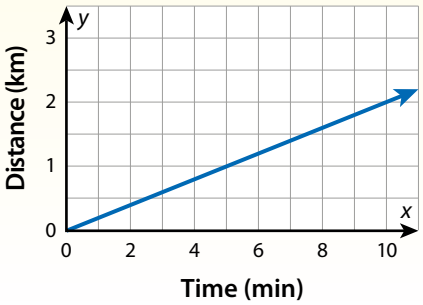
Explore Deriving $y = mx$

Previously, you learned about slope. In this lesson, you will learn about writing the equation of a line.

➤ **Use what you know to try to solve the problem below.**

Kendra is a blind marathon runner training for the Junior Paralympics. Kendra's coach graphs a line representing Kendra's distance from the start over the first 10 minutes of a practice 5K race. What is the slope of the line? What equation could you use to find y, Kendra's distance from the start after x minutes?



TRY IT

Math Toolkit graph paper, straightedges

DISCUSS IT

Ask: How might knowing what the slope represents help you write the equation?

Share: I knew . . . so I . . .

Learning Target **SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6, SMP 7**

Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at b.

CONNECT IT

1 **Look Back** What is the slope and what is equation of the line representing Kendra's distance from the start in terms of time? Explain how you found each.

2 **Look Ahead** The relationship between distance and time in **Try It** is proportional. You can use the slope formula to derive the general equation for a proportional relationship.

a. Use (x, y) and $(0, 0)$ as two points on the graph of a proportional relationship. Use the slope formula to find the slope between these two points. Fill in the blanks.

$$m = \frac{y - \square}{\square - 0}$$

$$= \frac{\square}{\square}$$

b. What can you do to get y alone on one side of the equation? Fill in the blanks.

$$m\square = \frac{y}{\square}\square$$

c. Simplify the equation and rewrite it with y on the left side. This is the general equation for all proportional relationships.

$$y = \square$$

3 **Reflect** In problem 2a, how do you know that the point $(0, 0)$ is on the graph of any proportional relationship?

Prepare for Deriving and Graphing Linear Equations of the Form $y = mx + b$

1 Think about what you know about slope and lines. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.

In My Own Words

My Illustrations

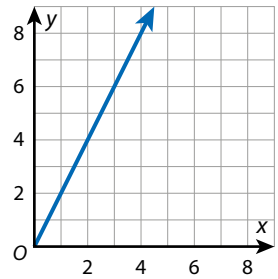
slope

Examples

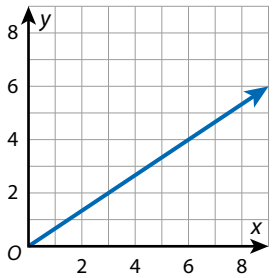
Non-Examples

2 What is the slope of each line?

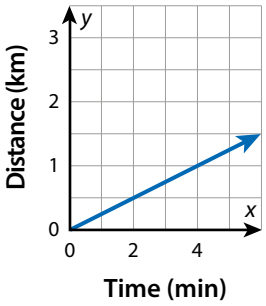
a.



b.



3 Ethan's coach graphs a line representing the first 5 minutes of Ethan's 5K race.



a. What is the slope of the line? What equation could you write to find Ethan's distance, y, for any number of minutes, x, during this first part of the race? Show your work.

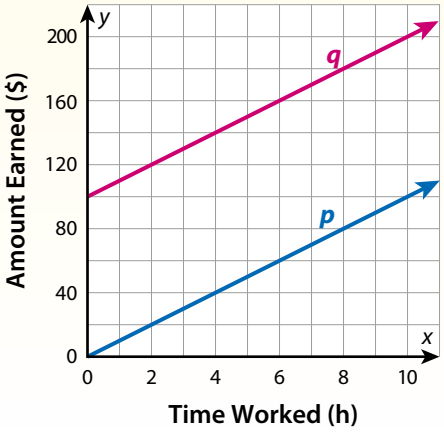
SOLUTION

b. Check your answer to problem 3a. Show your work.

Develop Deriving $y = mx + b$

➤ **Read and try to solve the problem below.**

Ramona has a new job as a chef. She earns the same amount per hour as she did in her old job, plus she got a $100 sign-on bonus. Line *p* represents Ramona's earnings in her old job. Line *q* represents her earnings in her new job. Write an equation for line *p*. What does the slope mean? How can you use the equation for line *p* to write an equation for line *q*?



TRY IT

Math Toolkit graph paper, straightedges

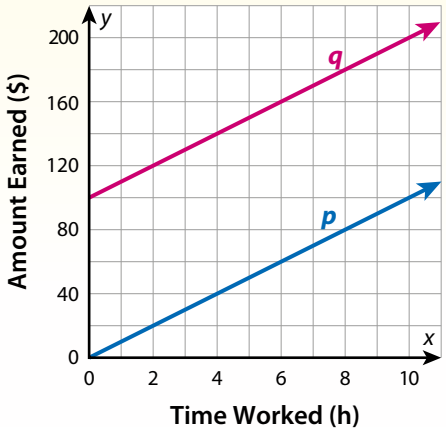
DISCUSS IT

Ask: How did you use the old job's equation to find the new job's equation?

Share: At first, I thought . . .

➤ **Explore different ways to derive $y = mx + b$.**

Ramona has a new job as a chef. She earns the same amount per hour as she did in her old job, plus she got a $100 sign-on bonus. Line *p* represents Ramona's earnings in her old job. Line *q* represents her earnings in her new job. Write an equation for line *p*. What does the slope mean? How can you use the equation for line *p* to write an equation for line *q*?

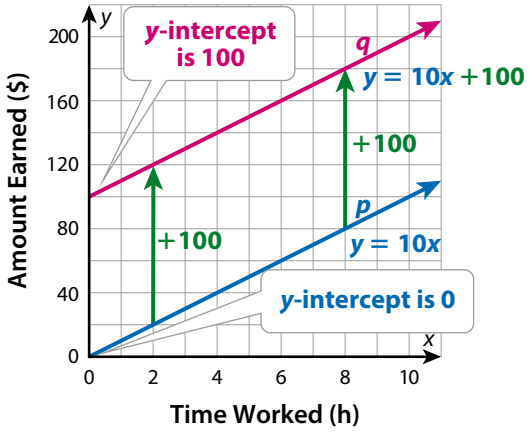


Model It

You can use a transformation to map **line *p*** onto **line *q***.

The slopes of the lines are equal since the earnings per hour at each job are the same. The lines are parallel.

The *y*-coordinate of the point where a line meets or crosses the *y*-axis is called the ***y*-intercept**.



Analyze It

You can write the equation for line *p* in the form $y = mx$.

Line *p* represents earnings at the **old job**. (0, 0) and (2, 20) are on line *p*.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{20 - 0}{2 - 0} = 10$$

The equation for line *p* is $y = 10x$ where *y* is the amount earned and *x* is the number of hours worked.

The equation for **line *q*** should include the hourly earnings at the **new job** plus the sign-on bonus. The equation is $y = 10x + 100$.

CONNECT IT

➤ **Use the problem from the previous page to help you understand how to derive $y = mx + b$.**

1 Look at **Model It**.

a. Describe how to map line p onto line q.

b. What does the y-intercept of line q represent?

2 Look at **Analyze It**. How are the equations for Ramona's earnings at the old job and the new job alike? How are they different? Explain.

3 A **linear equation** describes a straight line. It can be written in **slope-intercept form**, $y = mx + b$, where m is the slope and b is the y-intercept. The equation for line q is shown in slope-intercept form. Write the equation for line p in slope-intercept form. Circle the slope and underline the y-intercept.

slope y-intercept

$y = 10x + 100$

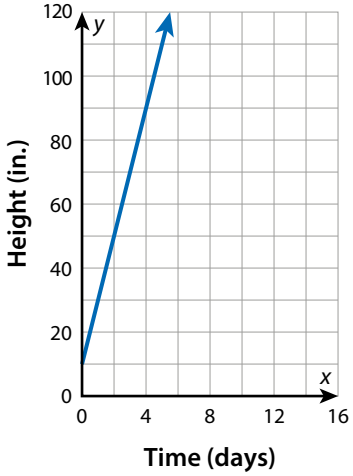
4 You can use the slope formula to also derive the slope-intercept form of a linear equation. Use the slope formula to find the slope between (x, y), any point on a line, and $(0, b)$, the point at the y-intercept. Then solve for y.

5 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to solve the **Try It** problem.

Apply It

Use what you learned to solve these problems.

6 Liam's class is planting bamboo seedlings in the school garden. The line represents the average height of a bamboo plant after it has been planted. Write an equation in slope-intercept form that Liam could use to predict the height y of his bamboo after x days. Explain what the slope and the y-intercept mean in this situation.



7 Jennifer's weather app has a graph that shows the predicted outside temperature starting at 7 AM. Which statements are true about the graph? Select all that apply.

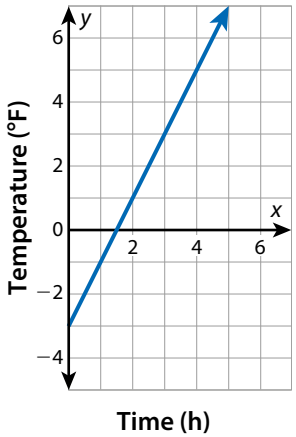
A The line is the graph of a linear equation.

B The slope of the line is $\frac{1}{2}$.

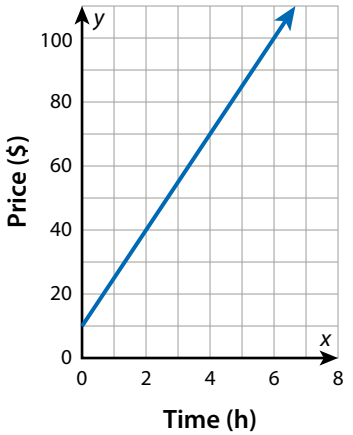
C The temperature increases throughout the morning at a steady rate.

D The equation of the line is $y = -3x + 2$ where y is the temperature in degrees Fahrenheit and x is the time in hours after 7 AM.

E The y-intercept means it was –3°F at 7 AM.



8 Julio sells hand-painted skateboards. The graph shows how the price of a skateboard is related to the amount of time Julio spends painting it. Julio says the equation of the line is $y = 10x + 15$. Explain what mistake Julio made. Write the correct equation for Julio's line.

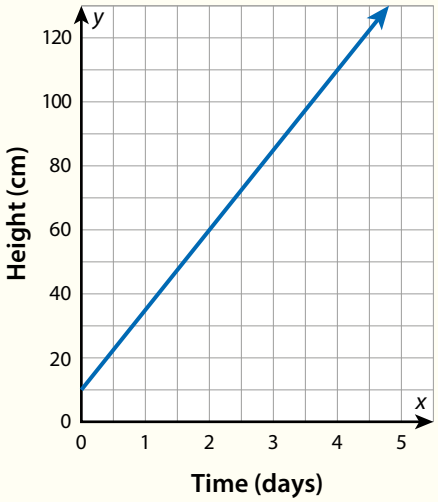


Practice Deriving $y = mx + b$

➤ **Study the Example showing how to write the equation of a line in slope-intercept form from a graph. Then solve problems 1–5.**

Example

An oceanographer is studying the growth of giant kelp. She selects one giant kelp plant and records its height each day. Then she draws this graph. What is the equation of the line in slope-intercept form? Define your variables.



(0, 10) and (2, 60) are two points on the line.

$$m = \frac{60 - 10}{2 - 0}$$

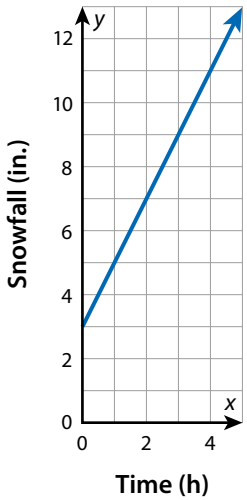
$$= \frac{50}{2}, \text{ or } 25 \qquad \text{The slope is 25.}$$

The line intersects the y-axis at (0, 10).
The y-intercept is 10.

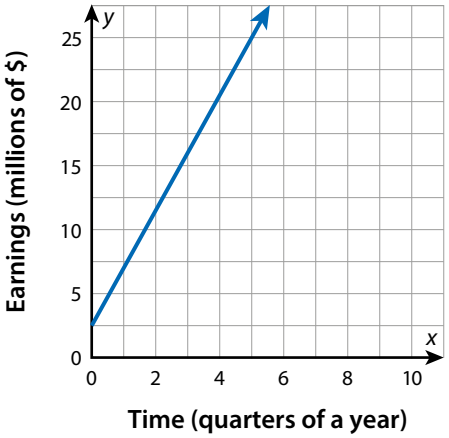
The equation $y = 25x + 10$ shows the height, y, of the giant kelp plant after x days.

1 What do the slope and y-intercept in the Example represent in this situation?

2 A meteorologist tracks the amount of snowfall over a 5-hour period. She graphs her measurements. What is the equation of the meteorologist's line in slope-intercept form? Define your variables.



3 The growth in earnings for a digital music service is shown in the graph. What is the equation of the line? Show your work. Define your variables.

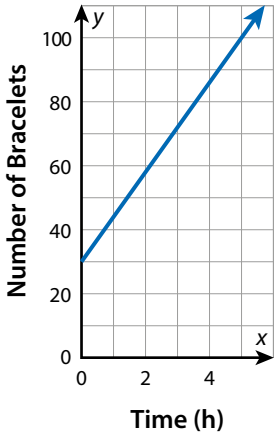


SOLUTION

4 Daria and her brother want to make 100 bracelets to sell at a craft fair. They have made some already. Daria made this graph to show how they can reach their goal. The equation of Daria's line is $y = 14x + 30$ where y is the number of bracelets and x is the time in hours.

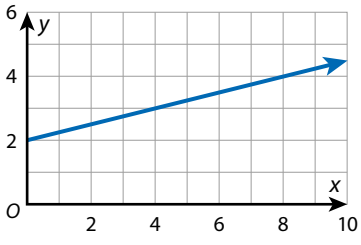
a. What is the slope of the line?

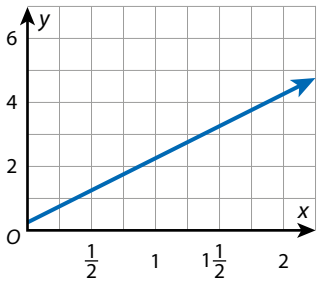
b. What is the y-intercept?

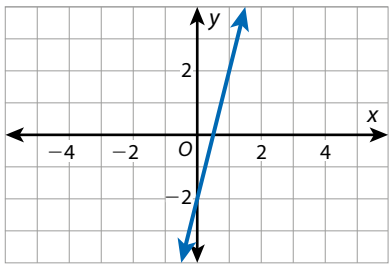


5 Write each linear equation under the graph of its line.

$y = 4x - 2$ $y = \frac{1}{4}x + 2$ $y = 2x + \frac{1}{4}$







Develop Graphing a Linear Equation of the Form $y = mx + b$

➤ **Read and try to solve the problem below.**

A 60-gallon rain barrel is filled to capacity. Elena opens the stopper to let water drain out to water her garden.

The equation $y = -3x + 60$ can be used to find y, the number of gallons of water left after the barrel drains for x minutes. Graph the equation.

TRY IT

Math Toolkit graph paper, straightedges

DISCUSS IT

Ask: How did you start to graph the equation?

Share: I started graphing by . . .

➤ **Explore different ways to graph a linear equation of the form $y = mx + b$.**

A 60-gallon rain barrel is filled to capacity. Elena opens the stopper to let water drain out to water her garden.

The equation $y = -3x + 60$ can be used to find y, the number of gallons of water left after the barrel drains for x minutes. Graph the equation.

Analyze It

You can look at the equation in slope-intercept form.

slope: -3 ; y-intercept: 60

$y = -3x + 60$

The y-intercept tells you where one point on the line is located. The slope tells you how the line slants.

Lines with positive slope slant up from left to right.

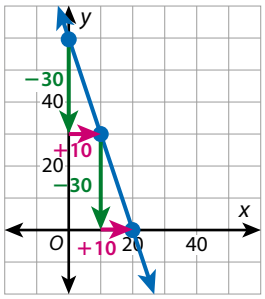
Lines with negative slope slant down from left to right.

Graph It

You can use the slope and the y-intercept to plot points.

A slope of -3 can be written as $\frac{-3}{1}$ in $\frac{\text{rise}}{\text{run}}$ form. So, for every **decrease of 3 in y**, there is an **increase of 1 in x**.

Because of the scale of this graph, it is easier to use the equivalent $\frac{\text{rise}}{\text{run}}$ quotient $\frac{-30}{10}$. So, for every **decrease of 30 in y**, there is an **increase of 10 in x**.



The y-intercept is 60, so one point on the line is (0, 60). Use the slope to find other points on the line.

$(0 + 10, 60 - 30) = (10, 30)$ $(10 + 10, 30 - 30) = (20, 0)$

CONNECT IT

➤ **Use the problem from the previous page to help you understand how to graph linear equations of the form $y = mx + b$.**

1 Look at **Graph It**. Do all the points on the line make sense for the situation? Explain.

2 **a.** Look at **Analyze It** and **Graph It**. Why does it make sense that the slope is negative? Why does it make sense that the y-intercept is positive?

3 **a.** Explain why a horizontal line has a slope of 0.

b. Explain why we use the term *undefined* to describe the slope of a vertical line.

4 How can you use the slope and y-intercept to graph a linear equation of the form $y = mx + b$?

5 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand graphing a linear equation of the form $y = mx + b$.

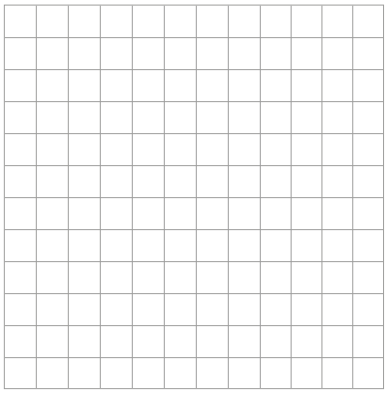
Apply It

Use what you learned to solve these problems.

6 Describe what the graph of the equation $y = 50x + 125$ will look like.

7 Graph the equations $y = -1$ and $x = -1$. What is the slope of each line? What is the *y*-intercept of each line?

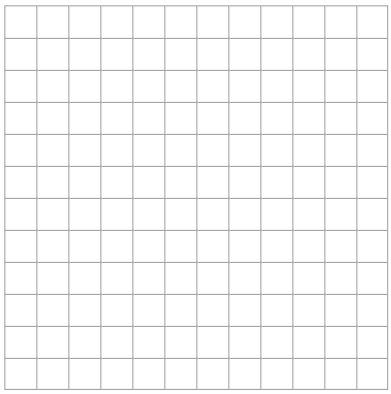
$y = -1$



slope: _____

y-intercept: _____

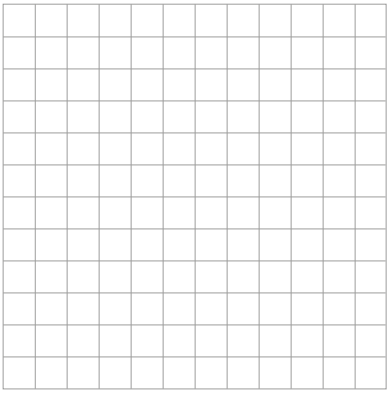
$x = -1$



slope: _____

y-intercept: _____

8 Graph the equation $y = -20x + 500$.



Practice Graphing a Linear Equation of the Form $y = mx + b$

➤ **Study the Example showing how to graph a linear equation of the form $y = mx + b$. Then solve problems 1–4.**

Example

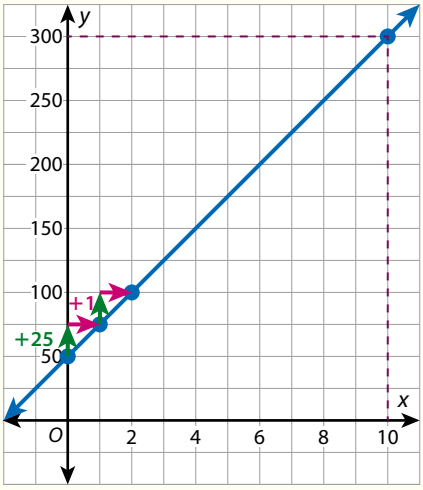
Mr. Díaz uses a hose to fill a kiddie pool with water. When full, the pool holds 300 gallons of water. The equation $y = 25x + 50$ can be used to find the number of gallons of water, y, in the pool x minutes after he turns on the hose. Graph the equation. How long does it take to fill the pool?

The y-intercept is 50, so the line intersects the y-axis at (0, 50). The slope is 25, or $\frac{25}{1}$. There is a **vertical change of 25** for every **horizontal change of 1**.

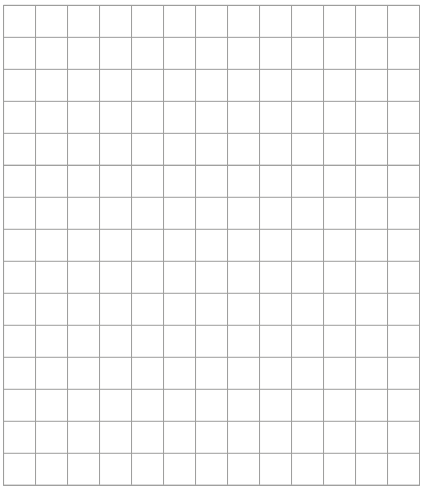
$(0 + 1, 50 + 25) = (1, 75)$

$(1 + 1, 75 + 25) = (2, 100)$

Plot the points and draw a line through them. The pool is filled when the number of gallons, y, is 300. This corresponds to an x-value of 10, so it takes 10 minutes to fill the pool.

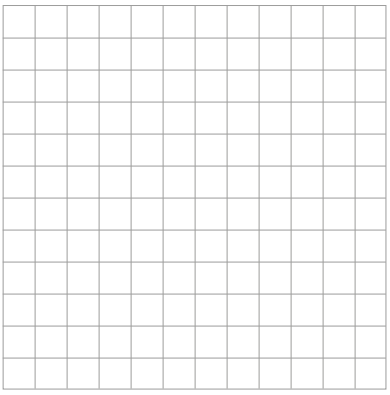


1 At the end of the day, Mr. Díaz drains the pool. The equation $y = -50x + 300$ can be used to find y, the number of gallons of water left after draining the pool for x minutes. Graph the equation. How long does it take to drain the pool? Explain.

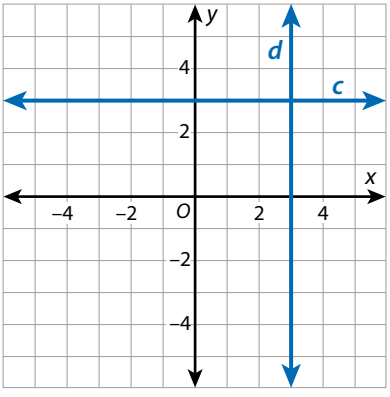


2 Tameka signs up for membership at a rock climbing gym. She pays a one-time $100 membership fee. Then she will pay a $25 monthly fee. The equation $y = 25x + 100$ can be used to find y, the total cost of a gym membership for x months. What is the slope of the line? What is the y-intercept?

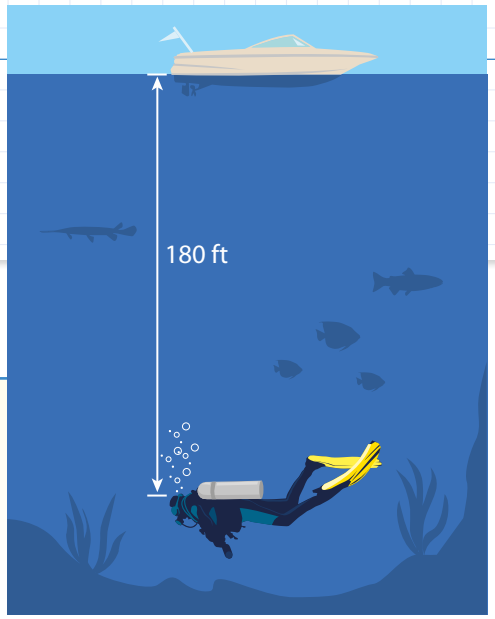
3 Graph the linear equation $y = -\frac{1}{2}x - 1.5$. Show your work.



4 Which line has the equation $y = 3$? Which has equation $x = 3$? Explain how you know.



Develop Graphing a Linear Equation Given in Any Form



➤ **Read and try to solve the problem below.**

A scuba diver dives to 180 feet below sea level. The linear equation $-60x + 2y = -360$ represents his trip back to the surface. The variable y is his elevation in feet relative to sea level after x minutes. Graph the equation.

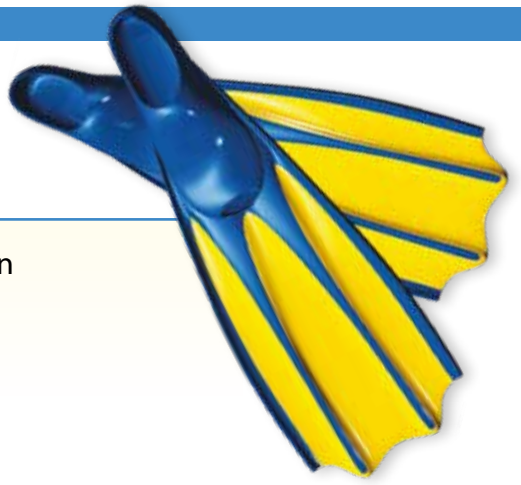
TRY IT

Math Toolkit graph paper, straightedges

DISCUSS IT

Ask: How is your strategy similar to mine? How is it different?

Share: My strategy is similar to yours . . . It is different . . .



➤ **Explore different ways to graph a linear equation given in any form.**

A scuba diver dives to 180 feet below sea level. The linear equation $-60x + 2y = -360$ represents his trip back to the surface. The variable y is his elevation in feet relative to sea level after x minutes. Graph the equation.

Model It

You can rewrite the linear equation in slope-intercept form, $y = mx + b$.

$$-60x + 2y = -360$$

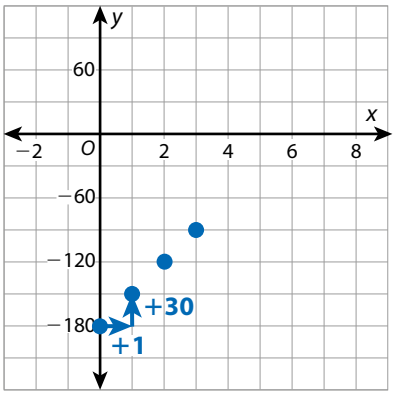
$$-60x + 60x + 2y = -360 + 60x$$

$$2y = -360 + 60x$$

$$\frac{2y}{2} = \frac{-360}{2} + \frac{60x}{2}$$

$$y = -180 + 30x$$

$$y = \mathbf{30}x \mathbf{- 180}$$



Use the **slope** and ***y*-intercept** to plot points.

Solve It

You can find two points to graph the linear equation.

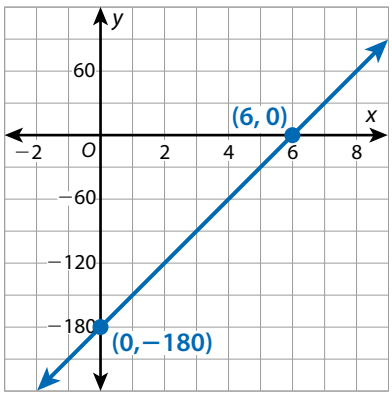
Substitute 0 for each variable.

$$-60\mathbf{x} + 2y = -360 \qquad -60x + 2\mathbf{y} = -360$$

$$-60(\mathbf{0}) + 2y = -360 \qquad -60x + 2(\mathbf{0}) = -360$$

$$2y = -360 \qquad -60x = -360$$

$$y = -180 \qquad x = 6$$



The points $(0, -180)$ and $(6, 0)$ are on the line. Plot these points and draw a line through them.

CONNECT IT

➤ **Use the problem from the previous page to help you understand how to graph a linear equation in any form.**

1. Look at **Model It**. How does writing the equation in slope-intercept form help you graph it?

2. Look at **Solve It**. To find a point on the line, you can substitute *any* value for one variable and solve for the other. Why might you choose substituting 0 for a variable?

3. What part of the graph represents the situation? How does slope-intercept form help you understand the problem better?

4. Describe two ways you can graph a linear equation if it is not given in slope-intercept form.

5. **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to solve the **Try It** problem.

Apply It

Use what you learned to solve these problems.

6 Graph the linear equation $-150x + 3y - 300 = 0$. Show your work.

7 Kiara said the line with equation $28x - \frac{1}{2}y = -20$ has a slope of 28. What mistake did Kiara make?

8 A marine biologist is using an underwater drone to study a delicate coral reef. The linear equation $20y - 30x = -900$ gives the drone's elevation, y, in meters from the surface of the water after x seconds. Graph the equation. What are the slope and y-intercept of the line? What part of the graph represents this situation?

Practice Graphing a Linear Equation Given in Any Form

➤ **Study the Example showing how to graph a linear equation given in any form. Then solve problems 1–4.**

Example

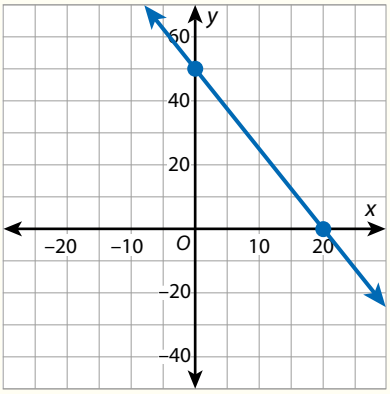
Conan has some money to spend on gas for his car. The linear equation $5x + 2y = 100$ represents y, the amount of money he has left after buying x gallons of gas. Graph the equation. What part of the graph represents this situation?

Find two points on the line by substituting 0 for x and y.

$5(0) + 2y = 100$
$2y = 100$
$y = 50$

$5x + 2(0) = 100$
$5x = 100$
$x = 20$

Plot (0, 50) and (20, 0) and draw a line through them. The situation is represented in Quadrant I of the graph.



1 **a.** Write the equation from the Example in slope-intercept form.

b. What is the slope of the line? What is the y-intercept?

2 Madison is reeling in her kite string at a steady rate. The linear equation $3y - 9x = -81$ can be used to find y, the number of feet of kite string she still needs to reel in after x seconds. Are the points $(0, -27)$ and $(-9, 0)$ on the line? Show your work.

Vocabulary

slope

for any two points on a line, the $\frac{\text{rise}}{\text{run}}$ or $\frac{\text{change in } y}{\text{change in } x}$.

slope-intercept form

a linear equation in the form $y = mx + b$, where m is the slope and b is the y-intercept.

***y*-intercept**

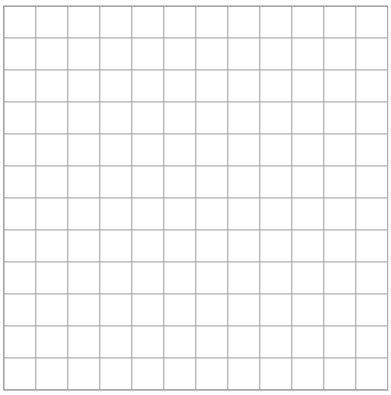
the y-coordinate of the point where a line intersects the y-axis.

SOLUTION _____

3 Bruno is a manager at a factory that makes in-line skates. The equation $200x - y + 500 = 0$ relates y, the number of pairs of skates the factory has in the warehouse and x, the number of hours after Bruno starts his shift.

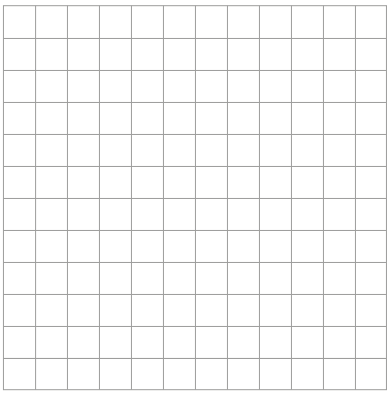
a. Show that the equation is a linear equation by writing it in slope-intercept form. Show your work.

b. Graph the equation. What part of the graph represents this situation? Show your work.



SOLUTION _____

4 Graph the linear equation $16x + 2y = 300$. Show your work.



Refine Deriving and Graphing Linear Equations of the Form $y = mx + b$

➤ **Complete the Example below. Then solve problems 1–8.**

Example

Ichiro lives on an island. He takes a ferry to school. One mile from the dock, the ferry leaves the harbor and travels at a constant speed. A graph relating the ferry's distance from the dock in miles to the time in minutes since it leaves the harbor is a line. The points (3, 2) and (6, 3) are on the line. What is the equation of the line in slope-intercept form? Define your variables.

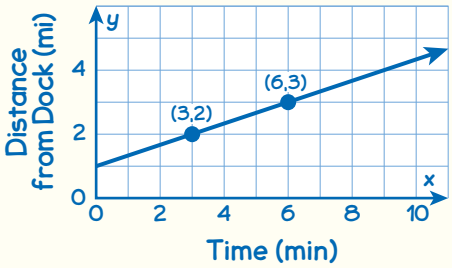
Look at how you could find the equation of the line using the two points and a graph.

The line goes through (0, 1).

y-intercept: 1

$m = \frac{3-2}{6-3} = \frac{1}{3}$

y is the distance the ferry traveled in miles after x minutes.



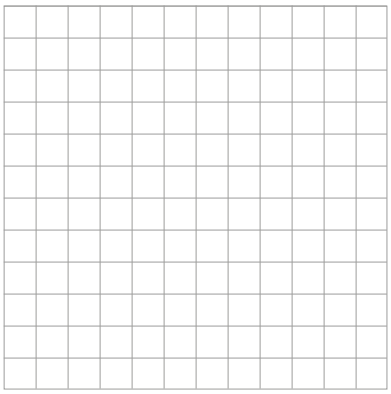
SOLUTION _____

CONSIDER THIS . . .
How can a graph help you find the *y*-intercept?

PAIR/SHARE
How can you check your equation?

Apply It

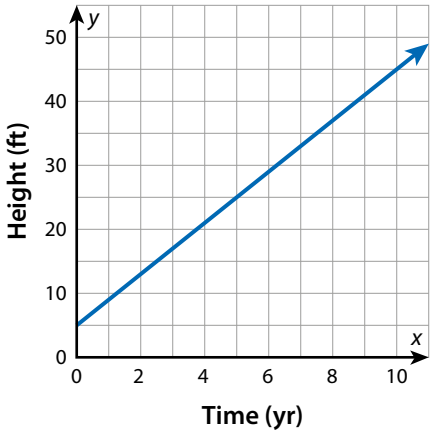
1 Graph the equation $y = \frac{3}{4}x + \frac{1}{2}$. Show your work.



CONSIDER THIS . . .
Understanding what the slope represents could help you set up and label the graph.

PAIR/SHARE
How else could you find points to graph?

2 A botanist is studying the growth of the sequoia tree. He selects one sequoia tree and records its height each year. He makes a graph to show the tree's growth. What is the equation of the line in slope-intercept form? Define your variables.
Show your work.



CONSIDER THIS . . .
How can you use the graph to help you write the equation?

PAIR/SHARE
How would the equation change if the *y*-intercept changed?

SOLUTION

3 A movie club is having a new-member sale, so Mindy signs up. The equation $-0.4x + 0.05y - 1.25 = 0$ relates y, the total cost, and x, the number of months. What is the y-intercept of the line represented by the equation?

A -1.25

B 0.05

C 8

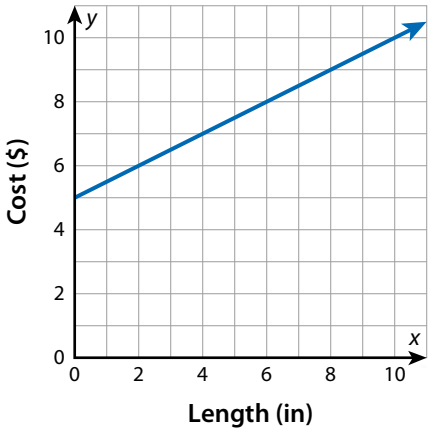
D 25

Greg chose C as the correct answer. How might he have gotten that answer?

CONSIDER THIS . . .
How could rewriting the equation in a different form help you to find the *y*-intercept?

PAIR/SHARE
How else could you find the *y*-intercept?

4 Juanita makes leather lanyards to sell. She charges a base fee and a cost per inch of the finished lanyard. The line shows the cost y for x inches of lanyard. Write an equation for the line in slope-intercept form. Show your work.



SOLUTION

5 Demarco has some money saved, but wants to save more. He decides to save the same amount every month. The linear equation $10y - 200x = 500$ can be used to find y, the amount of money Demarco has saved after x months. Demarco makes a graph of this equation. Tell whether each statement is *True* or *False*.

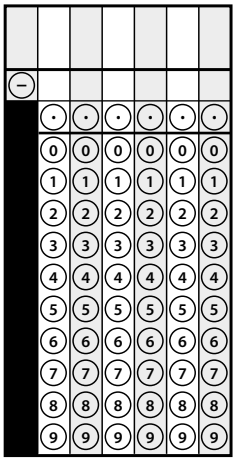
	True	False
a. The slope is 20.	○	○
b. The point (0, 500) is on the line.	○	○
c. The line slants downward from left to right.	○	○
d. The slope is −200.	○	○
e. The y-intercept is 50.	○	○

6 The slope of the line represented by $y = 5x$ is _____.

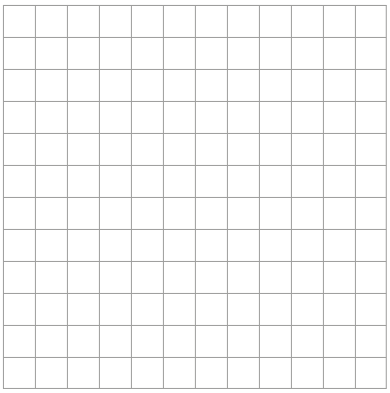
The slope of the line represented by $y = 3$ is _____.

The slope of the line represented by $x = 4$ is _____.

7 What is the y-intercept of a line that passes through the points (2, 7) and (6, 1)?



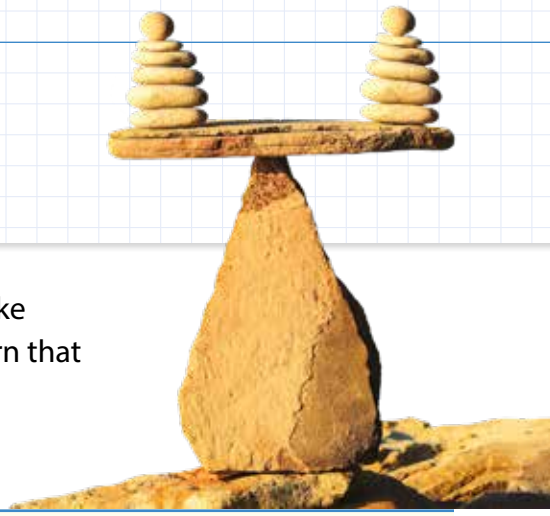
8 **Math Journal** Write a linear equation. Describe two ways you can graph the equation. Then graph the equation.



End of Lesson Checklist

- ☐ **INTERACTIVE GLOSSARY** Find the entry for *slope-intercept form*. Sketch a graph of an equation in slope-intercept form.
- ☐ **SELF CHECK** Go back to the Unit 3 Opener and see what you can check off.

Explore The Number of Solutions to One-Variable Linear Equations



Previously, you learned to use the distributive property and combine like terms to solve one-variable linear equations. In this lesson, you will learn that not all one-variable linear equations have exactly one solution.

➤ **Use what you know to try to solve the problem below.**

Solve the equation.

$4(x + 6) = 2(2x + 12)$

TRY IT

Math Toolkit algebra tiles, grid paper

DISCUSS IT

Ask: How did you decide to solve the equation?

Share: I knew . . . so I . . .

Learning Targets **SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6, SMP 7, SMP 8**

Solve linear equations in one variable.

- Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results.

CONNECT IT

1 **Look Back** What happened when you solved the equation? What happens when you substitute any number for x in the equation?

2 **Look Ahead** You know how to solve equations where you get a statement like $x = 5$ or $t = 17.8$. This means the equation is true for this one value of the variable. The equation has one solution. However, sometimes you solve an equation and get a statement like $32 = 32$ or $0 = 0$. This means the equation is true for any value of the variable. The equation has infinitely many solutions.

a. Solve $5x = 2$. How many solutions does the equation have? Show your work.

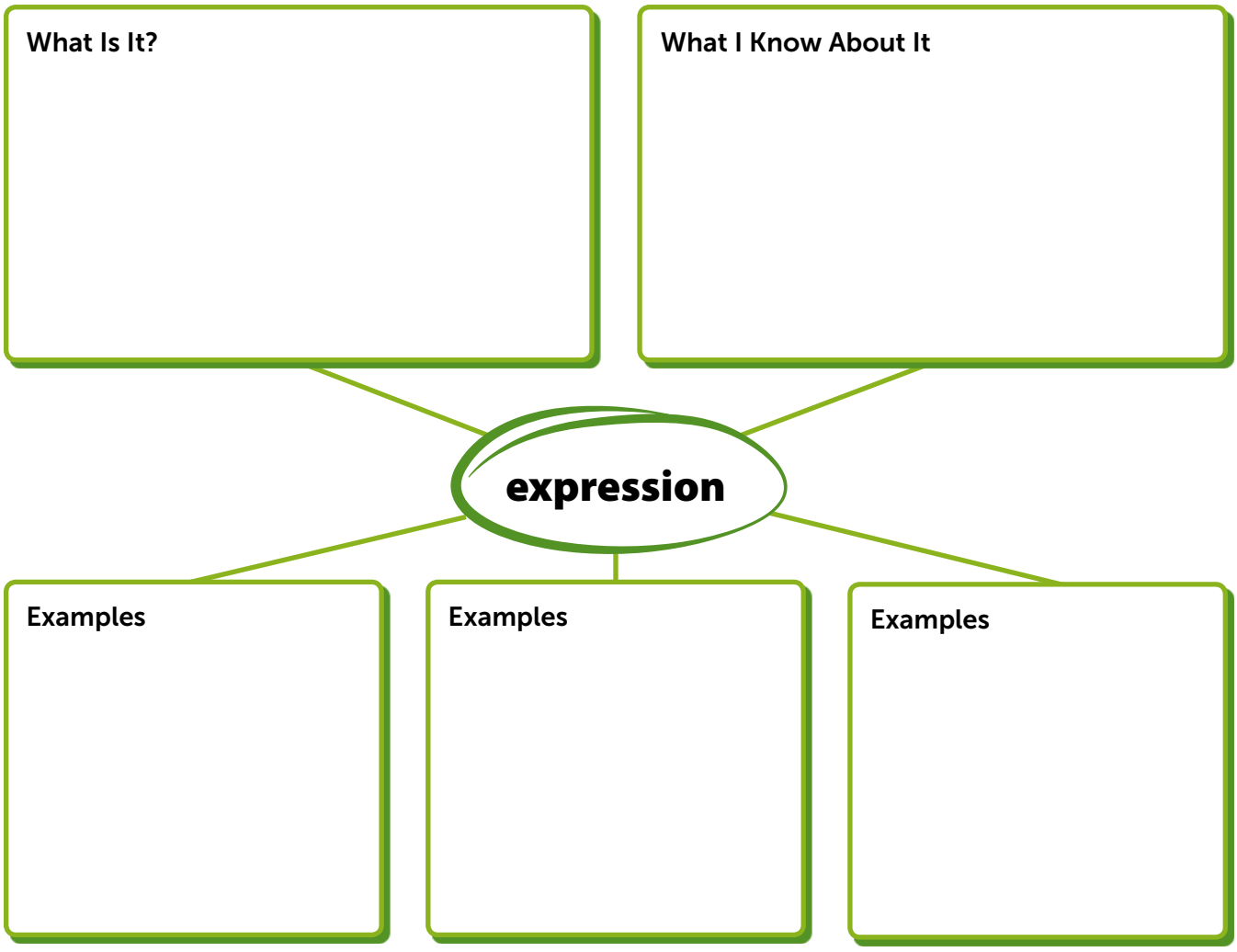
b. Solve $9x - 5 = 9x - 5$. How many solutions does the equation have? Show your work.

3 **Reflect** Look at the equation in problem 2b. How could you know that $9x - 5 = 9x - 5$ has infinitely many solutions without solving the equation?

 Name:

Prepare for Determining the Number of Solutions to an Equation

1 Think about what you know about expressions in mathematical statements.
Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.



2 Which of the following are expressions? Circle your answers.

$4x + 7$ $6b + 1 = 13$

$192 \div 8 = 24$ $y - 17$

3 **a.** Solve the equation $6(x + 2) = 3(2x + 4)$. How many solutions are there? Show your work.

SOLUTION _____

b. Check your answer to problem 3a. Show your work.

Develop Determining the Number of Solutions to One-Variable Equations

➤ **Read and try to solve the problem below.**

A zoologist observes two sloths sitting in a tree at different heights. Both sloths start climbing at the same time. They stop after x minutes and she notes one sloth's height in the tree is $\frac{1}{2}(2x + 4)$ meters and the other's height is $x + 3$ meters. How many values of x make the equation $\frac{1}{2}(2x + 4) = x + 3$ true?

TRY IT

Math Toolkit algebra tiles

DISCUSS IT

Ask: What did you do first to decide how many solutions the equation has?

Share: I started by …

➤ **Explore different ways to determine the number of solutions to a one-variable linear equation.**

A zoologist observes two sloths sitting in a tree at different heights. Both sloths start climbing at the same time. They stop after x minutes and she notes one sloth's height in the tree is $\frac{1}{2}(2x + 4)$ meters and the other's height is $x + 3$ meters. How many values of x make the equation $\frac{1}{2}(2x + 4) = x + 3$ true?

Model It

You can solve the equation by first using the distributive property.

$$\frac{1}{2}(2x + 4) = x + 3$$
$$x + 2 = x + 3$$
$$2 = 3$$

Model It

You can solve the equation by first eliminating the fraction.

$$\frac{1}{2}(2x + 4) = x + 3$$
$$2\left[\frac{1}{2}(2x + 4)\right] = 2(x + 3)$$
$$2x + 4 = 2x + 6$$
$$4 = 6$$

CONNECT IT

Use the problem from the previous page to help you understand how to determine the number of solutions to a one-variable linear equation.

1. The final statements for the **Model Its** are $2 = 3$ and $4 = 6$. Is either a true statement? Is 2, 3, 4, or 6 a solution of the equation? Explain.

2. Does the equation $\frac{1}{2}(2x + 4) = x + 3$ have infinitely many solutions? Does it have exactly one solution? Explain.

3. The statements $2 = 3$ and $4 = 6$ are simplified versions of the original equation. Because they are false statements, the original equation is also a false statement. Why does it make sense to conclude that the equation has no solution? What does this mean in terms of the situation?

4. Look at the equation $x + 2 = x + 3$ in the first **Model It**. How can you tell that this equation has no solution without solving further?

5. **Reflect** Think about all the models and strategies you discussed today. Describe how one of them helped you better understand how to solve the **Try It** problem.

Apply It

Use what you learned to solve these problems.

6 Gabriel solves the equation $6g + 5 = 7g + 5$. He gets $g = 0$. He concludes the equation has no solution. Is Gabriel correct? Explain your reasoning.

7 Which equations have no solution? Select all that apply.

A $x + 5 = x - 5$

B $0.5y = 0$

C $x - 7 = x - 7$

D $9(-1 + x) + 1 = 12x + 1$

E $8 + 4 \cdot f = 4(3 + f)$

8 Erin and Santo are stopped at different points along a bike trail. They happen to start riding again at the same time. After x hours, the distance each is from the start of the trail is shown.

a. Solve the equation $4x + 3.5 = 2(2x + 2)$ for x. Show your work.

SOLUTION _____

b. What does your answer to problem 8a mean in terms of the situation?

Practice Determining the Number of Solutions to One-Variable Equations

➤ **Study the Example showing how to determine the number of solutions to a one-variable equation. Then solve problems 1–6.**

Example

How many solutions does $\frac{1}{3}(6w - 12) = 2w + 2$ have?

You can rewrite the equation until you identify a true statement like $3 = 3$, identify a false statement like $1 = 4$, or solve for w.

$$\frac{1}{3}(6w - 12) = 2w + 2$$
$$2w - 4 = 2w + 2$$
$$-4 = 2$$

$-4 = 2$ is a false statement. No value of w makes the equation true. So the equation has no solution.

1 Could you have stopped solving the equation in the Example sooner, before you reached the false statement $-4 = 2$? Explain.

2 Tell whether each equation has *no solution, one solution,* or *infinitely many solutions*.

a. $1 + 3x = 3x + 1$

b. $4x + 1 = 3x + 2$

c. $5x + 1 = 5x - 2$

d. $-3(x + 1) = -3x + 3$

3 How many solutions does $3(x + 5) - 3 = 2(3x + 1) - 3x$ have? Show your work.

SOLUTION _____

4 Complete the following sentences about one-variable equations.

a. You solve an equation and get $8x + 7 = 8x + 7$. The equation has _____ solution(s).

b. You solve an equation and get $10t - 6 = 10t + 6$. The equation has _____ solution(s).

5 How many solutions does $4x + 5 = 6(x + 3) - 20 - 2x$ have? Show your work.

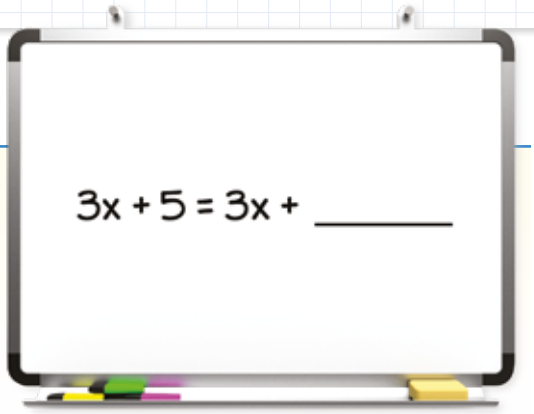
SOLUTION _____

6 Ria solves the equation $5 + 3r = 4 + 4r$ and gets $r = r$. She concludes that the equation has infinitely many solutions. What is the correct solution? What mistake did Ria make?

Develop Writing an Equation with No, One, or Infinitely Many Solutions

➤ **Read and try to solve the problem below.**

Mrs. Quinn writes this problem on the board. What number can you write on the line so the equation has no solution? What number can you write on the line so the equation has infinitely many solutions?



TRY IT

Math Toolkit algebra tiles

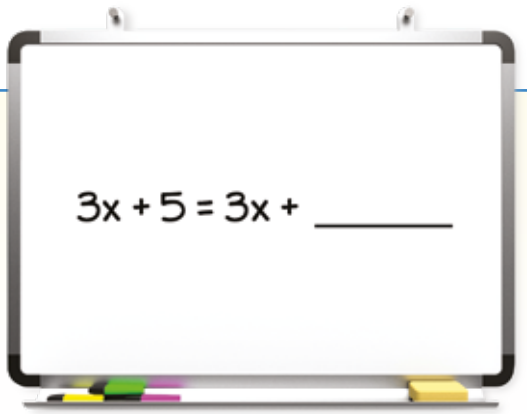
DISCUSS IT

Ask: How did you decide what number to write on the line?

Share: I knew … so I …

➤ **Explore different ways to write one-variable linear equations with no, one, or infinitely many solutions.**

Mrs. Quinn writes this problem on the board. What number can you write on the line so the equation has no solution? What number can you write on the line so the equation has infinitely many solutions?



Model It

You can solve the equation.

$$3x + 5 = 3x + \_\_\_\_\_$$

$$3x - 3x + 5 = 3x - 3x + \_\_\_\_\_$$

$$5 = \_\_\_\_\_$$

Think about what number gives you a false statement.

Think about what number gives you a true statement.

Analyze It

You can analyze the structure of the equation.

$$3x + 5 = 3x + \_\_\_\_\_$$

Compare the **variable terms** on each side of the equation.

Think about how the **constant terms** on each side of the equation should compare for the equation to have no solution.

Think about how the **constant terms** on each side of the equation should compare for the equation to have infinitely many solutions.

CONNECT IT

➤ **Use the problem from the previous page to help you understand how to write one-variable linear equations with different numbers of solutions.**

1 Look at **Analyze It**. What must be true about the constant terms on each side of the equation if the equation has no solution? What must be true about the constant terms on each side of the equation if the equation has infinitely many solutions? How do you know?

2 **a.** Is there more than one number you could write on the line so the equation has no solution? Explain.

b. Is there more than one number you could write on the line so the equation has infinitely many solutions? Explain.

3 What constant term or x-term could you write on the line so the equation has exactly one solution? Is there more than one possibility? How do you know?

4 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to write one-variable linear equations with no solution, one solution, or infinitely many solutions.

Apply It

Use what you learned to solve these problems.

5 Hai's teacher writes the equation $3x - 4 = 2(x + 3) + x$. Hai concludes that the equation has infinitely many solutions. Is Hai correct? Explain.

6 Which numbers could you substitute for c so the equation $4(4x + c) = 2(8x + 1)$ has no solution? Select all that apply.

A 0

B $\frac{1}{4}$

C $\frac{1}{2}$

D 1

E 2

7 Write a constant term or variable term on the line so that each equation has the number of solutions shown.

a. No solution:

$\frac{2}{7}m + 1 = \frac{2}{7}m +$ _____

b. One solution:

$m + 1 = m +$ _____

c. Infinitely many solutions:

$3p + 3 = 3p +$ _____

d. Infinitely many solutions:

$2x + 4 = 2x -$ _____

Practice Writing an Equation with No, One, or Infinitely Many Solutions

➤ **Study the Example showing how to write a one-variable linear equation with no, one, or infinitely many solutions. Then solve problems 1–4.**

Example

Write a constant term or variable term on the line to form an equation that has no solution, one solution, or infinitely many solutions.

$4x + 7 = 4x +$ _____

No solution: The x-terms on both sides of the equation are the same. Write a **constant term** so the constant terms on each side are different.

$4x + 7 = 4x + 8$

One solution: Write an ***x*-term** so the x-terms on each side of the equation will have different coefficients.

$4x + 7 = 4x + 14x$

Infinitely many solutions: **7** results in identical expressions on both sides of the equation.

$4x + 7 = 4x + 7$

1. Look at the Example. Decide whether there is more than one possible answer that will result in no solution, one solution, or infinitely many solutions. Where possible, write a different constant term or variable term.

   a. No solution: $4x + 7 = 4x +$ _____

   b. One solution: $4x + 7 = 4x +$ _____

   c. Infinitely many solutions: $4x + 7 = 4x +$ _____

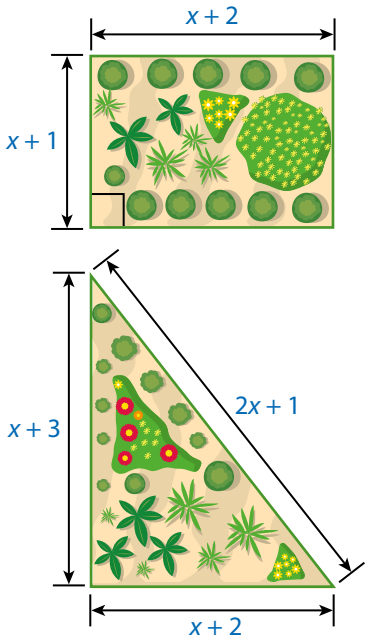
2. Complete the following sentences.

   a. The one-variable linear equation $13x + 6 = 13x +$ _____ has infinitely many solutions.

   b. The one-variable linear equation $x + 6 = x +$ _____ has no solution.

   c. The one-variable linear equation $4x + 5 =$ _____ $+ 10$ has one solution.

3 Two garden beds are shown. The perimeters of the two gardens are equal.



a. Write an equation that sets the perimeters equal. Then solve the equation.

b. The side length of a garden cannot be a negative number or zero. What value(s) of x make the equation you wrote in problem 3a true in the context of this problem?

4 Write an expression on the line to form an equation that has no solution, one solution, or infinitely many solutions.

a. No solution

$2(h + 3) =$ _____

b. One solution

$2h + 5 =$ _____

c. Infinitely many solutions

$2h - 12 =$ _____

Refine Determining the Number of Solutions to One-Variable Equations

➤ **Complete the Example below. Then solve problems 1–9.**

Example

The equation $10x - 12 = 8x - 6$ has one solution. Solve for x. Then change *one term* in the equation so that your new equation has no solution.

Look how you could solve the equation.

$$10x - 12 = 8x - 6$$
$$2x - 12 = -6$$
$$2x = 6$$
$$x = 3$$

The equation will have no solution if you change $8x$ to $10x$ or if you change $10x$ to $8x$.

SOLUTION _____

CONSIDER THIS . . .
What is true about the variable terms on both sides in an equation with no solution?

PAIR/SHARE
How could you change the equation in your answer to get an equation with infinitely many solutions?

Apply It

1 How many solutions does each equation have? Explain how you know.

a. $2x + 6 = 7x + 5$

b. $6v + 8 = 8 + 6v$

c. $10 - e = e - 10$

CONSIDER THIS . . .
You can analyze the structure of an equation to determine how many solutions it has.

PAIR/SHARE
How would your answer to part b change if the equation was $6v + 8 = -8 + 6v$?

2 What constant term or variable term could you write on the line to create an equation with the number of solutions shown? Explain how you know your answer is correct.

$12x - 3 = 12x +$ _____

a. One solution

b. No solution

c. Infinitely many solutions

CONSIDER THIS . . .
What is true about the constant terms on both sides in an equation with no solution?

PAIR/SHARE
Which parts have more than one possible answer?

3 How many solutions does $\frac{2}{3}(3x - 15) = x - 10$ have?

A Infinitely many solutions

B No solution

C One solution

D Two solutions

Mia chose B as the correct answer. How might she have gotten that answer?

CONSIDER THIS . . .
Why might it be helpful to multiply both sides of the equation by 3?

PAIR/SHARE
How could you check that you solved the equation correctly?

4 **a.** What are all the possible values of a and b that make $3x + 6 = ax + b$ have one solution?

b. What are all the possible values of c and d that make $3x + 6 = cx + d$ have infinitely many solutions?

c. What are all the possible values of e and f that make $3x + 6 = ex + f$ have no solution?

5 Which of the following expressions can be set equal to $2.74x - 7.9$ to form an equation that has no solution?

A $2.74x - 7.9$

B $7.9x - 7.9$

C $2.74x + 7.9$

D $7.9x + 2.74$

6 Which of the following statements are true? Select all that apply.

A If you rewrite a one-variable linear equation and see a statement like $4 = 4$ or $4a + 6 = 4a + 6$, then the equation has infinitely many solutions.

B If you rewrite a one-variable linear equation and the variable terms are the same on each side of the equation, then you can solve the equation and find the value of the variable.

C If a one-variable linear equation has one solution, then every value of the variable makes the equation true.

D If both sides of a one-variable linear equation have the same variable term and different constant terms, then the equation has infinitely many solutions.

E If a one-variable linear equation has no solution, then no value of the variable will make the equation true.

7 The cost of p inches of plain ribbon is represented by $6p$. The cost of p inches of striped ribbon is represented by $6p + 9$. Vivian says that $6p = 6p + 9$ for any value of p because the coefficients of p are the same on both sides of the equation. Is Vivian correct? Explain.

8 Write an equation that has the given number of solutions.

a. No solution

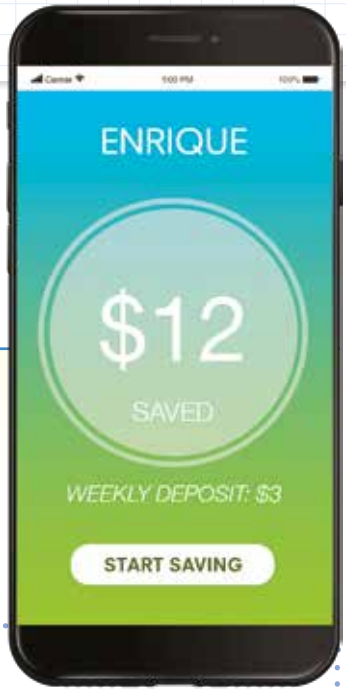
b. Infinitely many solutions

9 **Math Journal** Write a one-variable linear equation that has infinitely many solutions. Then change *one term* in your equation so that it has no solution. How do you know that each of your equations has the correct number of solutions?

End of Lesson Checklist

- ☐ **INTERACTIVE GLOSSARY** Find the entry for *linear equation*. Give 3 examples of linear equations.
- ☐ **SELF CHECK** Go back to the Unit 3 Opener and see what you can check off.

Explore Representing and Solving Problems with Systems of Linear Equations



Previously, you learned how to solve systems of linear equations. In this lesson, you will learn how to solve real-world and mathematical problems involving systems of linear equations.

➤ **Use what you know to try to solve the problem below.**

Jade and Enrique are saving money. Jade has $0 saved. She plans to save $5 each week. Enrique has $12 saved. He plans to save $3 each week. In how many weeks will they have the same amount of money saved? How much will they each have?

TRY IT

Math Toolkit counters, graph paper, straightedges

DISCUSS IT

Ask: How did you use the dollar amounts given in the problem?

Share: I used the amounts saved each week when I . . .

Learning Targets **SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6**

Analyze and solve pairs of simultaneous linear equations.

- Solve real-world and mathematical problems leading to two linear equations in two variables.

CONNECT IT

1 **Look Back** In how many weeks will Jade and Enrique have the same amount of money saved? How much will they each have? How did you find your answer?

2 **Look Ahead** You can use a different variable for each quantity when a problem has two unknown quantities. You can write a system of equations to solve for both variables.

a. What two quantities were you were asked to find in the **Try It** problem?

b. Explain why you cannot find both values by writing and solving a one-variable equation.

c. Write an expression for the number of dollars that Jade will save in x weeks.

d. Write an expression for the number of dollars Enrique will have in x weeks.

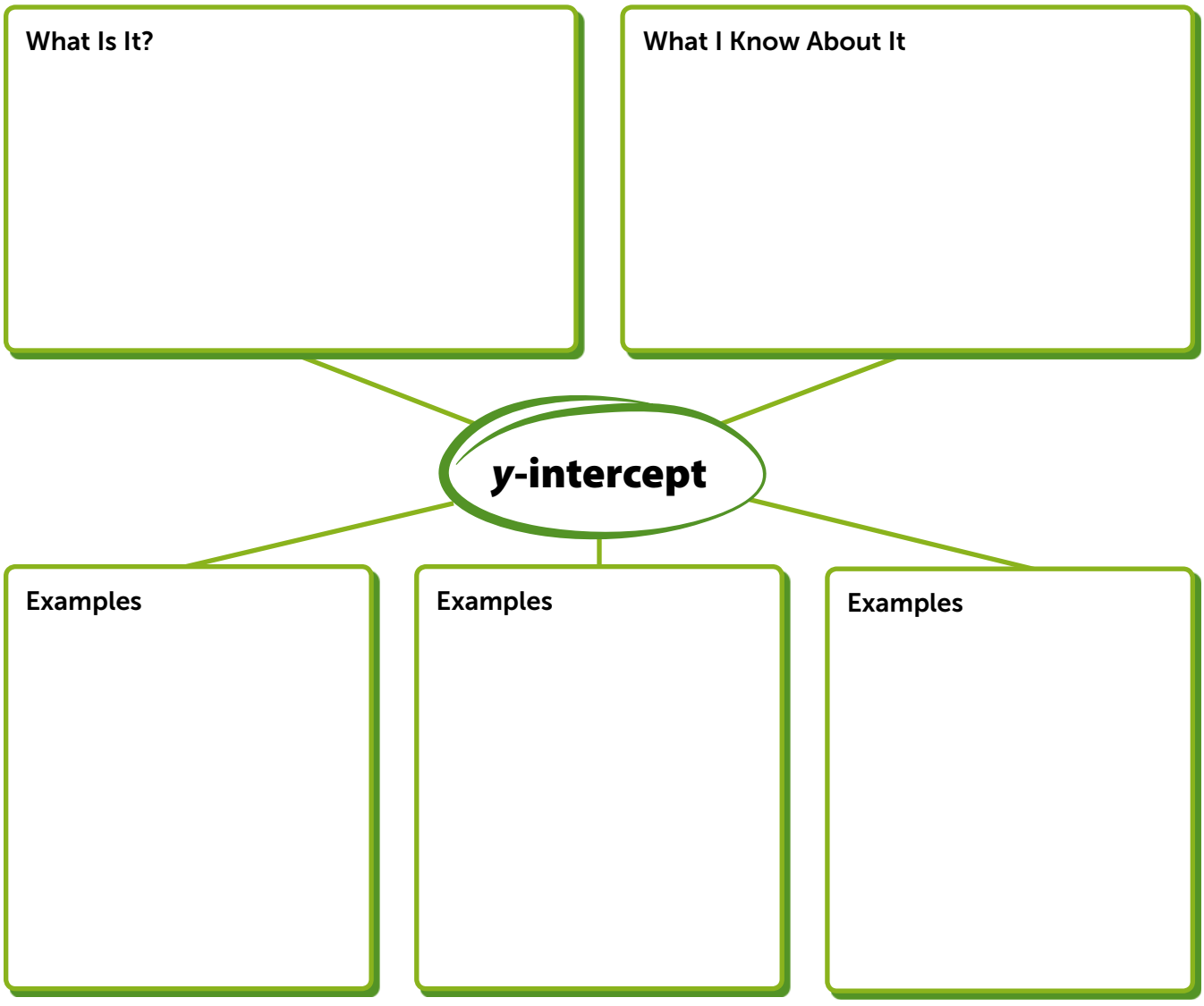
e. Use the expressions you wrote in problems 2c and 2d to write two equations for y, the number of dollars saved after x weeks. Write one equation for each person.

3 **Reflect** How would you use the equations you wrote in problem 2e to find the answer to the **Try It**? What values would you get for x and y?

 Name:

Prepare for Representing and Solving Problems with Systems of Linear Equations

1 Think about what you know about graphing lines. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.



2 What is the y-intercept of the graph of the equation $6x + 3y = -18$?

3 Adrian and Cyrus volunteer for a community service organization the number of hours shown. Cyrus has already volunteered 8 hours when Adrian begins to volunteer.

a. After how many weeks will they both have volunteered the same number of hours? How many hours will each of them have volunteered at that time? Show your work.

SOLUTION

b. Check your answer to problem 3a. Show your work.

Develop Solving Real-World Problems with Systems of Linear Equations

➤ **Read and try to solve the problem below.**

The Drama Club holds a cast party at a local café. All 12 of the café's tables are used to full capacity. Small tables seat 2 people and large tables seat 4 people. How many tables of each size are there?

TRY IT

Math Toolkit counters, graph paper, straightedges

DISCUSS IT

Ask: How did you represent the number of tables and the number of people?

Share: I modeled the situation by . . .

➤ **Explore different ways to solve a real-world problem with two unknowns.**

The Drama Club holds a cast party at a local café. All 12 of the café's tables are used to full capacity. Small tables seat 2 people and large tables seat 4 people. How many tables of each size are there?

Model It

You can use a table.

Let s be the number of small tables and ℓ be the number of large tables.

List possible combinations of each size that give you a total of 12 tables.

s	ℓ	$2s + 4\ell$
12	0	24
11	1	26
10	2	
9	3	
8	4	
7	5	
6	6	

Model It

You can write a system of equations.

Let s be the number of small tables and ℓ be the number of large tables.

$s + \ell = 12$

$2s + 4\ell = 32$

CONNECT IT

➤ **Use the problem from the previous page to help you understand how to solve problems with two unknowns.**

1 **a.** Look at the first **Model It**. What does the expression $2s + 4\ell$ represent?

b. Complete the table. What combination of tables will seat 32 people? How do you know?

2 **a.** Look at the second **Model It**. What does each equation in the system represent?

b. Solve the system. Do you get the same answer as you did in problem 1b?

3 Look at this problem: A banquet hall has seating for 200 people. Some tables seat 6 people and some tables seat 10 people. There are 26 tables in all. How many tables are there of each size?

a. Write a system of equations to represent the problem.

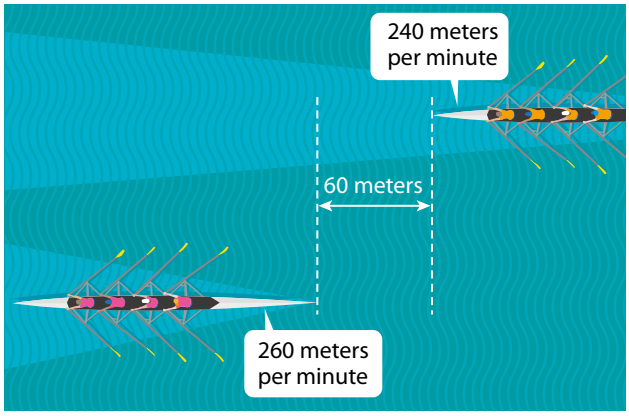
b. Why might someone choose to use a system of equations to solve this problem instead of making a table?

4 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to solve the **Try It** problem.

Apply It

Use what you learned to solve these problems.

5 Crew teams are racing in a regatta. Every 15 seconds a new crew starts the race. Today, the first crew rows at a speed of 240 meters per minute. They are 60 m ahead when the next crew starts, rowing 260 m per minute. Let x be the number of minutes after the second crew starts and y be the distance rowed. Write a system of equations that can be solved to find out when the two crews are the same distance from the start.



6 Lian buys 10 packs of batteries. C batteries are sold in packs of 6. AAA batteries are sold in packs of 8. Lian buys 72 batteries in all. Let x be the number of packs of C batteries. Let y be the number of packs of AAA batteries. Write and solve a system of equations to find how many packs of each type of battery Lian buys. Show your work.

SOLUTION _____

7 You have $3.10 in dimes and quarters. You have 3 more dimes than quarters. Write an equation that relates the number of coins and an equation for the value of the coins. How many of each kind of coin do you have? Show your work.

SOLUTION _____

Practice Solving Real-World Problems with Systems of Linear Equations

➤ **Study the Example showing how to use systems of equations to solve real-world problems. Then solve problems 1–4.**

Example

Sophia babysits for $15 per hour. She mows lawns for $12 per hour. This weekend, Sophia babysits 4 more hours than she mows lawns. She earns a total of $195. Write a system of equations that can be used to find how many hours she worked at each job.

Let b be hours babysitting. Let m be hours mowing.

$b = m + 4$ ← hours worked

$15b + 12m = 195$ ← total money earned

1 **a.** What do the expressions $15b$ and $12m$ represent in the Example?

b. Solve the problem in the Example. Show your work.

SOLUTION _____

2 You have 15 nickels and dimes. The coins are worth $1.20. How many of each coin do you have? Show your work.

SOLUTION _____

3 Mr. Lincoln buys juice and water for the school picnic. A pack of 8 juice boxes costs \$5. A pack of 6 water bottles costs \$3. Mr. Lincoln spends \$95 for 170 juice boxes and bottles of water.

a. Choose variables for the two unknown quantities in the problem and tell what each variable represents.

b. Use the variables you chose in problem 3a to write an equation for the amount of money Mr. Lincoln spends.

c. Use the variables you chose in problem 3a to write an equation for the number of drinks Mr. Lincoln buys.

d. Solve the system of equations. How many packs of juice boxes and how many packs of water does Mr. Lincoln buy? Show your work.

SOLUTION

4 A taxicab fare starts with a base charge. Then an additional amount is added for each mile. The system of equations shows the fares for two different cab companies.

Cab company A: $y = 3 + 2.25x$

Cab company B: $y = 2 + 3.50x$

a. What do x and y represent in each equation?

b. Solve the system to find x and y. What does the solution tell you about the two cab companies?

Develop Solving Mathematical Problems Involving Systems of Linear Equations

➤ **Read and try to solve the problem below.**

Lines *a* and *b* are a graph of a system of equations. Line *a* passes through the points (0, 4) and (8, 6). Line *b* passes through the points (0, −2) and (8, 1). Do the lines intersect?

TRY IT

Math Toolkit graph paper, straightedges

DISCUSS IT

Ask: How did you use the points given in the problem?

Share: I began solving the problem by . . .

➤ **Explore different ways to solve mathematical problems involving systems of equations.**

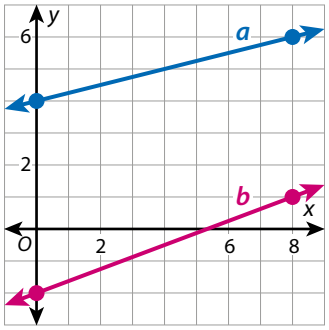
Lines *a* and *b* are the graph of a system of equations. Line *a* passes through the points (0, 4) and (8, 6). Line *b* passes through the points (0, −2) and (8, 1). Do the lines intersect?

Picture It

You can use the points to graph the lines and see if they intersect.

Plot the points **(0, 4)** and **(8, 6)** to graph **line *a***.

Plot the points **(0, −2)** and **(8, 1)** to graph **line *b***.



Model It

You can use the points to find and compare the slopes of the lines.

slope of **line *a***: $\frac{6-4}{8-0} = \frac{2}{8} = \frac{1}{4}$

slope of **line *b***: $\frac{1-(-2)}{8-0} = \frac{3}{8}$

CONNECT IT

Use the problem from the previous page to help you understand how to solve mathematical problems involving systems of equations.

1. Look at the graph in **Picture It**. How far apart are the lines at $x = 0$? At $x = 8$? How does this help you determine whether the lines intersect?

2. Look at **Model It**. How can the slopes of the lines help you determine whether the lines intersect?

3. **a.** Write the system of equations represented by lines a and b. At what point do the lines intersect?

   b. Was it necessary to solve a system of equations to determine whether the lines intersect? Was it necessary to solve a system of equations to answer problem 3a? Explain.

4. Suppose line c passes through the points (20, 8) and (24, 9). Explain why knowing the slope of line c is not enough information to conclude that lines a and c intersect.

5. **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to solve the **Try It** problem.

Apply It

Use what you learned to solve these problems.

6 Three times the sum of two numbers is 15. One of the numbers is 9 more than one-third of the other number.

a. How can you use a system of equations to find the two numbers?

b. What are the two numbers? Show your work.

SOLUTION

7 In the system of equations below, c and d are constants. In the coordinate plane, the graphs of the equations intersect at point P.

$y = -2x + c$

$y = 5x + d$

The x-coordinate of point P is 1. Which of the following statements is true? Select all that apply.

A $c < d$

B $d < 0$

C $c > d$

D $c - d = 7$

E $c > 0$

F $c + d = 7$

8 The solution of a system of equations is $(-4, -6)$. The graph of one of the equations is a vertical line. The graph of the other equation passes through the origin. What are the equations of the lines?

Practice Solving Mathematical Problems Involving Systems of Linear Equations

➤ **Study the Example showing how to solve a mathematical problem involving systems of linear equations. Then solve problems 1–6.**

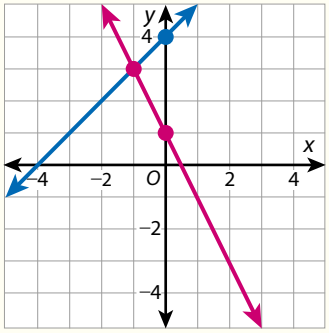
Example

A line with slope −2 and a line with slope 1 intersect at the point (−1, 3). Graph the system. What are the equations of the lines?

Plot the point (−1, 3). Use the slopes given to plot another point for each line.

The line with slope −2 crosses the *y*-axis at $y = 1$. The equation of the line is $y = -2x + 1$.

The line with slope 1 crosses the *y*-axis at $y = 4$. The equation of the line is $y = x + 4$.

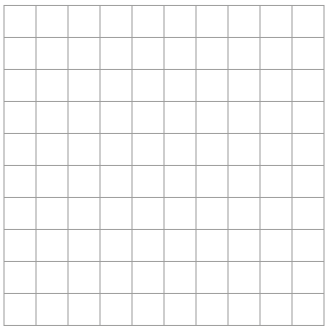


1 Two lines intersect at the point (2, −5). The lines cross the *y*-axis at (0, 1) and (0, −6).

a. Graph the system.

b. What are the equations of the lines?

c. Check that (2, −5) is the solution of the system of equations you wrote in problem 2b.



2 The sum of two numbers is 147. The difference of the two numbers is 25. What are the two numbers? Show your work.

SOLUTION _____

Vocabulary

system of linear equations

a group of related linear equations in which a solution makes all the equations true at the same time.

3 One number is 3 less than 4 times a second number. The difference of the first number and twice the second number is 7. What are the two numbers? Show your work.

SOLUTION

4 Line a passes through the points $(-3, -2)$ and $(0, 4)$. Line b passes through the points $(-2, -3)$ and $(0, 1)$. Tell whether each statement is *True* or *False*.

	True	False
a. Lines a and b intersect.	○	○
b. Lines a and b have different slopes.	○	○
c. Lines a and b have different y-intercepts.	○	○
d. Lines a and b are parallel.	○	○

5 In the system of equations shown, j and k are constants. The graphs of the equations intersect at point P.

$y = 8x + j$

$y = -12x + k$

The x-coordinate of point P is 2. Which of the following expressions are equal to the y-coordinate of point P?

A $-24 + k$ **B** $4 + j$ **C** $k - 40$

D $40 - j$ **E** $-6 + k$ **F** $16 + j$

6 Look at the equations in this system. Where do the lines intersect? Explain how you can tell without graphing or solving the system.

$y = 7x + 4$

$y = -5x + 4$

Refine Representing and Solving Problems with Systems of Linear Equations

➤ **Complete the Example below. Then solve problems 1–9.**

Example

In the system of equations, j and k are constants. The solution of the system is (3, 1). What are the values of j and k?

$jx - ky = 14$

$kx + jy = 8$

Look at how you could use the solution of the system to find j and k.

$j(3) - k(1) = 14 \rightarrow 3j - k = 14 \rightarrow 9j - 3k = 42$

$k(3) + j(1) = 8 \rightarrow 3k + j = 8 \rightarrow j + 3k = 8$

$10j = 50$

$j = 5$

$3(5) - k = 14 \rightarrow k = 1$

SOLUTION _____

CONSIDER THIS . . .
Substitute the x- and y-values of the solution into both equations.

PAIR/SHARE
How can you check your answer?

Apply It

1 The drama club sells tickets to their spring play. They sell 180 tickets for a total of $2,248. Adult tickets cost $14 each. Student tickets cost $10 each. How many adult tickets and how many student tickets do they sell? Show your work.

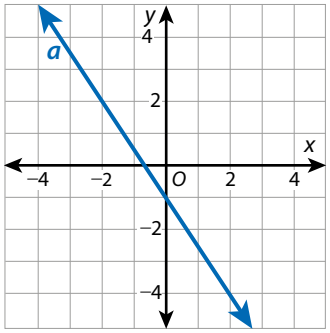
SOLUTION _____

CONSIDER THIS . . .
What will your variables represent?

PAIR/SHARE
Suppose the drama club sells 180 tickets for $2,192. How would the problem change?

2 Line *a* is shown. Graph line *b* in the same coordinate plane to make the following statements true.

- The solution of the system of equations is $(-2, 2)$.
- The *y*-intercept of line *b* is positive.
- The slope of line *b* is greater than 0 and less than 1.



CONSIDER THIS . . .
How can you use the *y*-intercept and the point $(-2, 2)$ to graph line *b*?

PAIR/SHARE
What *y*-intercepts are possible for line *b* to have?

3 Which system of equations can be used to solve the following problem? Reth and Allen both save money. Reth starts with $10. He then saves $7 each week. Allen starts with $16. He then saves $5 each week. After how many weeks will Reth and Allen have the same amount saved?

CONSIDER THIS . . .
What does each rate of change represent in this situation?

A $y = 5x + 10$

$y = 7x + 16$

B $y = 10x + 16$

$y = 7x + 5$

C $y = 7x + 10$

$y = 5x + 16$

D $y = 10x + 7$

$y = 16x + 5$

Elisa chose C as the correct answer. How might she have gotten that answer?

PAIR/SHARE
How many weeks does it take for Reth and Allen to have the same amount saved?

4 Evelyn knits hats and scarves for charity. She records the time it takes and the amount of yarn needed to make one of each item. Last winter Evelyn knitted for 180 hours. She used 2,520 yards of yarn. How many hats and scarves did Evelyn knit?

a. Choose variables for the two unknown quantities in the problem and tell what each variable represents.

b. Write a system of two equations to represent the situation.

c. How many hats and scarves did Evelyn knit? Show your work.

SOLUTION _____

5 Lines a and b form a system with no solution. The points $(-3, 2)$ and $(5, -4)$ lie on line a. Which two points could lie on line b?

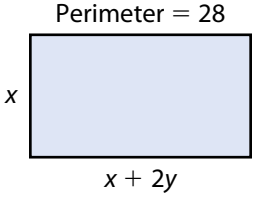
A $(2, 1)$ and $(6, 4)$

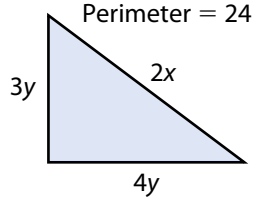
B $(1, -1)$ and $(9, -7)$

C $(-6, 4)$ and $(-2, 1)$

D $(3, 1)$ and $(5, -4)$

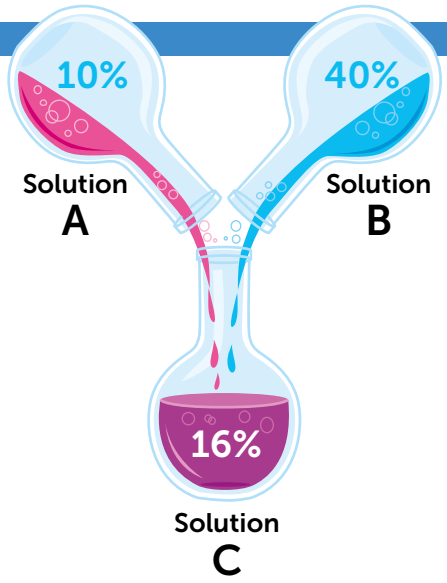
6 What are the values of x and y in the figures shown? Show your work.





SOLUTION _____

7 Uma is mixing solutions in chemistry class. Solution A is 10% acid and Solution B is 40% acid. She uses both to make 10 liters of a mixture, Solution C, that is 16% acid. Explain what x and y represent in the system of equations that models this situation.



$x + y = 10$

$0.10x + 0.40y = 0.16(10)$

8 Arturo walks from school to the city library. He walks 4 miles per hour. When Arturo is 0.2 mile from school, Carson leaves school. Carson jogs 6 miles per hour. The system of equations can be used to find when Carson catches up with Arturo.

Arturo: $y = 4x + 0.2$

Carson: $y = 6x$

a. What do x and y represent?

b. How long will it take Carson to catch up with Arturo?

9 **Math Journal** Cameron buys 4 notebooks and 2 packages of pens for $16. Olivia buys 5 notebooks and 1 package of pens for $14.75. Write and solve a system of equations to find the price of each notebook and the price of each package of pens. Tell what each variable represents and what each equation represents.

End of Lesson Checklist

- ☐ **INTERACTIVE GLOSSARY** Find the entry for *parallel lines*. Write a system of equations that represents a pair of parallel lines.
- ☐ **SELF CHECK** Go back to the Unit 3 Opener and see what you can check off.