9.2 teacher notes

Objectives

- When a set of ordered pairs is given, determine the output associated with a given input, and determine the input associated with a given output.
- Read and write the function notation $f(x)$.
- Evaluate a function $f(x)$ when a specific value of x is given.
- Use the graph of a function to determine input and output values.

Vocabulary

Function (Lesson 9-1)
Domain (Lesson 9-1)
Range (Lesson 9-1)
Function notation

Prerequisites

Evaluating expressions

Writing the equation of a line when given the slope and the y-intercept

Get Started

- What is a function? A function is a relation that assigns to each element of the domain exactly one element of the range.
- How can one tell by looking at a set of ordered pairs that the relation is a function? None of the values for x will be the same.
- How can one tell by looking at a graph that the graph represents a function? Use the vertical line test.

Section 1

Expand Their Horizons

In Section 1, students will review the concept of function and will find the inputs and outputs of functions from sets of ordered pairs.

Using a function machine may help students see that they are actually putting a number into the function and getting a value out.

Stress to students that an input in a set of ordered pairs is always an *x*-value. An output is always a *y*-value. Also, stress that each input produces a unique output.

1. To find the output associated with the input 2, find the ordered pair (2, 4) and choose the value for *y*, 4.
2. To find the input associated with the output 2, find the ordered pair (8, 2) and choose the value for *x*, 8.

Additional Examples

1. **In the set of ordered pairs {(–7, 4), (–2, 6), (3, 5), (6, –8)}, what output is associated with the input 3?**

   The ordered pair (3, 5) has the *x*-value 3 and *y*-value 5. Therefore, the output associated with the input 3 is 5.

2. **In the set of ordered pairs {(1, 6) (–7, 8), (0, –3), (5, –1), (3, 2)}, what input is associated with the output –1?**

   The ordered pair (5, –1) has the *y*-value –1 and the *x*-value 5. Therefore, the input associated with the output –1 is 5.

Section 2

Expand Their Horizons

In Section 2, students will learn to use function notation. This concept is sometimes confusing for students. Provide encouragement for them by assuring them that writing a function as "$f(x) =$" means the same as writing the function as "$y =$."

If students need extra help understanding that x is the input and that $-2x - 2$ is the ouput, pause the video and make a function machine for them with $-2x - 2$ as the rule and x as the input. Show them that when $x = 1$, the output is $-2x - 2 = -2(1) - 2 = -4$.

If the teacher used the function machine, they could then use 3 as an input, leave the rule as $-2x - 2$, and find the new output, –8. This process can help students understand that the function does not change even though there is an $f(3)$ on the left side of the equation. Remind students that $f(3)$ is not the same as $3f$. The 3 is not a coefficient. It means, "find the value of the function when $x = 3$."

When students evaluate the function $f(t) = 3t^2 + 2t - 8$ for t equal to –2, remind them to put the –2 in parentheses before squaring it. Note that $-2^2 = -4$, but $(-2)^2 = 4$.

Common Error Alert

Sometimes students become confused about function notation and treat the x in $f(x)$ as a factor. For example, in the problem "Find $f(2)$ if $f(x) = x + 1$," a student may write $2x = x + 1$. It is important to continually stress to students that "$f(x)$ equals" is another way of writing "y equals."

Students should realize that any letter can be used to represent a function.

A constant function always has the same output. Remind students that $k(x) = -4$ can also be written $y = -4$. Help them see that this equation represent the graph of a horizontal line. On a horizontal line, the output, or y value, is always constant.

3 Evaluate $t(9)$ if $t(x) = \sqrt{x} - 2x$. Remind students that this is another way of saying find t of x if x is equal to 9. $t(9) = \sqrt{9} - 2(9)$. $t(9) = 3 - 18$. $t(9) = -15$.

4 On this problem some students may substitute a positive one instead of a negative one for x because of the absolute value. Be sure the students understand that they perform the operation inside the absolute value symbol and then find the absolute value of negative five.

Look Beyond

Students will use the skill of evaluating functions throughout their mathematics' careers. When they begin studying trigonometry, they will be asked to evaluate trig functions to find the sides and angles of triangles.

5 If students evaluate this equation using a calculator, it might be necessary to help them with the parentheses. The expression should be typed into the calculator as $\frac{5 - 4}{5 + 3}$. Tell students that this method will cause the calculator first to evaluate the numerator, then to evaluate the denominator, and finally to divide these two values to reach the function value, $\frac{1}{8}$.

Additional Examples

1. Evaluate $t(4)$ if $t(x) = \frac{x + 2}{2x - 3}$.

$t(4) = \frac{4 + 2}{2(4) - 3}$

$t(4) = \frac{6}{5}$

2. Find $h(-2)$ if $h(x) = 2x^2 - 3x + 4$.

$h(-2) = 2(-2)^2 - 3(-2) + 4$

$h(-2) = 2(4) + 6 + 4$

$h(-2) = 18$

Section 3

Expand Their Horizons

In Section 3, students will learn to identify input and output values of a function by looking at its graph. They will also review writing a linear equation from a graph of a line.

The first example has points that are not labeled. It might be best to have the students label the points before Roxy does.

The second example is a graph of the line, $f(x) = \frac{1}{2}x - 4$. Caution students that they must use a straight edge and draw carefully if they are going to use a graph to find input and output values.

Connections

Physicists use their knowledge of evaluating functions to detect the position of an object in its trajectory (curved path), such as a baseball, an arrow shot from a bow, or a bullet fired from a gun. They use the formula $y = y_0 + \frac{1}{2}gt^2$ where y is the height of the object at a given time, y_0 is the beginning height of the object, g is the force of gravity acting upon the object, and t is time in seconds.

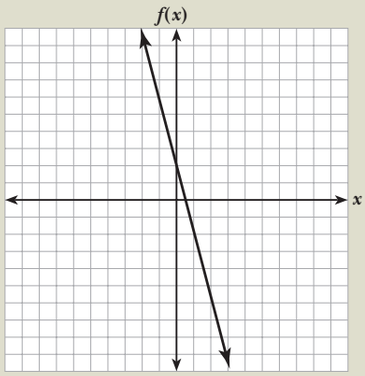
Two methods can be used to find $f(4)$. Either the student can find the point on the graph and use its y-coordinate, or the student can use the equation $f(4) = \frac{1}{2}(4) - 4$. Either way, the output value is –2.

6 Use the graph of $g(x)$ to find $g(0)$, $g(2)$, and $g(-4)$. First have students label all the points: (–6, –2), (–4, 0), (–1, 2), (0, 4), (2, 6), (5, 4). $g(0) = 4$. $g(2) = 6$. $g(-4) = 0$.

7 After the students find the point (1, 3) on the graph, have them use the equation they found, $h(x) = 2x + 1$, to find $h(1)$. $h(1) = 2(1) + 1 = 3$.

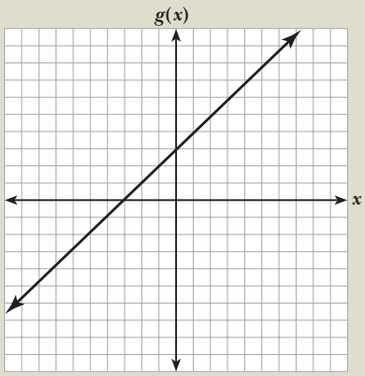
Additional Examples

1. Use the graph of $f(x)$ to find $f(-2)$.



$f(x) = -4x + 2$
$f(-2) = -4(-2) + 2$
$f(-2) = 10$

2. Use the graph of $g(x)$ to find $g(1)$.



$g(x) = x + 3$
$g(1) = 1 + 3$
$g(1) = 4$