# 3-2 Functions

**CONTENT STANDARD**
8.F.1

## What You'll Learn

To evaluate functions and complete input-output tables

**New Vocabulary** function, function rule

## Why Learn This?

The time it takes you to get to your destination is a function of how fast you travel. Your speed affects how long the trip will take.

A **function** is a rule that assigns to each input value exactly one output value. A **function rule** is an equation that describes a function.

You can use a function rule to evaluate a function. Functions have input variables and output variables. Examples of function rules appear below.

input variables

$$y = 4x + 4 \qquad d = 30t \qquad F = \frac{9}{5}C + 32$$

output variables
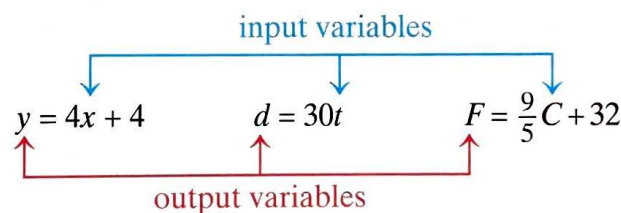
## EXAMPLE Evaluating Functions

**1** Juan begins his exercise walk from his friend's house which is 50 m from his own house. The function $d = 3t + 50$ gives the distance $d$ in meters after $t$ seconds that Juan is from his own house while walking. Find the output $d$ for the input $t = 10$.

$d = 3t + 50$  ← Write the function.

$d = 3(10) + 50$  ← Substitute 10 for $t$.

$d = 30 + 50$  ← Simplify.

$d = 80$

The output $d$ for the input $t = 10$ is 80. So, after 10 minutes of walking, Juan is 80 meters from his house.

## ✓ Quick Check

1. The function $F = \frac{9}{5}C + 32$ converts temperatures in degrees Celsius, $C$ to degrees Fahrenheit, $F$. Evaluate the function for $C = 20$.

An input-output table is useful to evaluate multiple values for a function. It also helps you organize data when the function represents a real-world situation.

## EXAMPLE  Input-Output Tables

**2** The function $t = \frac{1}{2}m - 12$ gives the temperature $t$ in a container in degrees Celsius $m$ minutes before, at the start, and during an experiment. Use the function to make an input-output table for $m = -2, -1, 0, 1,$ and 2.

| Input $m$ (mins) | Output $t$ (temp) |
|---|---|
| $-2$ | $-13$ |
| $-1$ | $-12\frac{1}{2}$ |
| $0$ | $-12$ |
| $1$ | $-11\frac{1}{2}$ |
| $2$ | $-11$ |

$\leftarrow \frac{1}{2}(-2) - 12 = -13$
$\leftarrow \frac{1}{2}(-1) - 12 = -12\frac{1}{2}$
$\leftarrow \frac{1}{2}(0) - 12 = -12$
$\leftarrow \frac{1}{2}(1) - 12 = -11\frac{1}{2}$
$\leftarrow \frac{1}{2}(2) - 12 = -11$

## ✓ Quick Check

**2.** Use the function $m = \frac{1}{3}n + 1$ to make an input-output table for $n = -1, 0, 1,$ and 2.

To encourage recycling, some states require a five-cent deposit on drink containers. The total deposit you pay depends on how many containers you buy. You can describe this relationship with a function rule.

$d = 0.05c \leftarrow$ input variable $c =$ number of containers
$\uparrow$
output variable $d =$ deposit

## EXAMPLE  Application: Recycling

**3** **Recycling** Complete the table of input-output pairs for the function rule $d = 0.05c$, where $d$ represents the deposit in dollars and $c$ represents the number of containers.

| Input $c$ (number of containers) | Output $d$ (dollars) |
|---|---|
| 6 | ▨ |
| 12 | ▨ |
| 24 | ▨ |

$\leftarrow 0.05 \times 6 = 0.30$
$\leftarrow 0.05 \times 12 = 0.60$
$\leftarrow 0.05 \times 24 = 1.20$

## ✓ Quick Check

**3.** The deposit on a drink container is $.10 in the state of Michigan. Use the function rule $d = 0.1c$. Make a table of input-output pairs to show the total deposits on 5, 10, and 15 containers.

1. **Vocabulary** How are a function and a function rule related?

2. Explain how to evaluate a function for a given input value.

3. **Number Sense** If the input value is negative, is the output value of $f = -4z + 12$ always positive or always negative? Explain.

4. Complete the input-output table for the function $f = 3 + n$.

| Input $n$ | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| Output $f$ | 3 | ■ | ■ | ■ |

## Homework Exercises

For more exercises, see **Extra Skills and Word Problems.**

Use the function rule $z = 2x + 3$. Find each output.

5. $x = 0$

6. $x = -2$

7. $x = 2$

8. $x = 10$

9. $x = -16.7$

10. **Energy** The function rule $E = 0.4h$ gives the total energy $E$ in kilowatts the stereo uses during $h$ hours. How much energy is used during 3 hr?

11. **Hockey** Copy and complete the table of input-output pairs for the function rule $t = \frac{n}{11}$. The variable $t$ represents the number of teams formed in a hockey league. The variable $n$ represents the number of people signed up for the league.

| Input $n$ (number of people) | Output $t$ (number of teams) |
|---|---|
| 44 | ■ |
| 132 | ■ |
| 165 | ■ |

12. The function rule $p = 1.5 + 2m$ represents the taxi fare $p$ in dollars for a ride that is $m$ miles long. Make a table of input-output pairs to show the fare for rides of 2, 6, and 13 miles.

**GPS**

13. **Guided Problem Solving** Paint brushes cost $1.79 each. The function rule $c = 1.79p$ gives the cost $c$ in dollars for $p$ paintbrushes. Jackson has $75.00 and must buy 27 paintbrushes and 2 gallons of paint which costs $13.29 per gallon. How much change will he receive?
   - How much is the cost of the paintbrushes?
   - How much does the paint cost?

14. **Reasoning** For what values of $a$ and $b$ will the function $I = at + b$ give the input-output table below?

| Input, $t$ | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Output, $I$ | 5 | 7 | 9 | 11 |

15. **Water Use** The function $w = 40\ell$ describes the number $w$ of gallons of water used to wash $\ell$ loads of laundry in a washing machine.
    a. Find the value of $w$ when $\ell = 6$. What does this represent?
    b. The *domain* of a function is all possible input values. The *range* of a function is all possible output values. Which variable, $w$ or $\ell$, represents the domain in part (a)? Explain.
    c. The input variable is also called the *independent variable*. The output variable is the *dependent variable*, because it depends on the input variable. Which is the dependent variable, $w$ or $\ell$?

16. **Writing in Math** Find several solutions of the equation $y = 3x - 2$. Explain how these solutions are related to input-output pairs for $y = 3x - 2$.

**Copy and complete the table of input-output pairs for each function.**

17. $y = 4x$

| Input x | Output y |
|---------|----------|
| 5 | ▨ |
| 7 | ▨ |
| 9 | ▨ |
| 11 | ▨ |

18. $d = 50t$

| Input t | Output d |
|---------|----------|
| 1 | ▨ |
| 2 | ▨ |
| 3 | ▨ |
| ▨ | 200 |

19. Fruit smoothies cost $1.50 each plus $.50 for each fruit mixed into the smoothie. The function $c = 1.5 + .5f$ gives the cost $c$ of a smoothie with $f$ fruits. Find the cost of a smoothie with 4 different fruits mixed in.

20. **Challenge** A furniture store charges a fee of $30 to deliver furniture, plus $2 per mile that it has to travel for the delivery. Write a function that describes this relationship where $c$ represents total cost and $m$ represents miles.

Ⓐ Ⓑ Ⓒ Ⓓ **Test Prep and Mixed Review**                                   **Practice**

Gridded Response

21. An ad in the newspaper costs $52 plus $2.50 for each line of the ad. What is the cost in dollars of placing a 7-line ad?

22. Using variables, three consecutive even integers can be represented by $n, n + 2$, and $n + 4$. The sum of three consecutive even integers is $-198$. What is the middle integer?

**Find the number of solutions of the equation.**

23. $-3(x - 2) + 1 = 2(4 - x) - 1 - x$

24. $3x + 7 = 2(x - 3)$

25. $6x - 5 - 5x + 3 = 4\left(1 + \frac{1}{4}x\right)$

26. $x + 3.5(x - 1) = 8x$