

5.1 Writing Linear Equations from Situations and Graphs

8.F.4

Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x,y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values

EXPLORE ACTIVITY

COMMON
CORE

8.F.4

Writing an Equation in Slope-Intercept Form

Greta makes clay mugs and bowls as gifts at the Crafty Studio. She pays a membership fee of \$15 a month and an equipment fee of \$3.00 an hour to use the potter's wheel, table, and kiln. Write an equation in the form $y = mx + b$ that Greta can use to calculate her monthly costs.

A What is the input variable, x , for this situation?

Hours for equipment

What is the output variable, y , for this situation?

Cost



B During April, Greta does not use the equipment at all.
 What will be her number of hours (x) for April? 0

What will be her cost (y) for April? \$ 15

What will be the y -intercept, b , in the equation? 15

$$y = mx + b$$

C Greta spends 8 hours in May for a cost of \$15 + 8(\$3) = \$ 39.

In June, she spends 11 hours for a cost of \$ 48.

From May to June, the change in x -values is 3.

From May to June, the change in y -values is 9.

What will be the slope, m , in the equation? $m = \frac{\Delta y}{\Delta x} \quad \frac{9}{3} = 3$

$$15 + 11(3)$$

$$11 - 8$$

$$48 - 39$$

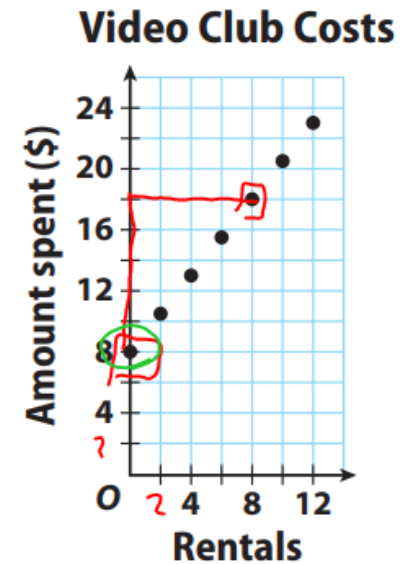
D Use the values for m and b to write an equation for Greta's costs in the form $y = mx + b$: $y = 3x + 15$

Writing an Equation from a Graph

EXAMPLE 1

A video club charges a one-time membership fee plus a rental fee for each DVD borrowed. Use the graph to write an equation in slope-intercept form to represent the amount spent, y , on x DVD rentals.

$$\begin{array}{l} x_1 \ y_1 \\ (0, 8) \\ x_2 \ y_2 \\ (8, 18) \end{array} \quad \frac{18-8}{8-0} = \frac{10}{8} = \frac{5}{4}$$



STEP 1 Find Slope using $\frac{\text{Rise}}{\text{Run}}$ or $\frac{y_2 - y_1}{x_2 - x_1}$ $\frac{\uparrow 10}{\rightarrow 8} = \frac{5}{4}$

STEP 2 Find y -intercept
 $b = 8$

STEP 3 Write equation in slope-intercept form
 $y = mx + b$
 $y = \frac{5}{4}x + 8$

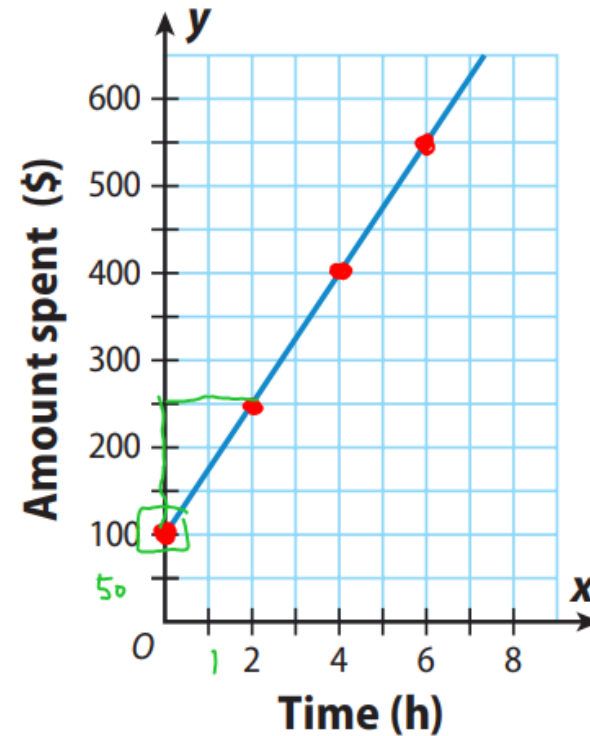
ADDITIONAL EXAMPLE 1

A DJ charges a setup fee plus an hourly fee to provide music for a dance party. Use the graph to write an equation in slope-intercept form to represent the amount spent, y , on x hours of music.

$$m = \frac{\uparrow 150}{\rightarrow 2} = \frac{150}{2} = 75$$

$$b = 100$$

Equation: $y = 75x + 100$



YOUR TURN

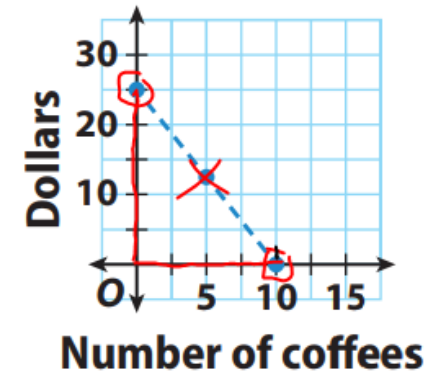
3. The cash register subtracts \$2.50 from a \$25 Coffee Café gift card for every medium coffee the customer buys. Use the graph to write an equation in slope-intercept form to represent this situation.

$$y = -\frac{5}{2}x + 25$$

$$m = \frac{-25}{10} = -\frac{5}{2}$$

$$b = 25$$

Amount on Gift Card




Writing an Equation from a Description

EXAMPLE 2

The rent charged for space in an office building is a linear relationship related to the size of the space rented. Write an equation in slope-intercept form for the rent at West Main Street Office Rentals.



(x, y)

West Main St. Office Rentals 

Offices for rent at convenient locations.

Monthly Rates:

600 square feet for **\$750**

900 square feet for **\$1150**

STEP 1 Identify Input/output

STEP 2 Write as ordered pairs
 $(600, 750)$ $(900, 1150)$

STEP 3 Find Slope $m = \frac{y_2 - y_1}{x_2 - x_1}$

$$m = \frac{1150 - 750}{900 - 600} = \frac{400}{300} = \frac{4}{3}$$

STEP 4 Find y-intercept

$$\begin{aligned} 750 &= \frac{4}{3}(600) + b \\ 750 &= 800 + b & -50 &= b \\ -800 & \quad -800 \end{aligned}$$

STEP 5 Write Equation

$$y = \frac{4}{3}x + -50$$

ADDITIONAL EXAMPLE 2

The cost for 25 square yards of carpet is \$650 including delivery and installation. The cost for 40 square yards of installed carpet is \$950. Write an equation in slope-intercept form for the cost of the installed carpet.

$$y = mx + b$$

Equation

$$y = 20x + 150$$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{950 - 650}{40 - 25} = \frac{300}{15} = \frac{20}{1} \quad b = 150$$

$$\begin{array}{l} x_1 \quad y_1 \\ (25, 650) \end{array}$$

$$\begin{array}{l} (40, 950) \\ x_2 \quad y_2 \end{array}$$

$$\begin{array}{r} 950 = 20(40) + b \\ 950 = 800 + b \\ \underline{-800 \quad -800} \\ 150 = b \end{array}$$

$$\begin{array}{r} y \quad m \quad x \quad b \\ 650 = 20(25) + b \\ 650 = 500 + b \\ \underline{-500 \quad -500} \\ 150 = b \end{array}$$

YOUR TURN

5. Hari's weekly allowance varies depending on the number of chores he does. He received \$16 in allowance the week he did 12 chores, and \$14 in allowance the week he did 8 chores.

Write an equation for his allowance in slope-intercept form.

$$y = \frac{1}{2}x + 10$$

(x) Independent: Chores

(y) Dependent: allowance

ordered pairs: $(x_1, y_1) = (12, 16)$ $(x_2, y_2) = (8, 14)$

$$m: \frac{1}{2}$$

$$b: 10$$

$$y = mx + b$$

$$16 = \frac{1}{2}(12) + b$$

$$16 = 6 + b$$

$$10 = b$$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{14 - 16}{8 - 12} = \frac{-2}{-4} = \frac{2}{4} = \frac{1}{2}$$

Guided Practice

1. Li is making beaded necklaces. For each necklace, she uses 27 spacers, plus 5 beads per inch of necklace length. Write an equation to find how many beads Li needs for each necklace. (Explore Activity)

a. input variable: beads/inch

b. output variable: total beads

c. equation: $y = mx + b$ $y = 5x + 27$

unit
rate
Slope

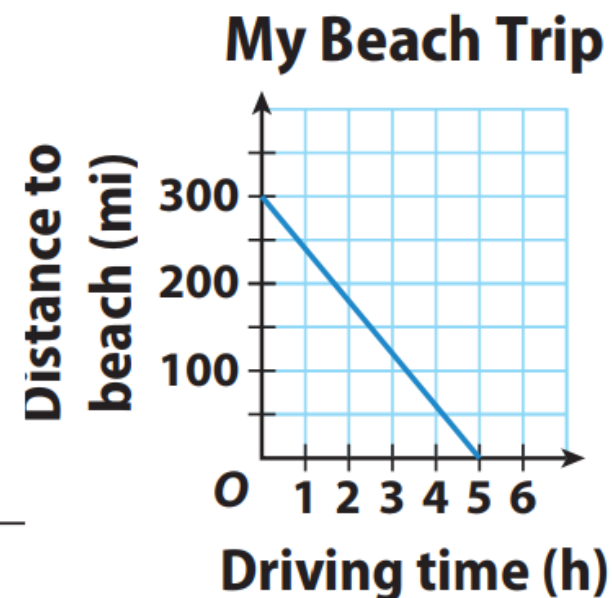
2. Kate is planning a trip to the beach. She estimates her average speed to graph her expected progress on the trip. Write an equation in slope-intercept form that represents the situation. (Example)

Choose two points on the graph to find the slope.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \underline{\hspace{10em}}$$

Read the y -intercept from the graph: $b = \underline{\hspace{10em}}$

Use your slope and y -intercept values to write an equation in slope-intercept form. $\underline{\hspace{10em}}$



- 3.** At 59°F , crickets chirp at a rate of 76 times per minute, and at 65°F , they chirp 100 times per minute. Write an equation in slope-intercept form that represents the situation. (Example 2)

Input variable: _____ Output variable: _____

$m = \frac{y_2 - y_1}{x_2 - x_1} =$ _____ Use the slope and one of the ordered

pairs in $y = mx + b$ to find b . _____ = _____ \cdot _____ + b ; _____ = b

Write an equation in slope-intercept form. _____

