

Explain It!

Xiu and Jon take the tram from the base camp to the mountain summit. After about six and a half minutes in the tram, Jon says, "Cool! We are a mile above sea level." Xiu says, "We passed the one-mile mark a couple of minutes ago."

Lesson 7-9

Analyze Linear Equations:

$$y = mx + b$$

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I can...
derive the equation $y = mx + b$.

A. Construct an argument to defend Xiu's statement.

B. What mistake could Jon have made? Explain.

Focus on math practices

Reasoning Can you use the equation $y = mx$ to represent the path of the tram? Is there a proportional relationship between x and y ? Explain.

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Essential Question

What is the equation of a line for a nonproportional relationship?

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EXAMPLE 1 Write the Equation of a Line

The Middle School Student Council is organizing a dance and has \$500 to pay for a DJ. DJ Dave will charge \$200 for a set-up fee and the first hour, or \$425 for a set-up fee and four hours.

How can the Student Council determine whether they can afford to have DJ Dave play for 5 hours?

STEP 1 Plot the total costs for DJ Dave for 1 hour and 4 hours. Find the initial value, or y -intercept, and the rate of change, or slope.

The initial value, or y -intercept, is 125. DJ Dave charges a \$125 initial fee.

STEP 2 Write an equation to represent the total cost for DJ Dave for any number of hours.

$$\text{Total Cost} = \text{Hourly Rate} + \text{Initial Fee}$$

$$y = 75x + 125$$

This equation is in **slope-intercept form**, $y = mx + b$, where m is the rate of change, or slope, and b is the initial value, or y -intercept.

STEP 3 Evaluate the equation to find the total cost for 5 hours.

$$y = 75x + 125$$

$$y = 75(5) + 125$$

$$= 375 + 125$$

$$= 500$$

The total cost is \$500. The student council can afford DJ Dave.

Try It! Write a linear equation in slope-intercept form for the graph shown.

The y -intercept of the line is .

The slope is . The equation in slope-intercept form is = x + .

Convince Me! What two values do you need to know to write an equation of a line, and how are they used to represent a line?

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EXAMPLE 2 Write a Linear Equation Given Its Graph

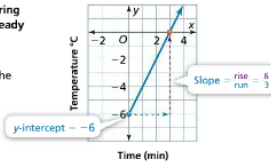
A salt water solution is cooled to -6°C . During an experiment, the mixture is heated at a steady rate. Write an equation to represent the temperature, y , after x minutes.

Identify the slope and the y -intercept from the graph.

$y = mx + b$
 $y = 2x - 6$

The slope $m = \frac{6}{3}$ or 2.
 The y -intercept $b = -6$.

The equation of the line is $y = 2x - 6$.



EXAMPLE 3 Graph a Given Linear Equation

Graph the equation $y = -4x + 3$.

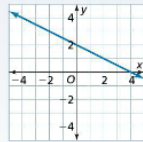
STEP 1 The y -intercept is 3. Plot a point at $(0, 3)$.

STEP 2 The slope is -4 or $-\frac{4}{1}$. To locate another point on the line, start at $(0, 3)$ and go down 4 and right 1.

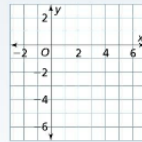
STEP 3 Draw a line through the points.

Try It!

a. What is an equation for the line shown?



b. Graph the line with equation $y = \frac{1}{3}x - 5$.



KEY CONCEPT

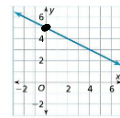
The equation of a line that represents a nonproportional relationship can be written in slope-intercept form, $y = mx + b$, where m is the slope of the line and b is the y -intercept.

Do You Understand?

- 1. Represent Quantities** What is the equation of a line for a nonproportional relationship?
- 2. Use Structure** The donations by a restaurant to a certain charity, y , will be two-fifths of its profits, x , plus \$50. How can you determine the equation in slope-intercept form that shows the relationship between x and y without graphing the line?
- 3. Be Precise** Priya will graph a line with the equation $y = \frac{1}{2}x - 4$. She wants to know what the line will look like before she graphs the line. Describe the line Priya will draw, including the quadrants the line will pass through.

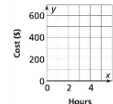
Do You Know How?

4. Chrissie says the equation of the line shown on the graph is $y = \frac{1}{2}x - 5$. George says that the equation of the line is $y = -\frac{1}{2}x + 5$. Which student is correct? Explain.



5. Fara wants to rent a tent for an outdoor celebration. The cost of the tent is \$500 per hour, plus an additional \$100 set-up fee.

a. Draw a line to show the relationship between the number of hours the tent is rented, x , and the total cost of the tent, y .



b. What is the equation of the line in slope-intercept form?

$y = 500x + 100$

$\frac{dy}{dx}$ slope
 $y = mx + b$
 \uparrow y -int: $(0, b)$

Hours	total cost
0	100 ($0 \cdot 500 + 100$)
1	600 ($1 \cdot 500 + 100$)
2	1100 ($2 \cdot 500 + 100$)
3	1600 ($3 \cdot 500 + 100$)
4	2100 ($4 \cdot 500 + 100$)
5	2600 ($5 \cdot 500 + 100$)

$$m = \frac{\Delta y}{\Delta x}$$

$$y = mx + b$$

$$y = 2x + 4$$

$m = \frac{2}{1}$ or $-\frac{2}{-1}$

$(0, 4)$ y-int

Name: _____

Practice & Problem Solving

6. **Leveled Practice** What is the graph of the equation $y = 2x + 4$?

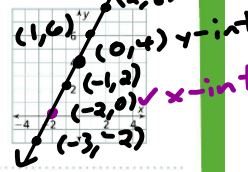
The y-intercept is , which means the line crosses the y-axis at the point , . Plot this point.

The slope of the line is positive, so it goes from left to right.

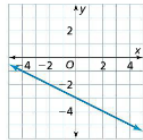
Start at the y-intercept. Move up and then move right .

You are now at the point , . Plot this point.

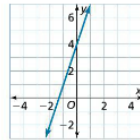
Draw a line to connect the two points.



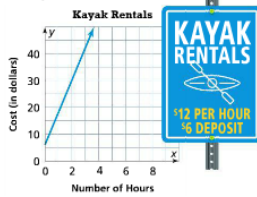
7. Write an equation for the line in slope-intercept form.



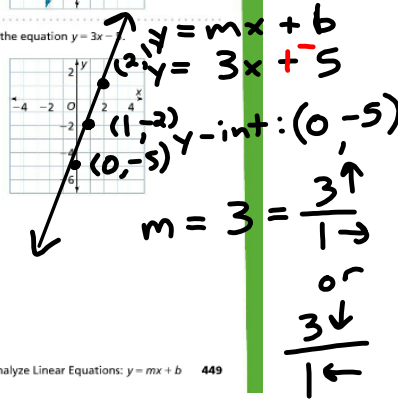
8. Write an equation for the line in slope-intercept form.



9. The line models the cost of renting a kayak. Write an equation in slope-intercept form for the line, where x is the number of hours the kayak is rented and y is the total cost of renting the kayak.

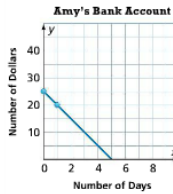


10. Graph the equation $y = 3x - 5$.



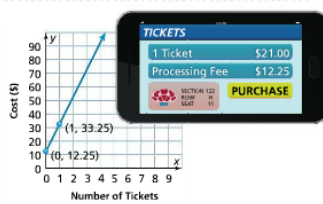
11. Amy began with \$25 in her bank account and spent \$5 each day. The line shows the amount of money in her bank account. She incorrectly wrote an equation for the line in slope-intercept form as $y = -5x + 5$.

- What is the correct equation for the line in slope-intercept form?
- Critique Reasoning** What mistake might Amy have made?



12. **Higher Order Thinking** The line represents the cost of ordering concert tickets online.

- Write an equation for the line in slope-intercept form, where x is the number of tickets and y is the total cost.
- Explain how you can write an equation for this situation without using a graph.



c. Is this graph a good representation of the situation? Explain.

Assessment Practice

13. What should you do first to graph the equation $y = \frac{2}{3}x - 1$?

- Plot the point $(0, 0)$.
- Plot the point $(2, 5)$.
- Plot a point at the x-intercept.
- Plot a point at the y-intercept.

14. Write an equation for the line in slope-intercept form.

