we arrive at *y*. Let's see if that works. If *x* equals __ and we add/subtract/multiply/divide __** (rule)**, then *y* should be __. Is that true for the first pair of *x* and *y*?**
Students	Yes.
Teacher	**Now, we have to make sure the rule works for every pair of *x* and *y* in the function table. What do we have to do?**
Students	See if the rule works for every pair.
Teacher	**If the rule only works for one or two pairs, then it isn't the correct rule for this function table. Let's see if the rule works for every pair of *x* and *y*. Does the rule work?**
Students	Yes!
Teacher	**So, we determined a rule about the relationship between *x* and *y* in this function table. What's the rule?**
Students	(Explains rule.)
Teacher	**Let's write the rule.** (Write rule. For example, + 6 or – 2 or ÷ 5.)
Teacher	**Now, let's write an expression for the rule. We'll use *x* in our expression. What happens to *x* with our rule?**
Students	(Explains rule.)
Teacher	**Using our rule, our expression would be *x* +/–/×/÷ __** (rule). **Let's write our expression.** (Write expression. For example, $x + 6$ or $x - 2$ or $x \div 5$.)
Teacher	**What's our expression?**
Students	__.
Teacher	**Excellent. We used this function table to do two things. First, we determined the rule that described the relationship between *x* and *y*. Second, we used that rule to write an expression that represented the rule. How did we determine the rule?**
Students	We looked at each pair of *x* and *y* and found the relationship that was the same for each pair.
Teacher	**How did we write the expression?**
Students	We used the rule to write an expression about *x*.
Teacher	**Great work! How can you use the function table to determine a rule and expression?**
Students	Look at all the pairs of *x* and *y*. Determine the change between *x* and *y* and see if that change is the same for all pairs. Then, use the rule to write an expression about *x*.

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Example

x	*y*
2	8
5	20
8	32

EXAMPLE

Teacher	**Let's determine the rule for a function table and write an expression that represents the rule. First, let's talk about a function table. A function table has two columns** (for tables presented vertically)**/two rows** (for tables presented horizontally)**. What does a function table have?**
Students	Two columns/two rows.
Teacher	**Look at this function table. What do you notice about this table?** (Show table.)
Students	*x* is in a column and *y* is in a column.
Teacher	**In this function table, *x* and *y* are at the top of each column. We can use *x* and *y* to determine a rule about the relationship between *x* and *y*. What can we determine?**
Students	A rule about the relationship between *x* and *y*.
Teacher	**Using that rule, we can write an expression that represents the rule. What's an expression?**
Students	Numbers and operator symbols.
Teacher	**That's right. An expression is made of numbers and at least one operator symbol – like the plus sign, minus sign, multiplication symbol, or division symbol. An expression doesn't have an equal sign. What does an expression not have?**
Students	An equal sign.
Teacher	**With this function table, let's determine the rule. That's the relationship between *x* and *y*. Look at the *x* column. What do you notice about the numbers in the *x* column?**
Students	All the *x* values are positive.
Teacher	**The numbers in the *x* column are all positive. Now, look at the *y* column. What do you notice about the numbers in the *y* column?**
Students	These *y* values are also positive. Each *y* value is greater than the corresponding *x* value.
Teacher	**The numbers in the *y* column are all positive. I also see that each *y* value is greater than the corresponding *x* value. Now, let's look at the relationship between each pair of *x* and *y* values. Look carefully. Do you see any relationship between *x* and *y* that is the same for every pair of numbers in the function table?**
Students	If you multiply *x* times 4, the product equals *y*.

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Teacher	**Let's test out that rule. You said that if we start with *x* and multiply *x* times 4, the product equals *y*. If *x* equals 2 and we multiply by 4, then *y* should be 8. Is that true for the first pair of *x* and *y*?**
Students	Yes.
Teacher	**Now, we have to make sure the rule works for every pair of *x* and *y* in the function table. What do we have to do?**
Students	See if the rule works for every pair.
Teacher	**If the rule only works for one or two pairs, then it isn't the correct rule for this function table. Let's see if the rule works for every pair of *x* and *y*. Does the rule work?**
Students	Yes!
Teacher	**So, we determined a rule about the relationship between *x* and *y* in this function table. What's the rule?**
Students	Times 4.
Teacher	**Let's write the rule. Our rule is times 4.** (Write rule: × 4.)
Teacher	**Now, let's write an expression for the rule. We'll use *x* in our expression. What happens to *x* with our rule?**
Students	When we multiply *x* times 4, the product is *y*.
Teacher	**Using our rule, our expression would be *x* times 4. Let's write our expression.** (Write expression: $x \times 4$.)
Teacher	**What's our expression?**
Students	*x* times 4.
Teacher	**Super. We used this function table to do two things. First, we determined the rule that described the relationship between *x* and *y*. Second, we used that rule to write an expression that represented the rule. How did we determine the rule?**
Students	We looked at each pair of *x* and *y* and found the relationship that was the same for each pair.
Teacher	**How did we write the expression?**
Students	We used the rule to write an expression about *x*.
Teacher	**Great work! How can you use the function table to determine a rule and expression?**
Students	Look at all the pairs of *x* and *y*. Determine the change between *x* and *y* and see if that change is the same for all pairs. Then, use the rule to write an expression about *x*.

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(2) Using the Rule in Function Tables

Routine

Materials:

- Module 20 Problem Sets
- Module 20 Vocabulary Cards
    - If necessary, review Vocabulary Cards before teaching

ROUTINE

Teacher	**Let's determine the rule for a function table and write an expression that represents the rule. First, let's talk about a function table. A function table has two columns** (for tables presented vertically)**/two rows** (for tables presented horizontally)**. What does a function table have?**
Students	Two columns/two rows.
Teacher	**And the columns/rows show *x* and *y*. What do the columns/rows show?**
Students	*x* and *y.*
Teacher	**We can use *x* and *y* to determine a rule about the relationship between *x* and *y*. What can we determine?**
Students	A rule about the relationship between *x* and *y.*
Teacher	**Using that rule, we can write an expression that represents the rule. What's an expression?**
Students	Numbers and operator symbols.
Teacher	**That's right. An expression is made of numbers and at least one operator symbol – like the plus sign, minus sign, multiplication symbol, or division symbol. An expression does not have an equal sign. Let's get started.** (Show function table.)
Teacher	**This is a function table. Tell me what you notice about the function table.**
Students	The information is organized in columns/rows. Each column/row represents *x* or *y*.
Teacher	**With this function table, first, we will determine the rule. That's the relationship between *x* and *y*. Look at the *x* column/row. What do you notice about the numbers in the *x* column/row?**
Students	(Comments on pattern.)
Teacher	**The numbers in the *x* column/row are …** (fill in information here about positive and negative numbers and other important aspects). **Now, look at the *y* column/row. What do you notice about the numbers in the *y* column/row?**
Students	(Comments on pattern.)
Teacher	**The numbers in the *y* column/row are …** (fill in information here about positive and negative numbers and other important aspects). **Now, let's look at the relationship between each pair of *x* and *y* values. Look carefully. Do you see any relationship between *x* and *y* that is the same for every pair of numbers in the function table?**
Students	(Comments on rule.)

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Teacher	**Let's test out that rule. You said that if we start with *x* and then add/subtract/multiply/divide __, then we arrive at *y*. Let's see if that works. If *x* equals __ and we add/subtract/multiply/divide __** (rule)**, then *y* should be __. Is that true for the first pair of *x* and *y*?**
Students	Yes.
Teacher	**Now, we have to make sure the rule works for every pair of *x* and *y* in the function table. What do we have to do?**
Students	See if the rule works for every pair.
Teacher	**If the rule only works for one or two pairs, then it isn't the correct rule for this function table. Let's see if the rule works for every pair of *x* and *y*. Does the rule work?**
Students	Yes!
Teacher	**So, we determined a rule about the relationship between *x* and *y* in this function table. What's the rule?**
Students	(Explains rule.)
Teacher	**Let's write the rule.** (Write rule. For example, + 6 or – 2 or ÷ 5.)
Teacher	**Now, let's write an expression for the rule. We'll use *x* in our expression. What happens to *x* with our rule?**
Students	(Explains rule.)
Teacher	**Using our rule, our expression would be *x* +/–/×/÷ __** (rule). **Let's write our expression.** (Write expression. For example, *x* + 6 or *x* – 2 or x ÷ 5.)
Teacher	**What's our expression?**
Students	__.
Teacher	**Great work. Now, this function table has missing information. It's our job to fill in the missing information using our rule. What information is missing?**
Students	*x* or *y*.
Teacher	**In this table, *x*/*y* is missing. What's the rule or the relationship between *x* and *y*?** (Explains rule.)
Teacher	**Let's use that rule to fill in the missing information.** (Fill in missing information in table.)
Teacher	**Awesome. How can you fill in missing information in a function table?**
Students	Look at all the pairs of *x* and *y*. Determine the change between *x* and *y* and see if that change is the same for all pairs. Then, use the rule to write an expression about *x*. Finally, use the rule or expression to figure out any missing *x* or *y* values.

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Example

x	2	4	7	10
y	-3	-1	__	5

EXAMPLE

Teacher	**Let's determine the rule for a function table and write an expression that represents the rule. First, let's talk about a function table. A function table has two columns** (for tables presented vertically)**/two rows** (for tables presented horizontally)**. What does a function table have?**
Students	Two columns/two rows.
Teacher	**Look at this function table. Tell me what you notice about this function table.** (Show table.)
Students	The information is organized by rows. Each row represents *x* or *y*.
Teacher	**We can use *x* and *y* to determine a rule about the relationship between *x* and *y*. What can we determine?**
Students	A rule about the relationship between *x* and *y*.
Teacher	**Using that rule, we can write an expression that represents the rule. What's an expression?**
Students	Numbers and operator symbols.
Teacher	**That's right. An expression is made of numbers and at least one operator symbol – like the plus sign, minus sign, multiplication symbol, or division symbol. An expression does not have an equal sign.**
Teacher	**This is a function table. Tell me what you notice about the function table.**
Students	The information is organized in rows. Each row represents *x* or *y*.
Teacher	**With this function table, first, we will determine the rule. That's the relationship between *x* and *y*. Look at the *x* row. What do you notice about the numbers in the *x* row?**
Students	The numbers are positive. The numbers are greater than the corresponding *y* values.
Teacher	**The numbers in the *x* row are positive. I also see that each *x* value is greater than the corresponding *y* value. Now, look at the *y* row. What do you notice about the numbers in the *y* row?**
Students	The numbers are a mix of positive and negative numbers. Each *y* value is less than the corresponding *x* value.
Teacher	**The numbers in the *y* row are less than each of the corresponding *y* values. Now, let's look at the relationship between each pair of *x* and *y* values. Look carefully. Do you see any relationship between *x* and *y* that is the same for every pair of numbers in the function table?**
Students	If you subtract 5 from *x*, the difference is *y*.
Teacher	**Let's test out that rule. You said that if we start with *x* and then subtract 5, then we arrive at *y*. Let's see if that works. If *x* equals 2 and we subtract 5, then *y* should be -3. Is that true for the first pair of *x* and *y*?**

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Students	Yes.
Teacher	**Now, we have to make sure the rule works for every pair of *x* and *y* in the function table. What do we have to do?**
Students	See if the rule works for every pair.
Teacher	**If the rule only works for one or two pairs, then it isn't the correct rule for this function table. Let's see if the rule works for every pair of *x* and *y*. Does the rule work?**
Students	Yes!
Teacher	**So, we determined a rule about the relationship between *x* and *y* in this function table. What's the rule?**
Students	Subtract 5.
Teacher	**Let's write the rule.** (Write rule: – 5.)
Teacher	**Now, let's write an expression for the rule. We'll use *x* in our expression. What happens to *x* with our rule?**
Students	*x* minus 5.
Teacher	**Using our rule, our expression would be *x* – 5. Let's write our expression.** (Write expression: *x* – 5.)
Teacher	**What's our expression?**
Students	*x* minus 5.
Teacher	**Now, this function table has missing information. It's our job to fill in the missing information using our rule. What information is missing?**
Students	*y*.
Teacher	**In this table, *y* is missing. What's the rule or the relationship between *x* and *y*?**
Students	*x* minus 5.
Teacher	**Let's use that rule to fill in the missing information. If *x* equals 7 and you subtract 5, what would *y* be?**
Students	2.
Teacher	**Let's write 2 in the blank for *y*.** (Write 2.)
Teacher	**Great job. How can you fill in missing information in a function table?**
Students	Look at all the pairs of *x* and *y*. Determine the change between *x* and *y* and see if that change is the same for all pairs. Then, use the rule to write an expression about *x*. Finally, use the rule or expression to figure out any missing *x* or *y* values.

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(3) Function Tables with Rules and Equations

Routine

Materials:

- Module 20 Problem Sets
- Module 20 Vocabulary Cards
  - If necessary, review Vocabulary Cards before teaching

ROUTINE

Teacher	**Let's determine the rule for a function table and write an equation that represents the rule. First, let's talk about a function table. A function table has two columns** (for tables presented vertically)**/two rows** (for tables presented horizontally)**. What does a function table have?**
Students	Two columns/two rows.
Teacher	**And the columns/rows show *x* and *y*. What do the columns/rows show?**
Students	*x* and *y*.
Teacher	**We can use *x* and *y* to determine a rule about the relationship between *x* and *y*. What can we determine?**
Students	A rule about the relationship between *x* and *y*.
Teacher	**Using that rule, we can write an equation that represents the rule. What's an equation?**
Students	Numbers and operator symbols with an equal sign.
Teacher	**That's right. An equation is made of numbers and at least one operator symbol – like the plus sign, minus sign, multiplication symbol, or division symbol as well as the equal sign. Let's get started.** (Show function table.)
Teacher	**This is a function table. Tell me what you notice about the function table.**
Students	The information is organized in columns/rows. Each column/row represents *x* or *y*.
Teacher	**With this function table, first, we will determine the rule. That's the relationship between *x* and *y*. Look at the *x* column/row. What do you notice about the numbers in the *x* column/row?**
Students	(Comments on pattern.)
Teacher	**The numbers in the *x* column/row are …** (fill in information here about positive and negative numbers and other important aspects). **Now, look at the *y* column/row. What do you notice about the numbers in the *y* column/row?**
Students	(Comments on pattern.)
Teacher	**The numbers in the *y* column/row are …** (fill in information here about positive and negative numbers and other important aspects). **Now, let's look at the relationship between each pair of *x* and *y* values. Look carefully. Do you see any relationship between *x* and *y* that is the same for every pair of numbers in the function table?**
Students	(Comments on rule.)

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Teacher	**Let's test out that rule. You said that if we start with *x* and then add/subtract/multiply/divide __, then we arrive at *y*. Let's see if that works. If *x* equals __ and we add/subtract/multiply/divide __** (rule)**, then *y* should be __. Is that true for the first pair of *x* and *y*?**
Students	Yes.
Teacher	**Now, we have to make sure the rule works for every pair of *x* and *y* in the function table. What do we have to do?**
Students	See if the rule works for every pair.
Teacher	**If the rule only works for one or two pairs, then it isn't the correct rule for this function table. Let's see if the rule works for every pair of *x* and *y*. Does the rule work?**
Students	Yes!
Teacher	**So, we determined a rule about the relationship between *x* and *y* in this function table. What's the rule?**
Students	(Explains rule.)
Teacher	**Let's write the rule.** (Write rule. For example, + 6 or – 2 or ÷ 5.)
Teacher	**Now, let's write an equation for the rule. We'll use both *x* and *y* in our equation. For a rule with addition or subtraction, let's write the equation as $y = x +/- a$. In this equation, a represents the number in the rule. How do we write an equation for a rule with addition and subtraction?**
Students	$y = x +/- a$.
Teacher	**For a rule with multiplication or division, let's write the equation as $y = ax$ or $y = x \div a$. In this equation, a represents the number in the rule. How do we write an equation for a rule with multiplication or division?**
Students	For multiplication, $y = ax$. For division, $y = x \div a$.
Teacher	**Using our rule, our equation would be *y* = __. Let's write our equation.** (Write equation.)
Teacher	**What's our equation?**
Students	*y* = __.
Teacher	**Nice work. We used this function table to do two things. First, we determined the rule that described the relationship between *x* and *y*. Second, we used that rule to write an equation that represented the rule. How did we determine the rule?**
Students	We looked at each pair of *x* and *y* and found the relationship that was the same for each pair.
Teacher	**How did we write the equation?**
Students	We used the rule to write an equation about *x* and *y*.
Teacher	**So, how can you use the function table to determine a rule and equation?**
Students	Look at all the pairs of *x* and *y*. Determine the change between *x* and *y* and see if that change is the same for all pairs. Then, use the rule to write an equation showing the relationship between *x* and *y*.

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Example

x	y
6	1
36	6
60	10

EXAMPLE

Teacher	**Let's determine the rule for a function table and write an equation that represents the rule. First, let's talk about a function table. A function table has two columns** (for tables presented vertically)**/two rows** (for tables presented horizontally)**. What does a function table have?**
Students	Two columns/two rows.
Teacher	**Look at this function table. What do you notice about this table?** (Show function table.)
Students	*x* and *y* are in columns.
Teacher	**We can use *x* and *y* to determine a rule about the relationship between *x* and *y*. What can we determine?**
Students	A rule about the relationship between *x* and *y*.
Teacher	**Using that rule, we can write an equation that represents the rule. What's an equation?**
Students	Numbers and operator symbols with an equal sign.
Teacher	**That's right. An equation is made of numbers and at least one operator symbol as well as the equal sign. Look at the function table. First, we will determine the rule. That's the relationship between *x* and *y*. Look at the *x* column. What do you notice about the numbers in the *x* column?**
Students	Each *x* is greater than each *y*.
Teacher	**The numbers in the *x* column are greater than each corresponding *y* value. Now, look at the *y* column. What do you notice about the numbers in the *y* column?**
Students	Each *y* value is less than each corresponding *x* value.
Teacher	**The numbers in the *y* column are less than each corresponding *x* value. Now, let's look at the relationship between each pair of *x* and *y* values. Look carefully. Do you see any relationship between *x* and *y* that is the same for every pair of numbers in the function table?**
Students	If you divide each *x* by 6, the quotient is *y*.
Teacher	**Let's test out that rule. You said that if we start with *x* and then divide by 6, then we arrive at *y*. Let's see if that works. If *x* equals 6 and we divide by 6, then *y* should be 1. Is that true for the first pair of *x* and *y*?**
Students	Yes.
Teacher	**Now, we have to make sure the rule works for every pair of *x* and *y* in the function table. What do we have to do?**
Students	See if the rule works for every pair.

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Teacher	**If the rule only works for one or two pairs, then it isn't the correct rule for this function table. Let's see if the rule works for every pair of *x* and *y.* Does the rule work?**
Students	Yes!
Teacher	**So, we determined a rule about the relationship between *x* and *y* in this function table. What's the rule?**
Students	Divide by 6.
Teacher	**Let's write the rule.** (Write rule: ÷ 6.)
Teacher	**Now, let's write an equation for the rule. We'll use both *x* and *y* in our equation. For a rule with addition or subtraction, let's write the equation as $y = x +/- a$. In this equation, *a* represents the number in the rule. How do we write an equation for a rule with addition and subtraction?**
Students	$y = x +/- a$.
Teacher	**For a rule with multiplication or division, let's write the equation as $y = ax$ or $y = x \div a$. In this equation, *a* represents the number in the rule. How do we write an equation for a rule with multiplication or division?**
Students	For multiplication, $y = ax$. For division, $y = x \div a$.
Teacher	**Using our rule, our equation would be $y = x \div 6$. Let's write our equation.** (Write: $y = x \div 6$.)
Teacher	**What's our equation?**
Students	$y = x \div 6$.
Teacher	**Nice work. We used this function table to do two things. First, we determined the rule that described the relationship between *x* and *y*. Second, we used that rule to write an equation that represented the rule. How did we determine the rule?**
Students	We looked at each pair of *x* and *y* and found the relationship that was the same for each pair.
Teacher	**How did we write the equation?**
Students	We used the rule to write an equation about *x* and *y.*
Teacher	**So, how can you use the function table to determine a rule and equation?**
Students	Look at all the pairs of *x* and *y.* Determine the change between *x* and *y* and see if that change is the same for all pairs. Then, use the rule to write an equation showing the relationship between *x* and *y.*

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(4) Function Tables and Ordered Pairs

Routine

Materials:

- Module 20 Problem Sets
- Module 20 Vocabulary Cards
  - If necessary, review Vocabulary Cards before teaching

ROUTINE

Teacher	**Let's use this function table to determine ordered pairs. First, what's a function table?**
Students	It's a table that shows the relationship between *x* and *y.*
Teacher	**Yes. A function table shows the relationship between *x* and *y.* Second, what's an ordered pair?**
Students	It's a way to write *x* and *y*.
Teacher	**An ordered pair shows the relationship between one *x* and *y* pair. We write an ordered pair in parentheses. What do we write in parentheses?**
Students	An ordered pair.
Teacher	**And we write the ordered pair as *x* comma *y.* How do we write the ordered pair?**
Students	*x* comma *y.*
Teacher	**Let's get started.**
	(Show function table.)
Teacher	**This is a function table. In this table, each *x* is paired with a *y.* The *x* represents the first number in an ordered pair. What does the *x* represent?**
Students	The first number in the ordered pair.
Teacher	**The *x* tells you how many spaces from the origin of a coordinate plane you move horizontally. What does *x* represent?**
Students	How many spaces from the origin you move horizontally or across.
Teacher	**The *y* represents the second number in an ordered pair. What does the *y* represent?**
Students	The second number in the ordered pair.
Teacher	**The *y* tells you how many spaces from the *x* of a coordinate plane you move vertically or up and down. What does y represent?**
Students	How many spaces from *x* you move vertically.
Teacher	**So, let's write all the ordered pairs we have in this function table. What's one ordered pair?**
Students	(*x*, *y*).
Teacher	**Yes. Let's write that ordered pair.**
	(Write ordered pair.)
Teacher	**What's another ordered pair from the function table?**
Students	(*x*, *y*).
Teacher	**Yes. Let's write that ordered pair.**

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	(Write ordered pair.)
Teacher	**Let's write all the ordered pairs from the function table.**
	(Write ordered pairs.)
Teacher	**Let's read our ordered pairs. We read them from left to right, like "three, four" or "negative seven, five."**
Students	(Reads ordered pairs.)
Teacher	**Super! We used this function table to write ordered pairs. We wrote each ordered pair in parentheses as *x* comma *y*. How did we write the ordered pairs?**
Students	We wrote each ordered pair in parentheses as *x* comma *y*.
Teacher	**Great. How could you explain ordered pairs to a friend?**
Students	In an ordered pair, *x* represents the number of spaces from the origin of a coordinate plane that you move horizontally. The *y* represents the number of spaces from *x* of a coordinate plane that you move vertically.

Example

x	-1	1	5
y	-3	-1	3

EXAMPLE

Teacher	**Let's use this function table to determine ordered pairs. First, what's a function table?**
Students	It's a table that shows the relationship between *x* and *y*.
Teacher	**Yes. A function table shows the relationship between *x* and *y*. Second, what's an ordered pair?**
Students	It's a way to write *x* and *y*.
Teacher	**An ordered pair shows the relationship between one *x* and *y* pair. We write an ordered pair in parentheses. What do we write in parentheses?**
Students	An ordered pair.
Teacher	**And we write the ordered pair as *x* comma *y*. How do we write the ordered pair?**
Students	*x* comma *y*.
Teacher	**Let's get started.**
	(Show function table.)
Teacher	**This is a function table. In this table, each *x* is paired with a *y*. The *x* represents the first number in an ordered pair. What does the *x* represent?**
Students	The first number in the ordered pair.
Teacher	**The *x* tells you how many spaces from the origin of a coordinate plane you move horizontally or across. What does *x* represent?**
Students	How many spaces from the origin you move horizontally or across.

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Teacher **The *y* represents the second number in an ordered pair. What does the *y* represent?**

Students The second number in the ordered pair.

Teacher **The *y* tells you how many spaces from the *x* of a coordinate plane you move vertically or up and down. What does y represent?**

Students How many spaces from *x* you move vertically or up and down.

Teacher **So, let's write all the ordered pairs we have in this function table. What's one ordered pair?**

Students (-1, -3).

Teacher **Yes. Let's write that ordered pair.**

(Write: (-1, -3).)

Teacher **What's another ordered pair from the function table?**

Students (1, -1).

Teacher **Yes. Let's write that ordered pair.**

(Write: (1, -1).)

Teacher **Let's write all the ordered pairs from the function table.**

(Write: (5, 3).)

Teacher **Let's read our ordered pairs. We read them from left to right.**

Students Negative 1, negative 3.

1, negative 1.

5, 3.

Teacher **Great work! We used this function table to write ordered pairs. We wrote each ordered pair in parentheses as *x* comma *y.* How did we write the ordered pairs?**

Students We wrote each ordered pair in parentheses as *x* comma *y.*

Teacher **Great. How could you explain ordered pairs to a friend?**

Students In an ordered pair, *x* represents the number of spaces from the origin of a coordinate plane that you move horizontally. The *y* represents the number of spaces from *x* of a coordinate plane that you move vertically.

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(5) Graphing Ordered Pairs

Routine

Materials:

- [Module 20 Problem Sets]
- [Module 20 Vocabulary Cards]
  - If necessary, review Vocabulary Cards before teaching

ROUTINE

Teacher	**Let's graph ordered pairs on a coordinate plane. What's an ordered pair?**
Students	It shows the relationship between one *x* and *y* pair.
Teacher	**Yes. An ordered pair shows the relationship between one *x* and *y* pair. Today, we'll plot or mark ordered pairs on this coordinate plane.** (Show coordinate plane.)
Teacher	**What do you notice about this coordinate plane?**
Students	It has an origin. It has one/four quadrants. It has an *x*-axis and a *y*-axis.
Teacher	**This is a coordinate plane. The coordinate plane has an origin. The origin is where the *x*-axis and *y*-axis intersect. What's the origin?**
Students	Where the *x*-axis and *y*-axis intersect.
Teacher	**Speaking of axes, this** (point) **is the *x*-axis. The *x*-axis is a line that runs horizontal or across. What's the *x*-axis?**
Students	A horizontal line.
Teacher	**This** (point) **is the *y*-axis. The *y*-axis is a line that runs vertical or up and down. What's the *y*-axis?**
Students	A vertical line.
Teacher	**The *x*-axis and *y*-axis are the *axes*. Say that with me.**
Students	Axes.
Teacher	**The axes create different quadrants. For example, sometimes, if we're only focused on positive numbers, our coordinate plane will have one quadrant. If we're focused on both positive and negative numbers, our coordinate plane will show four quadrants. A quadrant is the space created by the *x*-axis and *y*-axis from the origin. How many quadrants are in this coordinate plane?**
Students	One/four.
Teacher	**Let's get started.** (Show ordered pair.)
Teacher	**This is an ordered pair. Read this ordered pair.**
Students	(__, __).
Teacher	**The first number in an ordered pair represents *x*. What does the first number represent?**
Students	*x*.
Teacher	**The first number tells you how many spaces from the origin of a coordinate plane you move horizontally or across. What does *x* or the first number represent?**

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Students	How many spaces from the origin you move horizontally or across.
Teacher	**So, let's start at the origin. Where's the origin on this coordinate plane?** (Describes origin.)
Teacher	**The origin is the place where the *x*-axis and *y*-axis intersect. It's helpful to think of the origin as the ordered pair (0, 0). How can we interpret the origin as an ordered pair?**
Students	(0, 0).
Teacher	**If *x* is positive, we'll move forward from the origin along the *x*-axis. How do we move if *x* is positive?**
Students	Forward.
Teacher	**If *x* is negative, we'll move backward from the origin along the *x*-axis. How do we move if *x* is negative?**
Students	Backward.
Teacher	**Let's mark *x* on this coordinate plane. Starting at the origin, let's move our pencil 1, 2, 3, … spaces horizontally from the origin along the *x*-axis.** (Move pencil *x* spaces.)
Teacher	**Now, I leave my pencil where it is and turn my attention to the second number in the ordered pair. The second number in an ordered pair represents *y*. What does the second number represent?**
Students	*y*.
Teacher	**The second number tells you how many spaces from the *x* of a coordinate plane you move vertically or up and down. What does *y* or the second number represent?**
Students	How many spaces from *x* you move vertically or up and down.
Teacher	**So, let's start at *x*. Where's *x* on this coordinate plane?**
Students	(Describes *x*.)
Teacher	**If *y* is positive, we'll move up from *x* along the *y*-axis. How do we move if *y* is positive?**
Students	Up.
Teacher	**If *y* is negative, we'll move down from *x* along the *y*-axis. How do we move if *y* is negative?**
Students	Down.
Teacher	**Let's mark our ordered pair on this coordinate plane. Starting at *x*, let's move our pencil 1, 2, 3, … spaces vertically from *x* along the *y*-axis.** (Move pencil *y* spaces. Draw dot at location of ordered pair.)
Teacher	**So, we marked __** (ordered pair) **on the coordinate plane. Let's label this dot with our ordered pair.** (Write ordered pair.)
Teacher	**We used this coordinate plane to mark or plot an ordered pair. How did we plot the ordered pair?**
Students	We moved *x* spaces horizontally from the origin and then *y* spaces vertically from *x.*
Teacher	**Great. How could you explain plotting an ordered pair on a coordinate plane to a friend?**

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Students We started at the origin. We moved *x* spaces horizontally from the origin. Then, we moved *y* spaces vertically from the *x*. We drew a dot and labeled the ordered pair.

Example

(-4, 5)

Example

Teacher	**Let's graph ordered pairs on a coordinate plane. What's an ordered pair?**
Students	It shows the relationship between one *x* and *y* pair.
Teacher	**Yes. An ordered pair shows the relationship between one *x* and *y* pair. Today, we'll plot or mark ordered pairs on this coordinate plane.** (Show coordinate plane.)
Teacher	**What do you notice about this coordinate plane?**
Students	It has an origin. It has four quadrants. It has an *x*-axis and a *y*-axis.
Teacher	**This is a coordinate plane. The coordinate plane has an origin. The origin is where the *x*-axis and *y*-axis intersect. What's the origin?**
Students	Where the *x*-axis and *y*-axis intersect.
Teacher	**Speaking of axes, this** (point) **is the *x*-axis. The *x*-axis is a line that runs horizontal or across. What's the *x*-axis?**
Students	A horizontal line.
Teacher	**This** (point) **is the *y*-axis. The *y*-axis is a line that runs vertical or up and down. What's the *y*-axis?**
Students	A vertical line.
Teacher	**The *x*-axis and *y*-axis are the *axes*. Say that with me.**
Students	Axes.
Teacher	**The axes create different quadrants. For example, sometimes, if we're only focused on positive numbers, our coordinate plane will have one quadrant. If we're focused on both positive and negative numbers, our coordinate plane will show four quadrants. A quadrant is the space created by the *x*-axis and *y*-axis from the origin. How many quadrants in this coordinate plane?**
Students	Four.
Teacher	**Let's get started.** (Show ordered pair.)
Teacher	**This is an ordered pair. Read this ordered pair.**
Students	(-4, 5).
Teacher	**The first number in an ordered pair represents *x*. What does the first number represent?**
Students	*x*.
Teacher	**The first number tells you how many spaces from the origin of a coordinate plane you move horizontally or across. What does *x* or the first number represent?**
Students	How many spaces from the origin you move horizontally or across.

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Teacher	**So, let's start at the origin. Where's the origin on this coordinate plane?** (Describes origin.)
Teacher	**The origin is the place where the *x*-axis and *y*-axis intersect. It's helpful to think of the origin as the ordered pair (0, 0). How can we interpret the origin as an ordered pair?**
Students	(0, 0).
Teacher	**If *x* is positive, we'll move forward from the origin along the *x*-axis. How do we move if *x* is positive?**
Students	Forward.
Teacher	**If *x* is negative, we'll move backward from the origin along the *x*-axis. How do we move if *x* is negative?**
Students	Backward.
Teacher	**Let's mark *x* on this coordinate plane. Is x positive or negative?**
Students	Negative.
Teacher	**Because -4 is negative, we'll move backward from the origin. Starting at the origin, let's move our pencil -1, -2, -3, -4 horizontally from the origin along the *x*-axis.** (Move pencil backward 4 spaces from origin.)
Teacher	**Now, I leave my pencil where it is and turn my attention to the second number in the ordered pair. The second number in an ordered pair represents *y*. What does the second number represent?**
Students	*y*.
Teacher	**The second number tells you how many spaces from the *x* of a coordinate plane you move vertically or up and down. What does *y* or the second number represent?**
Students	How many spaces from *x* you move vertically or up and down.
Teacher	**So, let's start at *x*. Where's *x* on this coordinate plane?**
Students	(-4.)
Teacher	**If *y* is positive, we'll move up from *x* along the *y*-axis. How do we move if *y* is positive?**
Students	Up.
Teacher	**If *y* is negative, we'll move down from *x* along the *y*-axis. How do we move if *y* is negative?**
Students	Down.
Teacher	**Because 5 is positive, we'll move up vertically from -4. Starting at -4, let's move our pencil 1, 2, 3, 4, 5 spaces vertically from -4.** (Move pencil up 5 spaces from -4. Draw dot at location of ordered pair.)
Teacher	**So, we marked (-4, 5) on the coordinate plane. Let's label this dot with our ordered pair.** (Write (-4, 5).)
Teacher	**We used this coordinate plane to mark or plot an ordered pair. How did we plot the ordered pair?**
Students	We moved -4 spaces horizontally from the origin and then 5 spaces vertically from -4.

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Teacher	**Great. How could you explain plotting an ordered pair on a coordinate plane to a friend?**
Students	We started at the origin. We moved *x* spaces horizontally from the origin. Then, we moved *y* spaces vertically from the *x*. We drew a dot and labeled the ordered pair.

D. Problems for Use During Instruction

[See Module 20 Problem Sets.]

E. Vocabulary Cards for Use During Instruction

[See Module 20 Vocabulary Cards.]

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Module 20:
Functions and Ordered Pairs

Problem Sets

A.

x	*y*
2	4
4	6
6	8

A.

x	y
1	5
3	7
4	8

A.

x	*y*
3	10
4	11
5	12

A.

x	*y*
2	7
3	8
5	10

A.

x	y
1	9
4	12
7	15

A.

x	y
2	0
3	1
17	15

A.

x	*y*
10	2
13	5
18	10

A.

x	*y*
6	1
8	3
11	6

A.

x	y
14	11
18	15
22	19

A.

x	y
1	0
2	1
3	2

A.

x	y
1	3
2	6
7	21

A.

x	y
0	0
5	45
6	54

A.

x	y
4	4
6	6
7	7

A.

x	y
2	20
3	30
5	50

A.

x	y
1	5
3	15
4	20

A.

x	*y*
9	1
27	3
54	6

A.

x	*y*
14	2
28	4
49	7

A.

x	y
56	7
72	9
88	11

A.

x	y
3	1
6	2
9	3

A.

x	y
30	3
40	4
60	6

B.

x	2	4	6
y	4	6	8

B.

x	1	3	4
y	5	7	8

B.

x	3	4	5
y	10	11	12

B.

x	2	3	5
y	7	8	10

B.

x	1	4	7
y	9	12	15

B.

x	2	3	17
y	0	1	15

B.

x	10	13	18
y	2	5	10

B.

x	6	8	11
y	1	3	6

B.

x	14	18	22
y	11	15	18

B.

x	1	2	3
y	0	1	2

B.

x	1	2	7
y	3	6	21

B.

x	0	5	6
y	0	45	54

B.

x	4	6	7
y	4	6	7

B.

x	2	3	5
y	20	30	50

B.

x	1	3	4
y	5	15	20

B.

x	9	27	54
y	1	3	6

B.

x	14	28	49
y	2	4	7

B.

x	56	72	88
y	7	9	11

B.

x	3	6	9
y	1	2	3

B.

x	30	40	60
y	3	4	6

c.

x	*y*
2	5
5	8
6	9
9	___

c.

x	y
1	7
3	___
5	11
7	13

c.

x	*y*
4	___
7	12
10	15
14	19

c.

x	y
12	22
___	25
18	28
20	30

c.

x	*y*
5	19
6	20
___	21
10	24

c.

x	*y*
10	6
13	9
18	14
___	24

c.

x	y
13	3
29	___
58	48
65	55

c.

x	y
23	___
35	28
49	42
61	54

c.

x	*y*
___	11
34	25
47	38
59	50

c.

x	*y*
11	0
12	1
____	11
26	15

c.

x	y
___	4
2	8
3	12
4	16

c.

x	y
0	0
2	___
3	6
5	10

c.

x	*y*
2	22
3	33
4	44
___	55

c.

x	y
3	___
4	24
7	54
12	72

c.

x	y
2	16
____	32
5	40
6	48

c.

x	*y*
4	___
20	5
32	8
36	9

c.

x	***y***
16	2
___	3
56	7
64	8

c.

x	*y*
4	2
8	4
18	___
20	10

c.

x	*y*
10	2
___	3
20	4
25	5

c.

x	*y*
9	3
15	5
21	7
27	___

D.

x	2	5	6	9
y	5	8	9	___

D.

x	1	3	5	7
y	7	___	11	13

D.

x	4	7	10	14
y	___	12	15	19

D.

x	12	___	18	20
y	22	25	28	30

D.

x	5	6	___	10
y	19	20	21	24

D.

x	10	13	18	___
y	6	9	14	24

D.

x	13	29	58	65
y	3	___	48	55

D.

x	23	35	49	61
y	___	28	42	54

D.

x	___	34	47	59
y	11	25	38	50

D.

x	11	12	___	26
y	0	1	11	15

D.

x	___	2	3	4
y	4	8	12	16

D.

x	0	2	3	5
y	0	___	6	10

D.

x	2	3	4	___
y	22	33	44	55

D.

x	3	4	7	12
y	___	24	54	72

D.

x	2	___	5	6
y	16	32	40	48

D.

x	4	20	32	36
y	___	5	8	9

D.

x	16	___	56	64
y	2	3	7	8

D.

x	4	8	18	20
y	2	4	___	10

D.

x	10	___	20	25
y	2	3	4	5

D.

x	9	15	21	27
y	3	5	7	___

E.

x	y
-1	3
-2	2
-3	1

E.

x	*y*
-9	-6
-8	-5
-7	-4

E.

x	*y*
-6	0
-12	-6
-18	-12

E.

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

E.

x	*y*
-8	-5
4	1
7	4

E.

x	*y*
2	-3
7	2
13	8

E.

x	*y*
-4	-16
-5	-20
6	24

E.

x	*y*
-5	0
-7	0
-16	0

E.

x	*y*
8	4
-8	-4
-12	-6

E.

x	*y*
-6	-1
-12	-2
18	3

F.

x	-1	-2	-3
y	3	2	1

F.

x	-9	-8	-7
y	-6	-5	-4

F.

x	-6	-12	-18
y	0	-6	-12

F.

x	0	1	2
y	-2	-1	0

F.

x	-8	4	7
y	-5	1	4

F.

x	2	7	13
y	-3	2	8

F.

x	-4	-5	6
y	-16	-20	24

F.

x	-5	-7	-16
y	0	0	0

F.

x	8	-8	-12
y	4	-4	-6

F.

x	-6	-12	18
y	-1	-2	3

G.

x	*y*
___	-10
-10	0
0	10
10	20

G.

x	*y*
-16	-8
-8	0
-4	4
0	___

G.

x	*y*
-45	-30
____	-15
-15	0
15	30

G.

x	*y*
-1	-6
0	___
1	-4
2	-3

G.

x	*y*
18	9
-9	0
___	-12
-18	-27

G.

x	*y*
26	13
14	1
-23	___
-54	-67

G.

x	y
-7	-49
-9	-63
-10	-70
___	-77

G.

x	*y*
3	___
4	48
5	60
6	72

G.

x	*y*
___	-11
-63	-9
-42	-6
-21	-3

G.

x	*y*
-8	___
-6	3
-4	2
-2	1

H.

x	___	-10	0	10
y	-10	0	10	20

H.

x	-16	-8	-4	0
y	-8	0	4	___

H.

x	-45	___	-15	15
y	-30	-15	0	30

H.

x	-1	0	1	2
y	-6	___	-4	-3

H.

x	18	-9	____	-18
y	9	0	-12	-27

H.

x	26	14	-23	-54
y	13	1	___	-67

H.

x	-7	-9	-10	___
y	-49	-63	-70	-77

H.

x	3	4	5	6
y	___	48	60	72

H.

x	___	-63	-42	-21
y	-11	-9	-6	-3

H.

x	-8	-6	-4	-2
y	___	3	2	1

1.

(5, 8)

1.

(9, 5)

I.

(7, 7)

1.

(0, 4)

1.

(6, 2)

1.

(5, 0)

I.

(9, 9)

1.

(3, 2)

I.

(0, 7)

1.

(1, 1)

1.

(3, 6)

I.

(7, 15)

1.

(8, 11)

1.

(8, 10)

I.

(12, 0)

1.

(4, 4)

1.

(6, 4)

1.

(2, 5)

1.

(4, 3)

I.

(13, 3)

J.

(-5, 8)

J.

(-9, 5)

J.

(7, -7)

J.

(0, -4)

J.

(-6, 2)

J.

(-5, 0)

J.

(9, -9)

J.

(-3, 2)

J.

(0, -7)

J.

(1, -1)

J.

(3, -6)

J.

(7, -15)

J.

(8, -11)

J.

(-8, 10)

J.

(-12, 0)

J.

(-4, 4)

J.

(6, -4)

J.

(-2, 5)

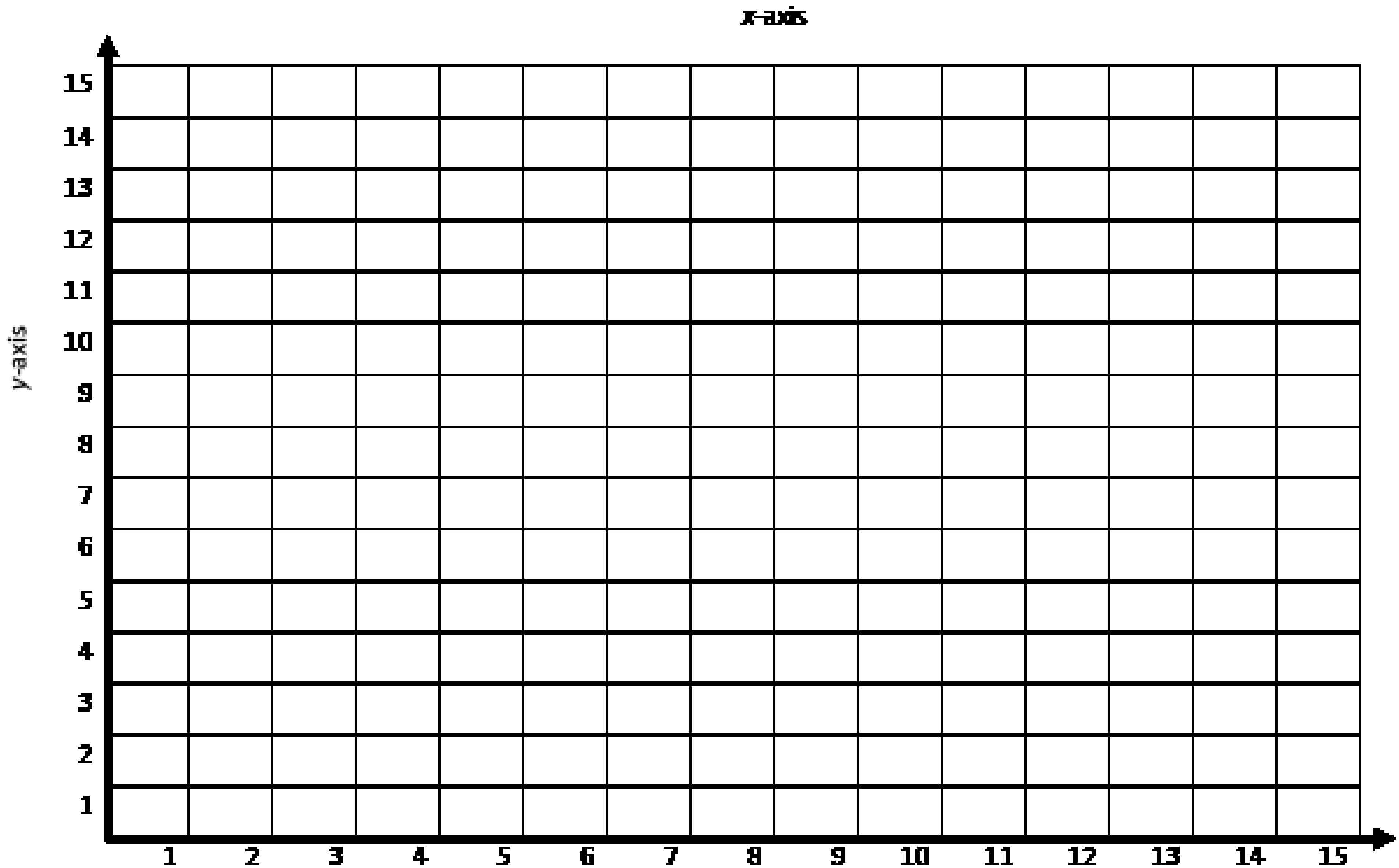
J.

(4, -3)

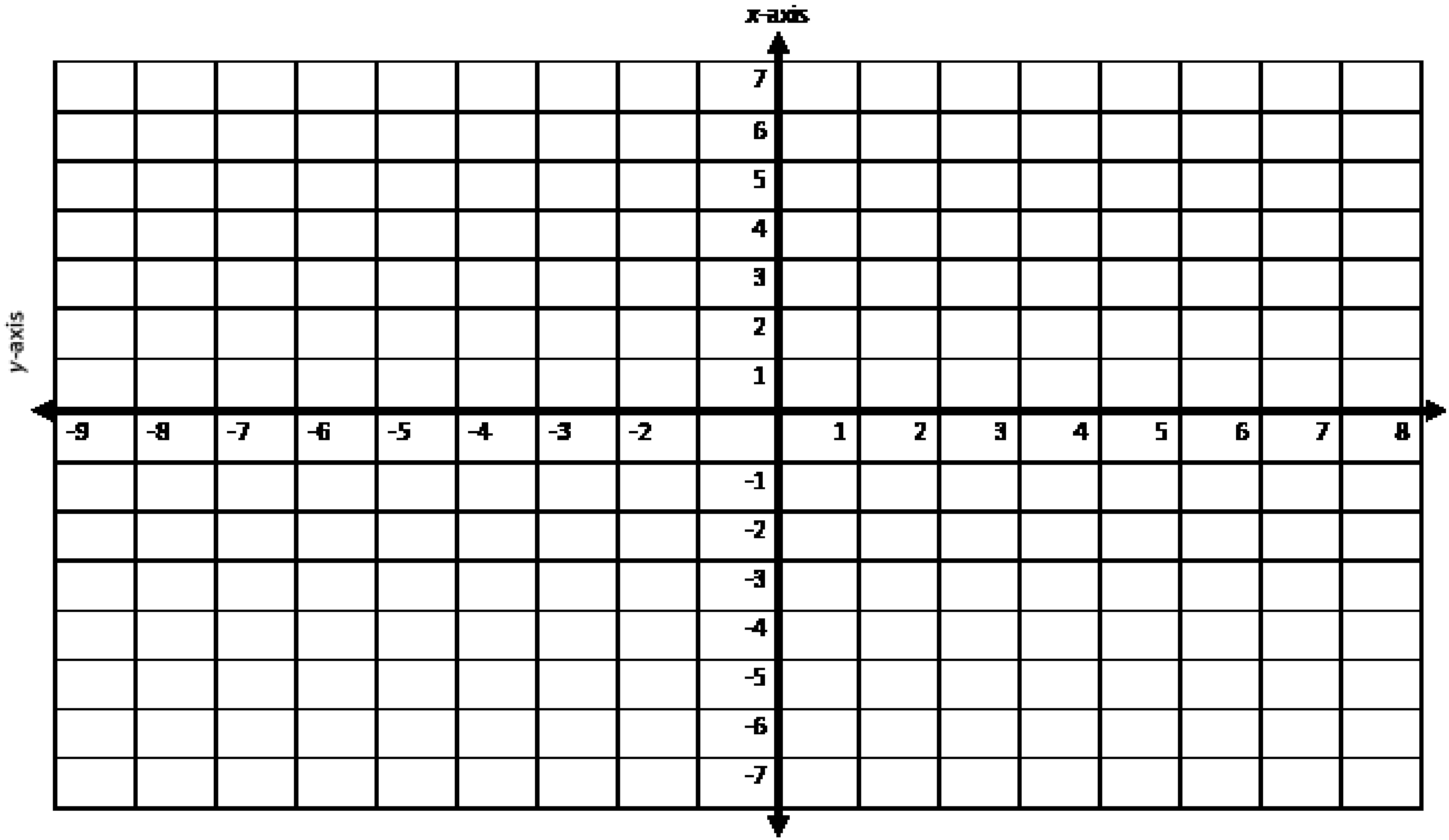
J.

(-13, 3)

K.


x-axis
y-axis
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

L.



Module 20:

Functions and Ordered Pairs

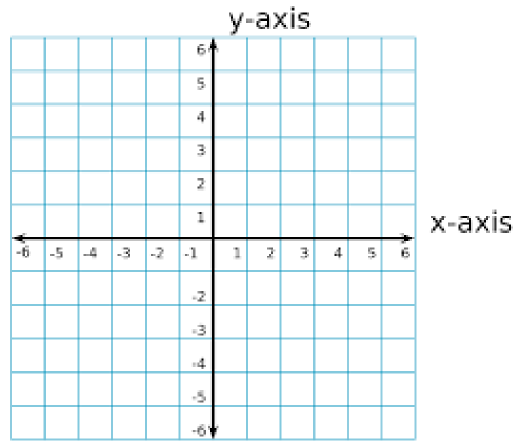
Vocabulary Cards

coordinate plane
equation
expression
function
function table
input variable

ordered pair
origin
output variable
quadrant
***x*-axis**
***y*-axis**

coordinate plane

A two-dimensional plane formed at the intersection of the *x*-axis and *y*-axis.



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equation

A mathematical statement that two expressions are the same or equal; must have an equal sign.

$$5x + 9 = 24$$

5x + 9 = 24 is an equation

(<u>DOES</u> have an = sign)

expression

A combination of variables, numbers, and/or operations that represents a mathematical relationship; does not have an equal sign.

$5x + 9$ $\qquad$ 24

$5x + 9$ and 24 are expressions

(<u>DOES NOT have an = sign</u>)

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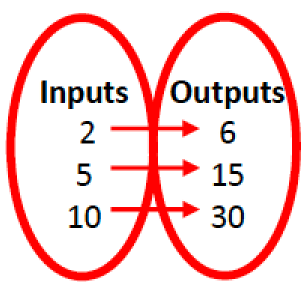
function

A relationship between two quantities in which every input corresponds to exactly one output.



x	y
2	6
5	15
10	30

function table

A table that displays a set of inputs and outputs in such a way that each input has a unique output.

x	y
1	5
3	7
4	8

x	1	3	4
y	5	7	8

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input variable

The x of an equation; the information put in to find the output.

In the equation $x + 1 = y$, x is the input variable

ordered pair

A pair of numbers used to locate a point on a coordinate plane.

Examples:

(-4, 3) (0, 2) (6, -1)

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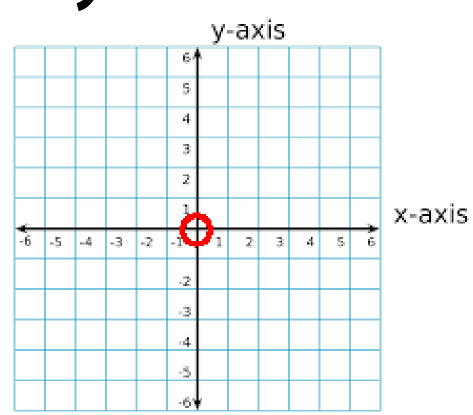
origin

A point where the *x*-axis and *y*-axis intersect. The origin has the coordinates (0, 0).



output variable

The *y* of an equation; the information gained after the input is plugged into an equation.

In the equation $x + 1 = y$, y is the output variable

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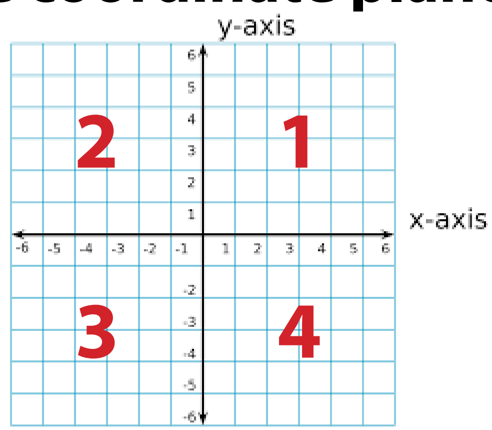
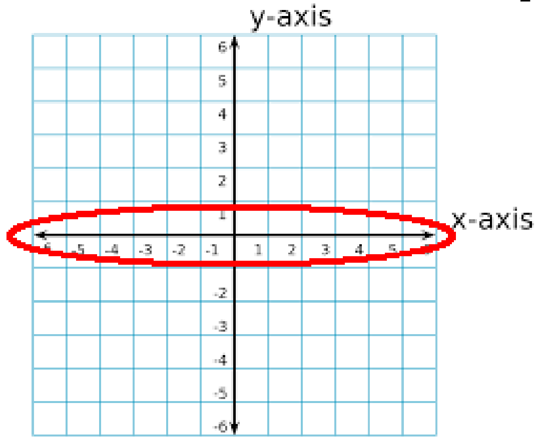
quadrant

The *x*- and *y*-axes divide the coordinate plane into four regions called quadrants.



x-axis

The horizontal number line on a coordinate plane.



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y-axis

The vertical number line on a coordinate plane.