4-3 Writing Rules for Linear Functions

Check Skills You'll Need

1. **Vocabulary Review** What is *slope-intercept form*?

For each function, find the slope and *y*-intercept.

2. $y = 3x - 2$
3. $y = x + 5$
4. $y = 8x$

GO for Help Lesson 4-2

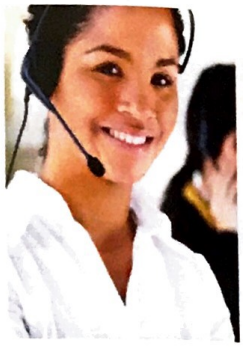
What You'll Learn

To write function rules from words, tables, and graphs

Why Learn This?

A business owner can calculate the cost of a toll-free number if she can write a rule for the function.

Just as you can translate words to an equation, you can also translate words to a function rule. Be sure to identify the input and the output.



CONTENT STANDARD 8.F.4

EXAMPLE 1 Writing a Function Rule From Words

a. Multiple Choice A toll-free telephone number is \$2.95 per month plus \$.10 per minute. Which function rule represents the monthly cost?

(A) $y = 0.1 + 2.95x$ (C) $y = 2.95 - 0.1x$

(B) $y = 2.95 + 0.1x$ (D) $y = 0.1x - 2.95$

Words monthly cost = \$2.95 plus \$0.10 times number of minutes

Let x = the number of minutes. ← input

Let y = the monthly cost. ← output

Function $y = 2.95 + 0.1 \cdot x$

$y = 2.95 + 0.1x$

The correct answer is choice B.

b. What are the initial value and rate of change of the function?

The initial value, or *y*-intercept, of the function is \$2.95, which represents the initial cost of the toll-free number. The rate of change, or slope, of the function is \$0.10, which represents the cost per minute.

Test Prep Tip

The form of each of these answer choices is similar to slope-intercept form. In order to identify the correct answer easily, write your answer in a similar form.

Quick Check

1. An orchestra buys music stands for \$42 each with \$298 in its bank account. Write a function rule that shows how the account balance depends on the number of stands bought. What are the initial value and rate of change of the function?

EXAMPLE 2 Writing a Rule From a Table

Number of Days, x	0	2	4	6	8
Water Level Compared to Average (inches), y	10	7	4	1	−2

The table at the left shows how the water level of a lake over time compares to its average water level. Write a function rule. What are the initial value and rate of change?

Find the slope. Two points in the table are $(2, 7)$ and $(0, 10)$.

$$\text{slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{7 - 10}{2 - 0} = -\frac{3}{2}.$$

The point $(0, 10)$ lies on the graph of the function. So the y-intercept is 10.

Use slope-intercept from to write a function rule.

$$y = -\frac{3}{2}x + 10 \quad \leftarrow \text{Substitute } -\frac{3}{2} \text{ for } m \text{ and 10 for } b.$$

The initial value, or y-intercept, is 10, which indicates that the initial water level of the lake is 10 in. above average. The rate of change, or slope, is $-\frac{3}{2}$ inches per day.

GO for Help

For help with slope-intercept form, go to Lesson 4-2, Example 1.

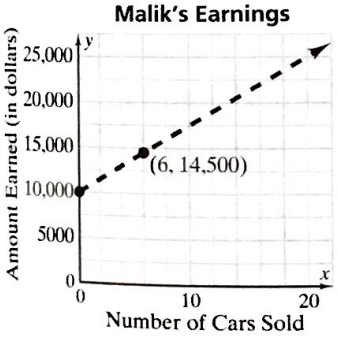
Quick Check

Number of Hours, x	3	6	9	12
Inches of Snow, y	4.5	9	13.5	18

2. The table shows the number of inches of snow that fell during a snowstorm. Write a function rule. What are the initial value and rate of change?

EXAMPLE 3 Writing an Equation From a Graph

Business Malik is a car salesman. He earns a base salary and a commission for each car he sells. The graph shows this relationship. Write a function rule. What is Malik's base salary? How much does he earn in commission for each car he sells?



The graph is linear so use the form $y = mx + b$. Find m and b.

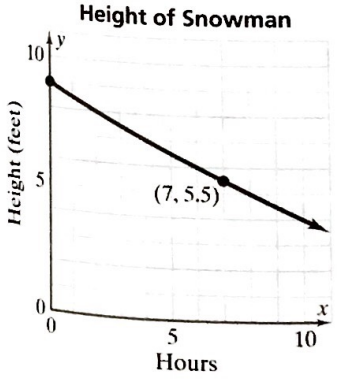
The line intersects the y-axis at $(0, 10{,}000)$. So the y-intercept is 10,000.

Find the slope. Two points on the line are $(0, 10{,}000)$ and $(6, 14{,}500)$.

$$m = \frac{\text{change in } y\text{-coordinates}}{\text{change in } x\text{-coordinates}} = \frac{14{,}500 - 10{,}000}{6 - 0} = \frac{4{,}500}{6} = 750$$

The function rule is $y = 750x + 10{,}000$.

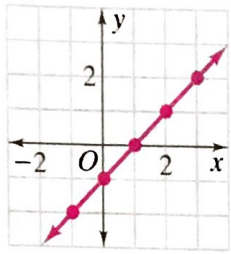
Malik's base salary is \$10,000. The rate of change is \$750, which is the amount of commission he earns for each car he sells.



Quick Check

3. The graph shows the height of a snowman over time. Write a function rule. What is the initial height of the snowman? What is the rate of change of his height over time?

Check Your Understanding



1. **Vocabulary** How is slope-intercept form related to a linear function rule?

2. Use the graph at the left to find the slope and complete the equation for the line.

   a. slope $= \frac{y_2 - y_1}{x_2 - x_1} =$ ■ b. y-intercept is ■ c. $y =$ ■$x +$ ■

Homework Exercises

For more exercises, see Extra Skills and Word Problems.

GO for Help

For Exercises	See Examples
3–4	1
5–6	2
7–8	3

3. **Sales** Mrs. Savin receives a weekly base salary of $500, plus a commission of $1,200 on each car that she sells. Write a function rule relating her total weekly pay p to cars she sells c. What are the initial value and rate of change?

4. **Ecology** Water flows over a dam at a rate of 500 gallons per minute. Write a function rule relating the amount of water a that flows over the dam to the number of minutes m that have passed. What are the initial value and rate of change?

The relationship between the x- and y-values in each table is linear. Write a function rule. Find the initial amount and rate of change.

5.

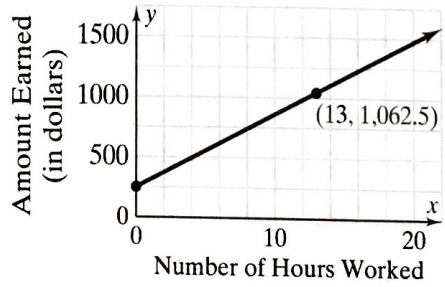
Years, x	4	7	8	12
Height, y (ft)	10	17.5	20	30

6.

Weeks, x	2	5	7	10
Coins, y	29	41	49	61

Use the slope and two points to write an equation for each line. Find the initial amount and rate of change.

7.



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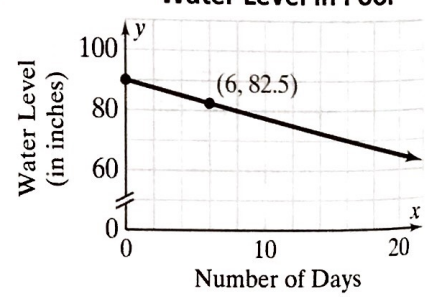

GPS

9. **Guided Problem Solving** Prices at a laundromat are $1.25 per load of wash and $.75 per 20 minutes of drying time. An average load takes 1 hour to dry. Write a function rule to describe the total cost of washing and drying as a function of the number of loads. What is the initial cost and rate of change?
   - What is the cost for one load of laundry to be washed and dried?
   - Let n be the number of loads. Let C be the cost of n loads.

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Caricatures are pictures of people in which certain features are exaggerated for comic effect.

10. **Art** At a fair, an artist draws caricatures. He pays the fair $30 for space to set up his table, and $2 for each drawing that he sells.
    a. Write a function rule to represent the artist's total payment to the fair as a function of the number of drawings he sells. What is the initial payment and rate of change?
    b. **Reasoning** What input is paired with the output $54? What does this input represent?

Writing in Math **Find the equation of each line with the given slope and passing through the given point. Write a word problem for each equation. Explain what the initial amount and rate of change mean in terms of the problem situation.**

11. slope $= \frac{3}{4}$; $(2, -3)$

12. slope $= -\frac{1}{2}$; $(4, -6)$

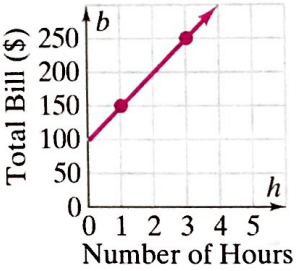
13. **Challenge** A water theme park charges a $15 entrance fee and $1 per ride. The park also offers a plan with a $30 admission fee and a charge of $.50 per ride. Write and graph a function rule to show the total cost C for r rides for each plan. Which is the best plan for someone who intends to go on many rides? Explain.

Test Prep and Mixed Review

Practice

Multiple Choice

14. Gomez Plumbing's total bill includes a service charge and an hourly rate. The graph shows this relationship. Which is the service charge and hourly rate?



Ⓐ $100 service charge and $100 per hour
Ⓑ $100 service charge and $50 per hour
Ⓒ $50 service charge and $50 per hour
Ⓓ $50 service charge and $150 per hour

15. The volume of a cube-shaped packing box is 216 cm^3. What is the length of the side of the box?
Ⓕ 6 cm Ⓖ 15 cm Ⓗ 36 cm Ⓙ 216 cm

16. Which set of lengths can form the sides of a right triangle?
Ⓐ 5 in., 12 in., 14 in.
Ⓑ 10 in., 24 in., 26 in.
Ⓒ 2 in., 4 in., 6 in.
Ⓓ 8 in., 8 in., 10 in.

GO for Help

For Exercises	See Lesson
17–20	2-4

Solve.

17. $2x + 5 = 6x + 33$

18. $9y + 17 = 6y + 29$

19. $17z - 9 = 7z - 59$

20. $2a + 11 = -14a + 59$