

## 3.2 Linear Functions

### Linear function:

- The graph of a linear equation is a line
- A function whose graph is a nonvertical line
- Has a constant rate of change
- Slope-Intercept Form:  $y = mx + b$
- Solution is an ordered pair  $(x, y)$

### Example 1: Parts of a linear function.

Identify the parts of slope-intercept form

$$y = mx + b$$

### Example 2: Identifying Linear Functions

Do the tables represent a linear function?

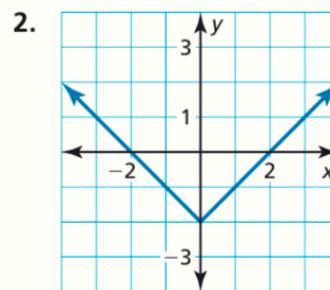
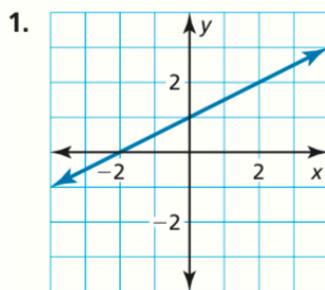
a)

<b>x</b>	3	6	9	12
<b>y</b>	36	30	24	18

b)

<b>x</b>	1	3	5	7
<b>y</b>	2	9	20	35

**Try on your own:** Do the following represent a linear function?



3.

<b>x</b>	0	1	2	3
<b>y</b>	3	5	7	9

4.

<b>x</b>	1	2	3	4
<b>y</b>	16	8	4	2

**Example 3: Identifying Linear Functions**

Which of the following represents a linear function?

- a)  $y = 2.5$       b)  $y = \sqrt{x}$       c)  $y = \frac{2}{x}$       d)  $y = 6(x - 1)$       e)  $x^2 + y = 1$       f)  $y = 2x + 1$

**Core Concepts:**

Discrete and Continuous Domains

**Discrete domain:** set of input values that consists of only certain numbers in an interval



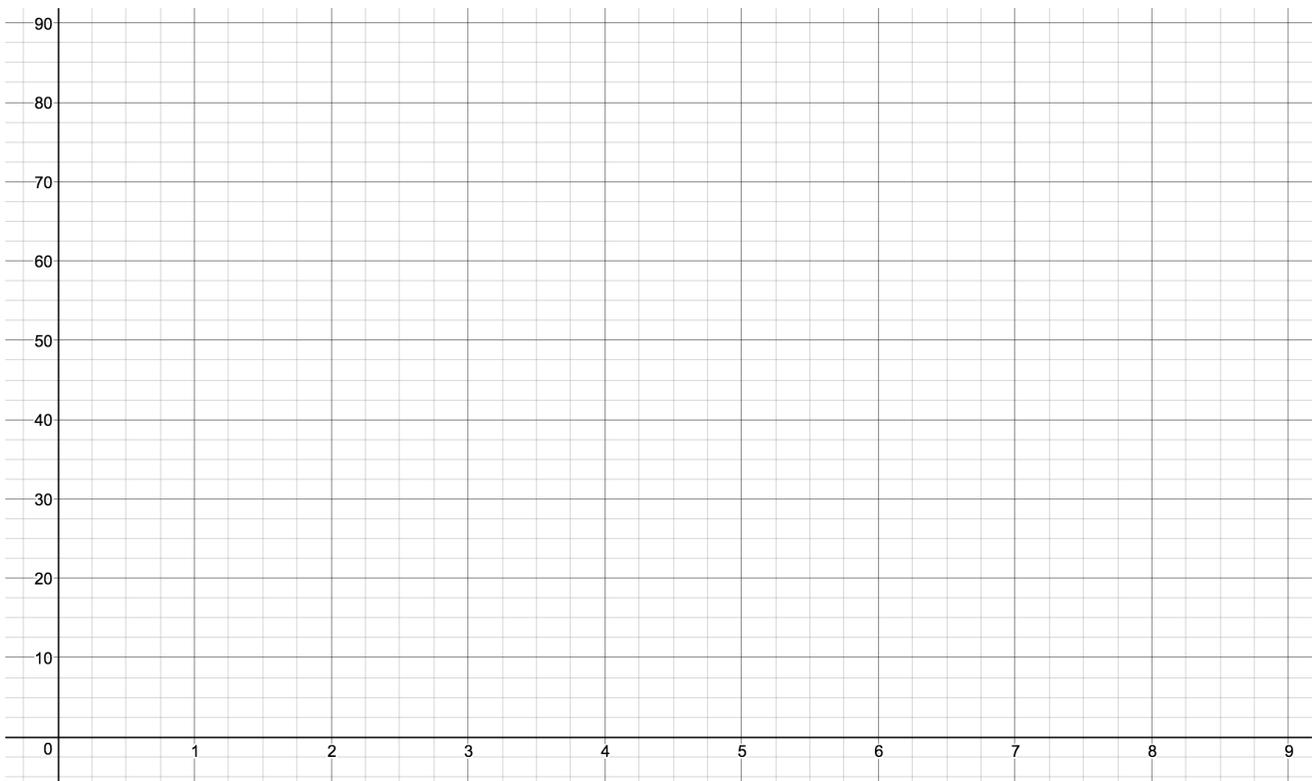
**Continuous domain:** set of input values that consists of all numbers in an interval



**Example 4: Graphing Discrete Data**

The linear function  $y = \$12.50x$  represents the cost  $y$  (in dollars) of  $x$  tickets for a school concert. Each customer can buy a maximum of 6 tickets.

- a) Find the domain of the function.
- b) Is the domain discrete or continuous?
- c) Graph the function using its domain



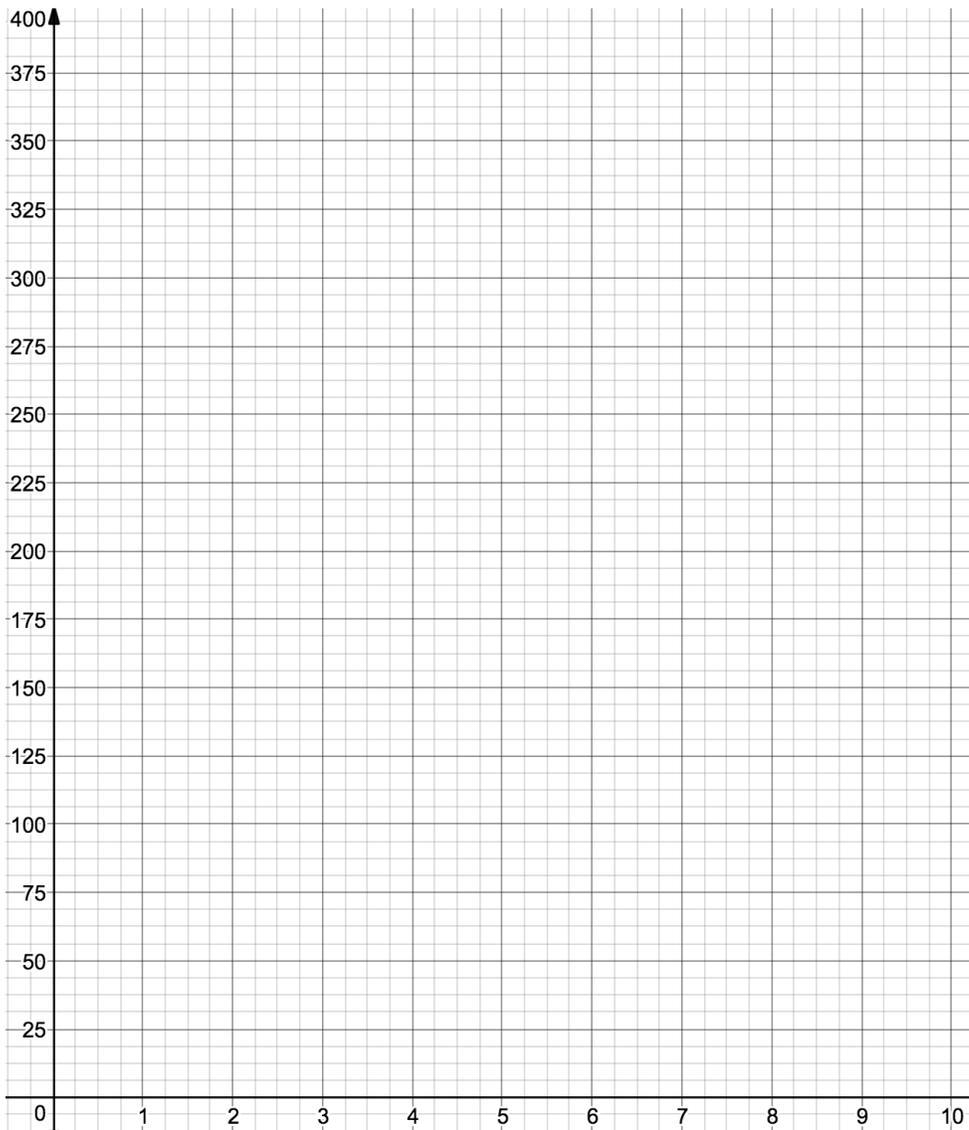
**Try on your own:**

The linear function  $m = 80 - 5t$  represents the amount  $m$  (in dollars) of money you have after buying  $t$  tacos. Find the domain of the function. Is the domain discrete or continuous?

**Example 5: Graphing Continuous Data**

A cereal bar contains 75 calories. The number  $c$  of calories consumed is a function of the number  $b$  of bars eaten.

- a) Does this situation represent a linear function?
- b) Find the domain of the function.
- c) Is the domain discrete or continuous?
- d) Graph the function



Homework: 12-14, 16-24, 27-28, 35, 36,

## 3.2 Exercises

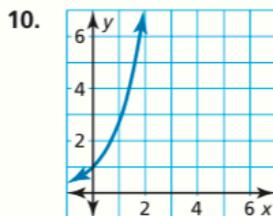
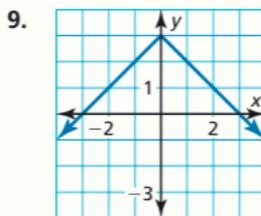
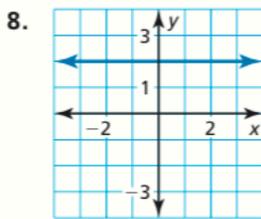
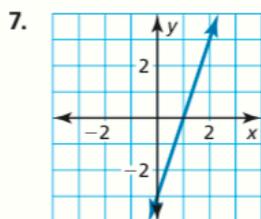
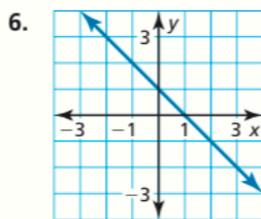
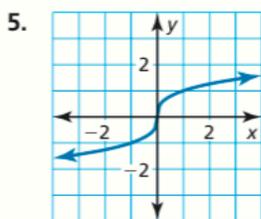
Dynamic Solutions available at [BigIdeasMath.com](http://BigIdeasMath.com)

### Vocabulary and Core Concept Check

- COMPLETE THE SENTENCE** A linear equation in two variables is an equation that can be written in the form \_\_\_\_\_, where  $m$  and  $b$  are constants.
- VOCABULARY** Compare linear functions and nonlinear functions.
- VOCABULARY** Compare discrete domains and continuous domains.
- WRITING** How can you tell whether a graph shows a discrete domain or a continuous domain?

### Monitoring Progress and Modeling with Mathematics

In Exercises 5–10, determine whether the graph represents a *linear* or *nonlinear* function. Explain. (See Example 1.)



In Exercises 11–14, determine whether the table represents a *linear* or *nonlinear* function. Explain. (See Example 2.)

11. 

x	1	2	3	4
y	5	10	15	20

12. 

x	5	7	9	11
y	-9	-3	-1	3

13. 

x	4	8	12	16
y	16	12	7	1

14. 

x	-1	0	1	2
y	35	20	5	-10

**ERROR ANALYSIS** In Exercises 15 and 16, describe and correct the error in determining whether the table or graph represents a linear function.

15. 

x	2	4	6	8
y	4	16	64	256

As  $x$  increases by 2,  $y$  increases by a constant factor of 4. So, the function is linear.

16. 

The graph is a line. So, the graph represents a linear function.

In Exercises 17–24, determine whether the equation represents a *linear* or *nonlinear* function. Explain. (See Example 3.)

17.  $y = x^2 + 13$

18.  $y = 7 - 3x$

19.  $y = \sqrt[3]{8} - x$

20.  $y = 4x(8 - x)$

21.  $2 + \frac{1}{6}y = 3x + 4$

22.  $y - x = 2x - \frac{2}{3}y$

23.  $18x - 2y = 26$

24.  $2x + 3y = 9xy$

25. **CLASSIFYING FUNCTIONS** Which of the following equations *do not* represent linear functions? Explain.

(A)  $12 = 2x^2 + 4y^2$

(B)  $y - x + 3 = x$

(C)  $x = 8$

(D)  $x = 9 - \frac{3}{4}y$

(E)  $y = \frac{5x}{11}$

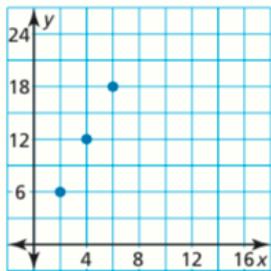
(F)  $y = \sqrt{x} + 3$

26. **USING STRUCTURE** Fill in the table so it represents a linear function.

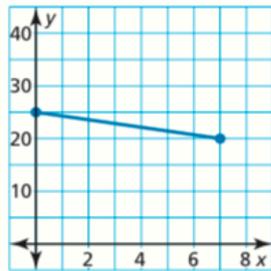
<b>x</b>	5	10	15	20	25
<b>y</b>	-1				11

In Exercises 27 and 28, find the domain of the function represented by the graph. Determine whether the domain is *discrete* or *continuous*. Explain.

27.



28.



In Exercises 29–32, determine whether the domain is *discrete* or *continuous*. Explain.

29.

<b>Input Bags, x</b>	2	4	6
<b>Output Marbles, y</b>	20	40	60

30.

<b>Input Years, x</b>	1	2	3
<b>Output Height of tree (feet), y</b>	6	9	12

31.

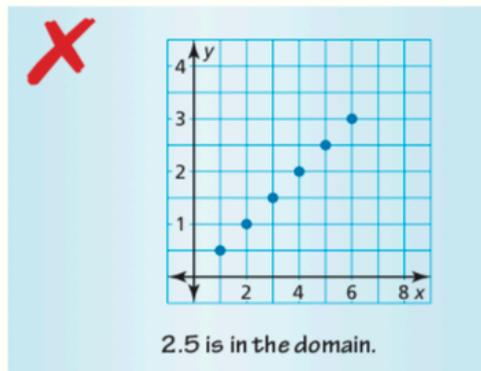
<b>Input Time (hours), x</b>	3	6	9
<b>Output Distance (miles), y</b>	150	300	450

32.

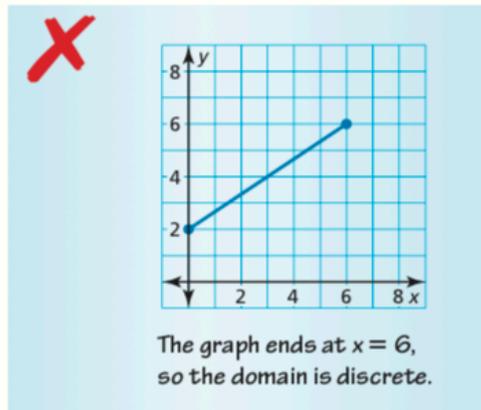
<b>Input Relay teams, x</b>	0	1	2
<b>Output Athletes, y</b>	0	4	8

**ERROR ANALYSIS** In Exercises 33 and 34, describe and correct the error in the statement about the domain.

33.



34.



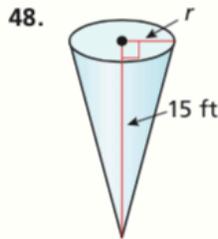
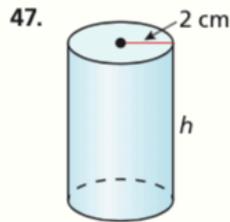
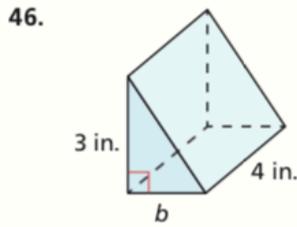
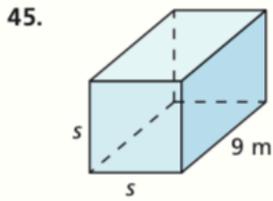
35. **MODELING WITH MATHEMATICS** The linear function  $m = 55 - 8.5b$  represents the amount  $m$  (in dollars) of money that you have after buying  $b$  books. (See Example 4.)

- Find the domain of the function. Is the domain discrete or continuous? Explain.
- Graph the function using its domain.





**MATHEMATICAL CONNECTIONS** In Exercises 45–48, tell whether the volume of the solid is a linear or nonlinear function of the missing dimension(s). Explain.



49. **REASONING** A water company fills two different-sized jugs. The first jug can hold  $x$  gallons of water. The second jug can hold  $y$  gallons of water. The company fills  $A$  jugs of the first size and  $B$  jugs of the second size. What does each expression represent? Does each expression represent a set of discrete or continuous values?

- a.  $x + y$
- b.  $A + B$
- c.  $Ax$
- d.  $Ax + By$

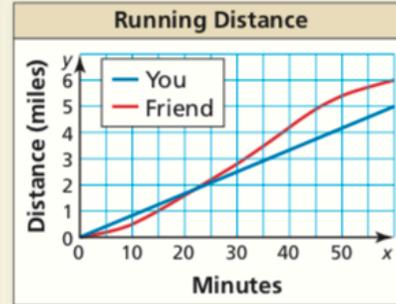


50. **THOUGHT PROVOKING** You go to a farmer's market to buy tomatoes. Graph a function that represents the cost of buying tomatoes. Explain your reasoning.

51. **CLASSIFYING A FUNCTION** Is the function represented by the ordered pairs linear or nonlinear? Explain your reasoning.

$(0, 2), (3, 14), (5, 22), (9, 38), (11, 46)$

52. **HOW DO YOU SEE IT?** You and your friend go running. The graph shows the distances you and your friend run.



- a. Describe your run and your friend's run. Who runs at a constant rate? How do you know? Why might a person not run at a constant rate?
- b. Find the domain of each function. Describe the domains using the context of the problem.

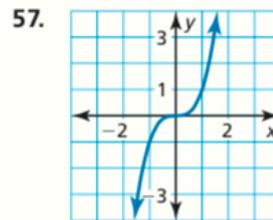
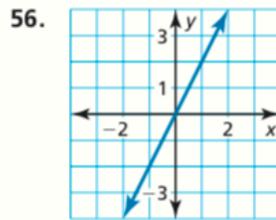
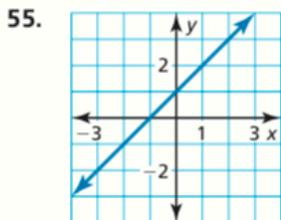
**WRITING** In Exercises 53 and 54, describe a real-life situation for the constraints.

- 53. The function has at least one negative number in the domain. The domain is continuous.
- 54. The function gives at least one negative number as an output. The domain is discrete.

## Maintaining Mathematical Proficiency

Reviewing what you learned in previous grades and lessons

Tell whether  $x$  and  $y$  show direct variation. Explain your reasoning. (*Skills Review Handbook*)



Evaluate the expression when  $x = 2$ . (*Skills Review Handbook*)

58.  $6x + 8$

59.  $10 - 2x + 8$

60.  $4(x + 2 - 5x)$

61.  $\frac{x}{2} + 5x - 7$