Chapter 3
Graphing Linear Functions

3.1 Functions
Definitions:

  Relation: pairs inputs with outputs.
  Function: a relation that pairs each input with *exactly* one output.

Example 1: Determining whether relations are functions
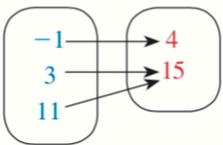Determine whether each relation is a function. Explain.

a. (−2, 2), (−1, 2), (0, 2), (1, 0), (2, 0)

b. (4, 0), (8, 7), (6, 4), (4, 3), (5, 2)

c.

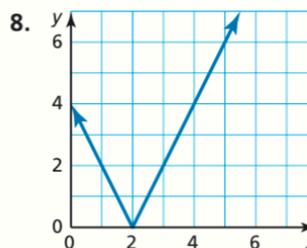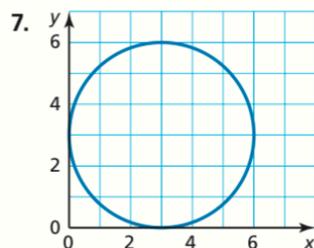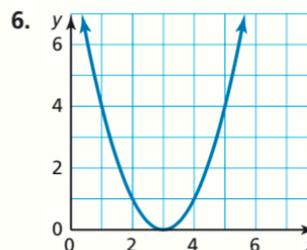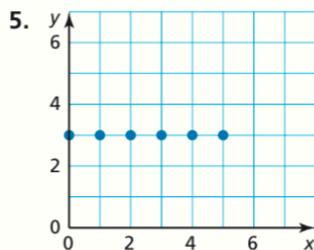| Input, x	−2	−1	0	0	1	2
Output, y	3	4	5	6	7	8

d. Input, x   Output, y

Vertical Line Test:
A graph represents a function when no vertical line passes through more than one point on the graph:

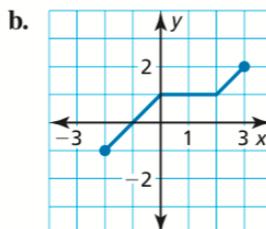**Example 2:** Determine if the graph represents a function.
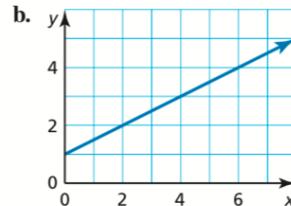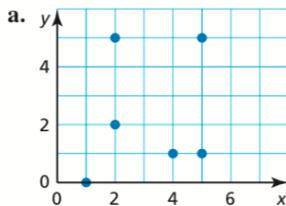
Try on your own:

Domain & Range

Domain: the set of all possible *input* values
Range: the set of all possible *output* values

Example 3: Finding the domain and range
Find the domain and range of the function

a.

b.
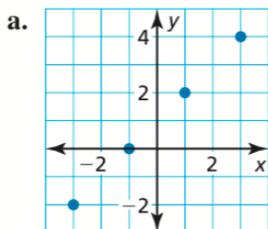
Try on your own: Find the domain and range of the function.

9.

10.
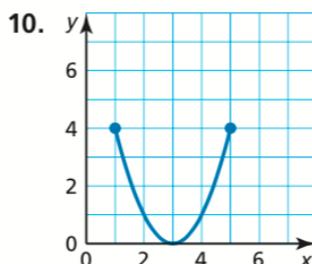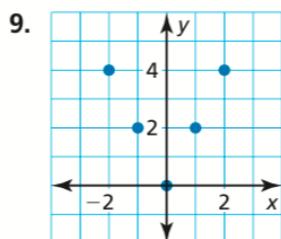
What is the difference between **Independent** and **Dependent?**

Example 4: Identifying Independent and Dependent Variables
The function $y = -3x + 12$ represents the amount y (in fluid ounces) of juice remaining in a bottle after you take x gulps.

  a) Identify the independent and dependent variables.

  b) What is the domain and range?

Homework:
3-16, 18, 24, 25, 28, 35-38*

Vocabulary and Core Concept Check

1. **WRITING** How are independent variables and dependent variables different?

2. **DIFFERENT WORDS, SAME QUESTION** Which is different? Find "both" answers.

Find the range of the function represented by the table.

Find the inputs of the function represented by the table.

x	−1	0	1
y	7	5	−1

Find the *x*-values of the function represented by (−1, 7), (0, 5), and (1, −1).

Find the domain of the function represented by (−1, 7), (0, 5), and (1, −1).
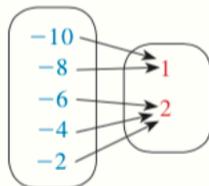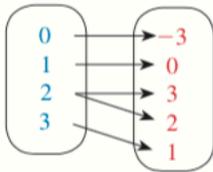
Monitoring Progress and Modeling with Mathematics

In Exercises 3–8, determine whether the relation is a function. Explain. (*See Example 1.*)

3. (1, −2), (2, 1), (3, 6), (4, 13), (5, 22)

4. (7, 4), (5, −1), (3, −8), (1, −5), (3, 6)

5. Input, *x*   Output, *y*   6. Input, *x*   Output, *y*

7.

Input, x	16	1	0	1	16
Output, y	−2	−1	0	1	2

8.

Input, x	−3	0	3	6	9
Output, y	11	5	−1	−7	−13

In Exercises 9–12, determine whether the graph represents a function. Explain. (*See Example 2.*)

9.

10.

11.

12.
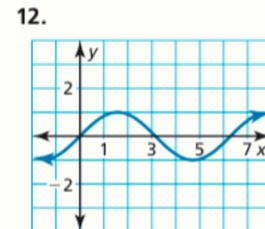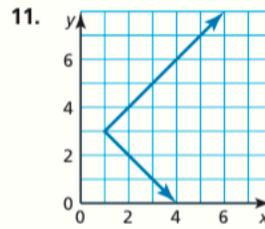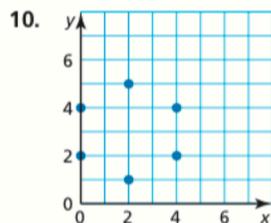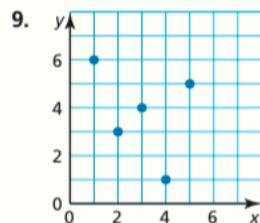
In Exercises 13–16, find the domain and range of the function represented by the graph. (*See Example 3.*)

13.

14.

15.

16.
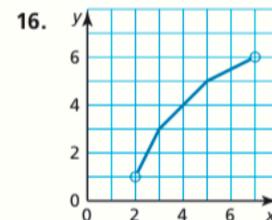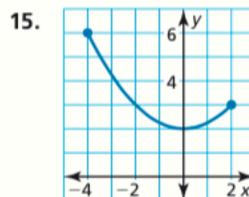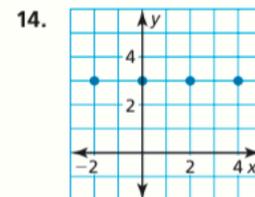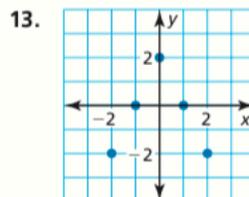
17. **MODELING WITH MATHEMATICS** The function $y = 25x + 500$ represents your monthly rent y (in dollars) when you pay x days late. (*See Example 4.*)

   a. Identify the independent and dependent variables.

   b. The domain is 0, 1, 2, 3, 4, and 5. What is the range?

18. **MODELING WITH MATHEMATICS** The function $y = 3.5x + 2.8$ represents the cost y (in dollars) of a taxi ride of x miles.

a. Identify the independent and dependent variables.

b. You have enough money to travel at most 20 miles in the taxi. Find the domain and range of the function.

ERROR ANALYSIS In Exercises 19 and 20, describe and correct the error in the statement about the relation shown in the table.

Input, x	1	2	3	4	5
Output, y	6	7	8	6	9

19.

The relation is *not* a function. One output is paired with two inputs.

20.

The relation is a function. The range is 1, 2, 3, 4, and 5.

ANALYZING RELATIONSHIPS In Exercises 21 and 22, identify the independent and dependent variables.

21. The number of quarters you put into a parking meter affects the amount of time you have on the meter.

22. The battery power remaining on your MP3 player is based on the amount of time you listen to it.

23. **MULTIPLE REPRESENTATIONS** The balance y (in dollars) of your savings account is a function of the month x.

Month, x	0	1	2	3	4
Balance (dollars), y	100	125	150	175	200

a. Describe this situation in words.

b. Write the function as a set of ordered pairs.

c. Plot the ordered pairs in a coordinate plane.

24. **MULTIPLE REPRESENTATIONS** The function $1.5x + 0.5y = 12$ represents the number of hardcover books x and softcover books y you can buy at a used book sale.

a. Solve the equation for y.

b. Make an input-output table to find ordered pairs for the function.

c. Plot the ordered pairs in a coordinate plane.

25. **ATTENDING TO PRECISION** The graph represents a function. Find the input value corresponding to an output of 2.
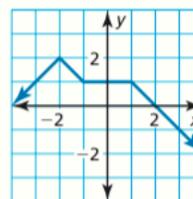
26. **OPEN-ENDED** Fill in the table so that when t is the independent variable, the relation is a function, and when t is the dependent variable, the relation is not a function.

t			
v			

27. **ANALYZING RELATIONSHIPS** You select items in a vending machine by pressing one letter and then one number.

a. Explain why the relation that pairs letter-number combinations with food or drink items is a function.

b. Identify the independent and dependent variables.

c. Find the domain and range of the function.

28. HOW DO YOU SEE IT? The graph represents the height h of a projectile after t seconds.

Height of a Projectile
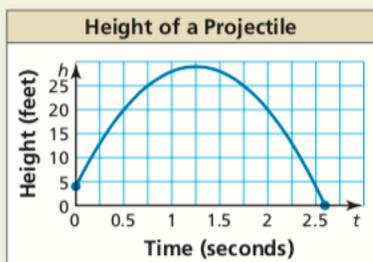
a. Explain why h is a function of t.

b. Approximate the height of the projectile after 0.5 second and after 1.25 seconds.

c. Approximate the domain of the function.

d. Is t a function of h? Explain.

29. MAKING AN ARGUMENT Your friend says that a line always represents a function. Is your friend correct? Explain.

30. THOUGHT PROVOKING Write a function in which the inputs and/or the outputs are not numbers. Identify the independent and dependent variables. Then find the domain and range of the function.

ATTENDING TO PRECISION In Exercises 31–34, determine whether the statement uses the word *function* in a way that is mathematically correct. Explain your reasoning.

31. The selling price of an item is a function of the cost of making the item.

32. The sales tax on a purchased item in a given state is a function of the selling price.

33. A function pairs each student in your school with a homeroom teacher.

34. A function pairs each chaperone on a school trip with 10 students.

REASONING In Exercises 35–38, tell whether the statement is true or false. If it is false, explain why.

35. Every function is a relation.

36. Every relation is a function.

37. When you switch the inputs and outputs of any function, the resulting relation is a function.

38. When the domain of a function has an infinite number of values, the range always has an infinite number of values.

39. MATHEMATICAL CONNECTIONS Consider the triangle shown.
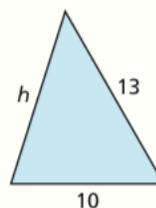
a. Write a function that represents the perimeter of the triangle.

b. Identify the independent and dependent variables.

c. Describe the domain and range of the function. (*Hint:* The sum of the lengths of any two sides of a triangle is greater than the length of the remaining side.)

REASONING In Exercises 40–43, find the domain and range of the function.

40. $y = |x|$

41. $y = -|x|$

42. $y = |x| - 6$

43. $y = 4 - |x|$

Maintaining Mathematical Proficiency
Reviewing what you learned in previous grades and lessons

Write the sentence as an inequality. *(Section 2.1)*

44. A number y is less than 16.

45. Three is no less than a number x.

46. Seven is at most the quotient of a number d and -5.

47. The sum of a number w and 4 is more than -12.

Evaluate the expression. *(Skills Review Handbook)*

48. 11^2

49. $(-3)^4$

50. -5^2

51. 2^5