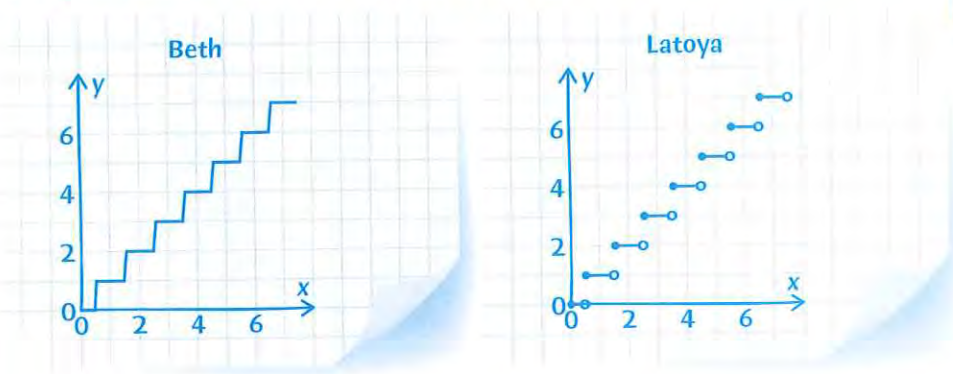


5-3

Step Functions

CRITIQUE & EXPLAIN

Students are told there is a function where decimals are the inputs and each decimal is rounded to the nearest whole number to get the output. Beth and Latoya each make a sketch of the graph of the function.



A. **Make Sense and Persevere** What is causing both students to create graphs that look like steps? © MP.1

B. Which graph do you think is correct? Explain.

C. What does the graph of this function look like? Explain.

HABITS OF MIND

Communicate Precisely In the graphs, what information do the pairs of open and closed circles convey that the connected lines do not? © MP.6



EXAMPLE 1

**Try It! Understand Step Functions**

1. Evaluate each function for the given value.

a. $f(x) = \lceil x \rceil$; $x = 2.65$

b. $f(x) = \text{floor}(x)$; $x = 2.19$

HABITS OF MIND

Look for Relationships Why are the graphs of floor and ceiling functions composed of horizontal sections? © MP.7



**EXAMPLE 2** **Try It!** Use a Step Function to Represent a Real-World Situation

2. The postage for a first-class letter weighing one ounce or less is \$0.47. Each additional ounce is \$0.21. The maximum weight of a first-class letter is $3\frac{1}{2}$ oz. Write a function to represent the situation.

EXAMPLE 3 **Try It!** Use a Step Function

3. You rent a karaoke machine at 1 P.M. and plan to return it by 4 P.M. Will you save any money if you return the machine 15 min early? Explain.

HABITS OF MIND

Model With Mathematics Why are ceiling functions useful in modeling real-world situations? © MP.4

Do You UNDERSTAND?

- ESSENTIAL QUESTION** How are step functions related to piecewise-defined functions?
- Vocabulary** How are the *ceiling function* and the *floor function* similar? How are they different?
- Error Analysis** Jason defined the following step function.

$$f(x) = \begin{cases} 5, & 0 \leq x \leq 10 \\ 6, & 10 \leq x \leq 20 \\ 7, & 20 \leq x \leq 30 \end{cases}$$

What is the error that Jason made? © MP.3
- Reason** For the function that rounds numbers to the nearest whole number, what are the pieces of the domain for the interval from 0 to 4? © MP.2

Do You KNOW HOW?

Evaluate the ceiling function for the given value.

5. $f(x) = \lceil x \rceil$; $x = 5.13$

6. $f(x) = \text{ceiling}(x)$; $x = 11.71$

Evaluate the floor function for the given value.

7. $f(x) = \lfloor x \rfloor$; $x = 9.37$

8. $f(x) = \text{floor}(x)$; $x = 5.49$

9. Graph the function f .

x	$f(x)$
$0 < x \leq 1$	4
$1 < x \leq 2$	5
$2 < x \leq 3$	6
$3 < x \leq 4$	7
$4 < x \leq 5$	8
$5 < x \leq 6$	9

