

4-3

Writing Rules for Linear Functions

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.



EXAMPLE

Writing a Function Rule From Words

- 1 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 $y = 2.95 + 0.1x$

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.

Examples

- ① **Writing a Function Rule From Words** A rate for Internet access is \$15 per month plus \$.25 per hour of use. Which function rule represents the monthly bill for x hours of use?

A. $y = 0.25 + 15x$

C. $y = 15 - 0.25x$

B. $y = 15 + 0.25x$

D. $y = 0.25x - 15$

Words

monthly cost = \$15 plus \$.25 times **number of hours**

Let x = the number of hours. ← input

Let y = the monthly cost. ← output

Function

$$y = \$15 + \$0.25x$$

$$y = 15 + 0.25x$$

The function rule $y = 15 + 0.25x$ represents the monthly cost for x hours of use. The correct answer is choice **B**.

EXAMPLE

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

- 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 form to write a function rule.

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

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.

- 2 **Writing a Rule From a Table** Do the values in the table below represent a linear function? If so, write a function rule.

		+1	+1	+1
		↖ ↗ ↖ ↗ ↖ ↗		
x	0	1	2	3
y	5	2	-1	-4
		↖ ↗ ↖ ↗ ↖ ↗		
		-3	-3	-3

← Find the changes in inputs.

← Find the changes in outputs.

$$\frac{\text{change in } y}{\text{change in } x} = \frac{-3}{1} = \frac{-3}{1} = \frac{-3}{1} \quad \leftarrow \text{ Compare the changes as ratios.}$$

Since each ratio is the same, the function **is** linear. The slope is **-3**.

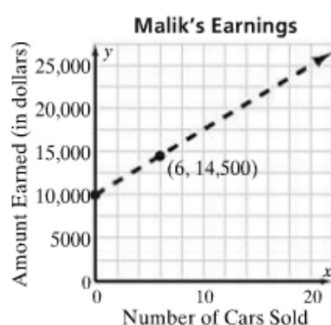
The point $(0, \mathbf{5})$ lies on the graph of the function. So the y -intercept is **5**. Use the slope-intercept form to write a function rule.

$$y = \mathbf{-3}x + \mathbf{5}$$

← Substitute **-3** for m and **5** for b .

EXAMPLE Writing an Equation From a Graph

- 3 **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 $y = 750x + 10,000$.

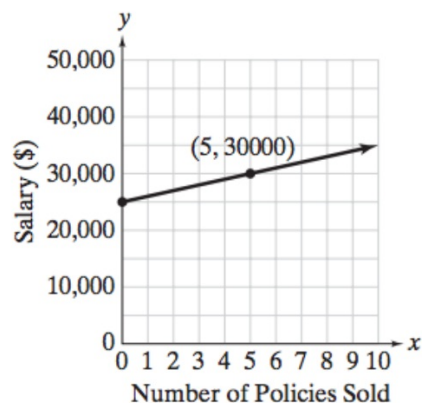
Malik's base salary is \$10,000. The rate of change is \$750, which is the amount of commission he earns for each car he sells.

- 3 **Writing an Equation From a Graph** An insurance salesperson earns an annual base salary plus a commission for each insurance policy that she sells. The graph shows this relationship. Write a function rule. What is base salary and rate of change?

The point $(0, 25,000)$ lies on the y -axis so the y -intercept, b , is $25,000$.

Two points are shown, so use them to find the slope, m .

$$\begin{aligned}
 m &= \frac{\text{change in } y\text{-coordinates}}{\text{change in } x\text{-coordinates}} \\
 &= \frac{30,000 - 25,000}{5 - 0} \\
 &= \frac{5,000}{5} \\
 &= 1,000
 \end{aligned}$$



The function rule is $y = 1,000x + 25,000$.

The base salary is $\$25,000$. The rate of change is $\$1,000$, which is the commission for each policy the salesperson sells.

Table talk about these problems.

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?

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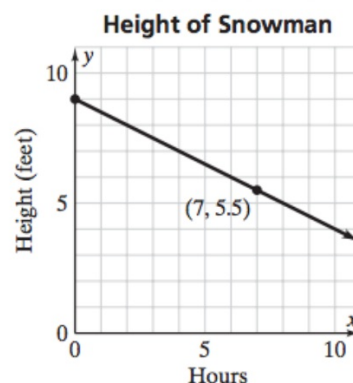
2. The table shows the inches of snow during a snowstorm. Write a function rule. What is the initial value and rate of change?

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

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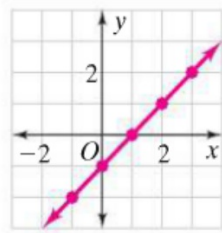
3. The graph shows the height of a snowman over time. Write a function rule. What is the initial height and rate of change?

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Check Your Understanding



- Vocabulary** How is slope-intercept form related to a linear function rule?
- 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. $y =$ $x +$

Today's big ideas summarized:

Sometimes you can write a function rule to describe a situation.

Cookies at a bazaar sell for \$2 each. The booth costs \$25 to rent for the day. The profit depends on how many cookies are sold.

Words: Profit = $2 \times$ (number of cookies sold) - \$25

Function rule: $y = 2x - 25$

The output y is the profit.

The input x is the number of cookies sold.

You can use the graph of a linear function to write its function rule.

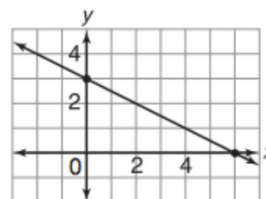
First, you need to find the slope and the y-intercept.

- From the graph, the slope (m) is $-\frac{1}{2}$.
- The point $(0, 3)$ is on the graph so the y-intercept (b) is 3.
- Substitute in the slope-intercept form.

$$y = mx + b$$

$$y = -\frac{1}{2}x + 3$$

The function rule is $y = -\frac{1}{2}x + 3$.



You have a practice worksheet for your assignment, and time to begin working on it.

Make sure you read the directions. Some of the questions ask you to identify three things.

Name _____ Class _____ Date _____

Practice 4-3

Writing Rules for Linear Functions

Write a linear function rule for each situation. Identify the initial value and rate of change.

- Amy sells tote bags at a craft fair for a day. She pays \$50 to rent a booth. The materials and labor cost on each tote bag is \$3.50. Her expenses for the day depend on how many tote bags she sells.

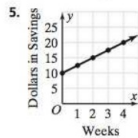
- Ms. Watson receives a base pay of \$150 plus a commission of \$45 on each appliance that she sells. Her total pay depends on how many appliances she sells.

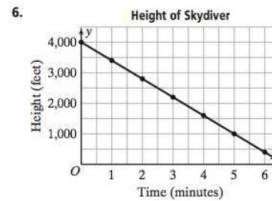
Write a function rule for the data in the table. Find the initial amount and rate of change.

3. Number of Sessions, x	3	6	9	12
Cost for Music Lessons, y	115	205	295	385

4. Number of People, x	2	4	6	8
Admission Price, y	28	56	84	112

Write a function rule for the data in the graph. Find the initial amount and rate of change.





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