Date ______________

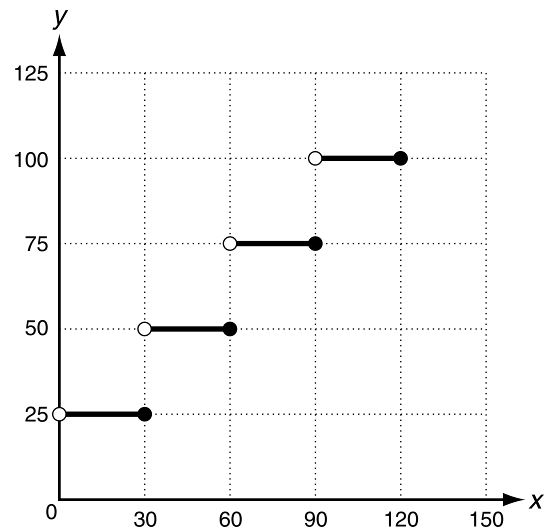
Dear Family,

So far, your child has learned about many types of functions: linear, polynomial, exponential, and rational, to name a few. In Chapter 9, your child will learn more properties and attributes of functions.

Possibly without realizing it, your child has already seen that a function can be represented with multiple representations. If you are given only one representation, you can often generate the others. The ability to translate between the various representations is extremely useful when solving real-world problems.

A **piecewise function** combines together different functions in different parts of the domain. For example, if a parking meter charges 25¢ for each 30 minutes with a maximum of two hours, then the price in cents of parking x minutes is given by the function

$$f(x) = \begin{cases} 25 & \text{if } 0 < x \leq 30 \\ 50 & \text{if } 30 < x \leq 60 \\ 75 & \text{if } 60 < x \leq 90 \\ 100 & \text{if } 90 < x \leq 120 \end{cases}$$



Because the parking-meter example is constant for each interval of its domain, it is a special type of piecewise function called a **step function**.

You'll recall that earlier chapters have introduced transformations of functions. These will be studied in more detail and combined in new ways. Here's a review of the fundamental transformations:

Transformations of $f(x)$	
$f(x - h)$	**Horizontal translation** h units.
$f(x) + k$	**Vertical translation** k units.
$f(-x)$	**Horizontal reflection** across the y-axis.
$-f(x)$	**Vertical reflection** across the x-axis.
$f\left(\frac{1}{b}x\right)$	**Horizontal stretch/compression** by a factor of b.
$a \cdot f(x)$	**Vertical stretch/compression** by a factor of a.

Like numbers and expressions, you can add, subtract, multiply, or divide functions. Special notation is used to represent these function operations.

Function Operations	
Operation	**Notation**
Addition	$f(x) + g(x) = (f + g)(x)$
Subtraction	$f(x) - g(x) = (f - g)(x)$
Multiplication	$f(x) \cdot g(x) = (fg)(x)$
Division	$f(x) \div g(x) = \left(\frac{f}{g}\right)(x)$
Composition	$f(g(x)) = (f \circ g)(x)$

A fifth type of operation, called the **composition of functions**, uses the output of one function as the input of another function. Here's an example:

Given $f(x) = x^2 + 2$ and $g(x) = 2x - 5$, find $(f \circ g)(2)$.

First find the output of $g(2)$.

$$g(2) = 2(2) - 5 = -1$$

Then use the results as the input of $f(x)$.

$$f(-1) = (-1)^2 + 2 = 3$$

So, $(f \circ g)(2) = f(g(2)) = f(-1) = 3$

Recall that relations that "undo" each other are called *inverses*. Not all inverses are functions. One way to check is to use the *horizontal line test* on the graph of the original relation. If it passes the horizontal line test, then when you reflect the graph across the line $y = x$, the graph of the inverse will be a function that passes the vertical line test.

If both a relation and its inverse are functions, then both are **one-to-one functions** in which each y-value is paired with exactly one x-value.

Because inverse functions "undo" each other, you can check whether or not two functions are inverses by composing them. When you compose a function with its inverse, the result should be the input value x. That is, $f(f^{-1}(x)) = x$ and $f^{-1}(f(x)) = x$.

Determine whether $f(x) = 2x + 6$ and $g(x) = \frac{1}{2}x - 3$ are inverses.

Check that $f(g(x)) = x$.

$$f(g(x)) = f\left(\frac{1}{2}x - 3\right) = 2\left(\frac{1}{2}x - 3\right) + 6 = (x - 6) + 6 = x$$

Check that $g(f(x)) = x$.

$$g(f(x)) = g(2x + 6) = \frac{1}{2}(2x + 6) - 3 = (x + 3) - 3 = x$$

Yes, the functions are inverses.

The chapter ends with another familiar topic—using functions to model real-world data and make predictions. By using a combination of by-hand and calculator methods, you child will be able to solve problems from the fields of biology, agriculture, business, economics, and real-estate.

For additional resources, visit go.hrw.com and enter the keyword MB7 Parent.