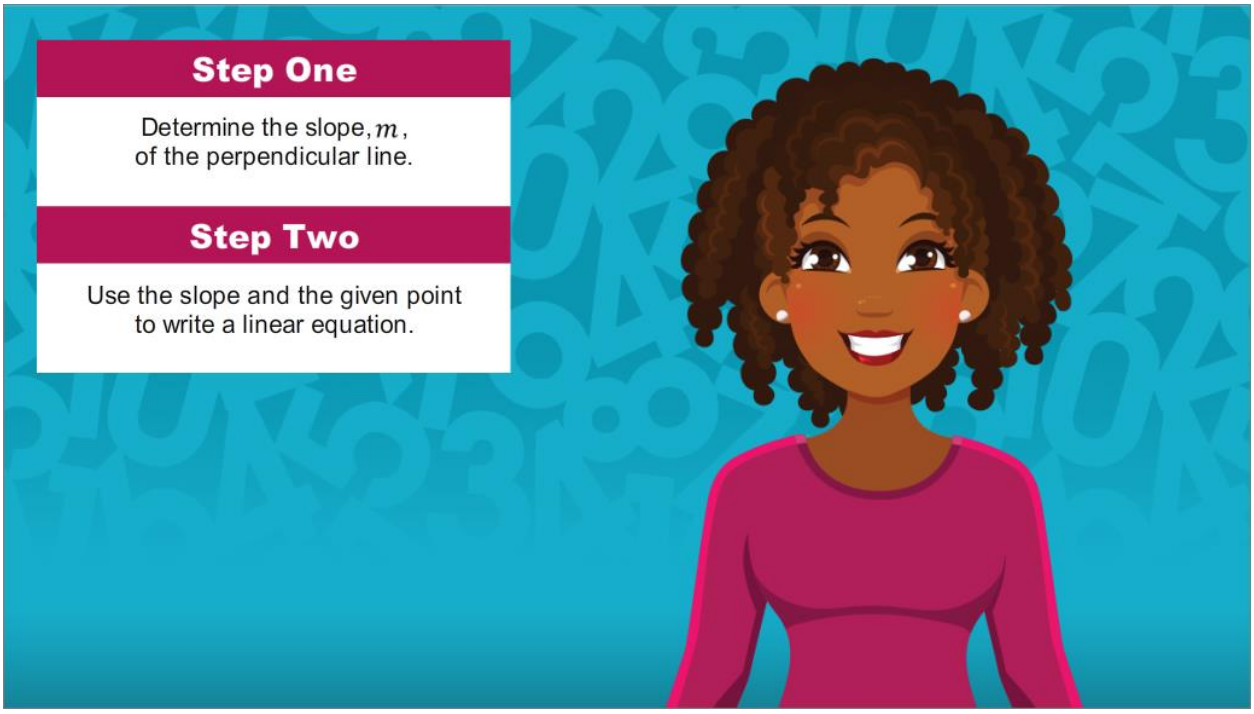
Module 9: Writing Linear Equations
Topic 3 Content: Writing the Equation of a Line Perpendicular to a Given Line

Introduction

Hi there! I'm so glad you could join me for this lesson in Algebra I. In this lesson, you will learn how to write the equation of a line that is perpendicular to a given line and passes through a given point.

Module 9: Writing Linear Equations
Topic 3 Content: Writing the Equation of a Line Perpendicular to a Given Line

Anticipatory Set



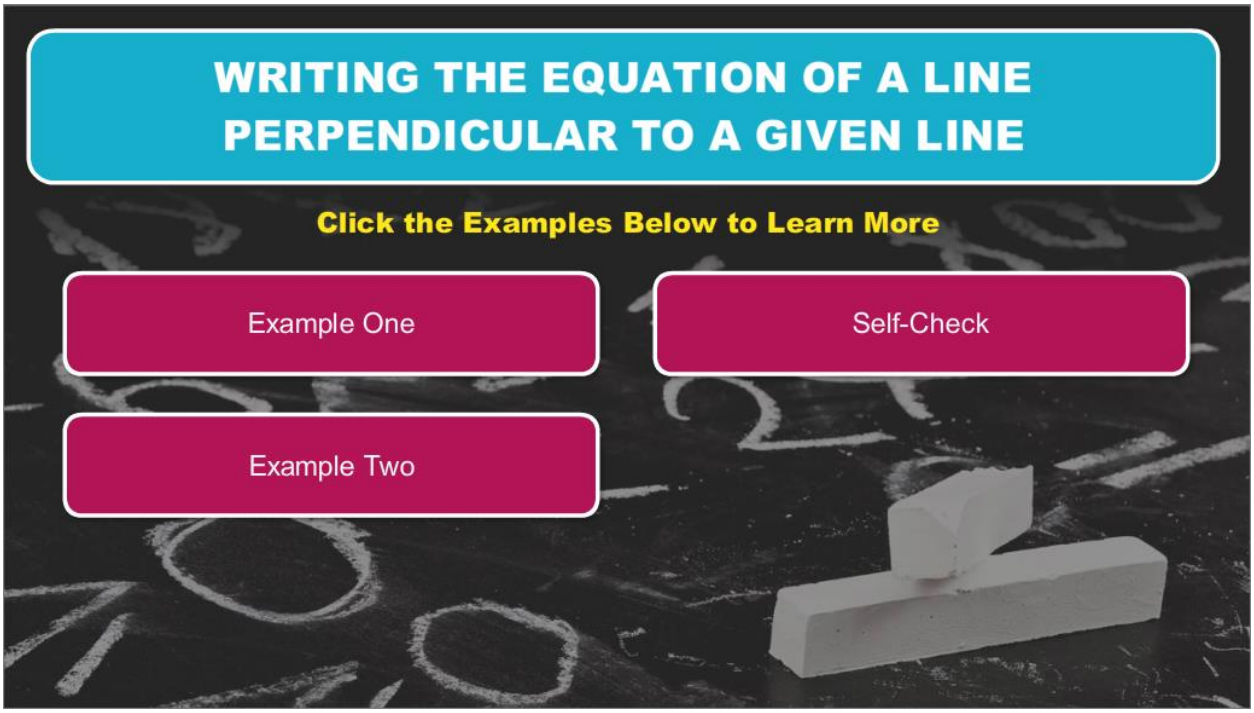
Use the following steps to guide you in the process of writing the equation of a line that is perpendicular to a given line and passes through a given point.

Step 1: Determine the slope, m, of the perpendicular line.

Step 2: Use the slope and the given point to write a linear equation.

Keep these steps in mind as you work through the following examples.

Writing the Equation of a Line Perpendicular to a Given Line



Click the examples below to learn more.

- Example One
- Example Two
- Self-Check

Module 9: Writing Linear Equations
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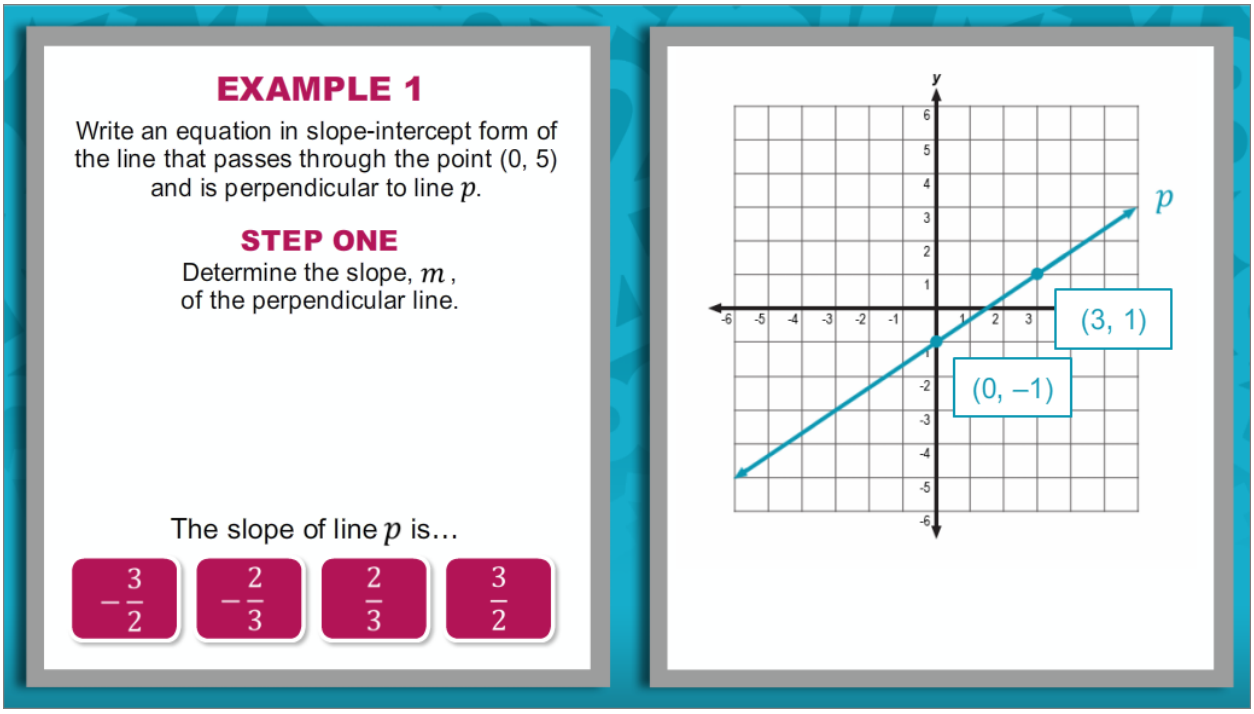
Example 1



Write an equation in slope-intercept form of the line that passes through the point $(0, 5)$ and is perpendicular to line p.

Step 1: Determine the slope, m, of the perpendicular line.

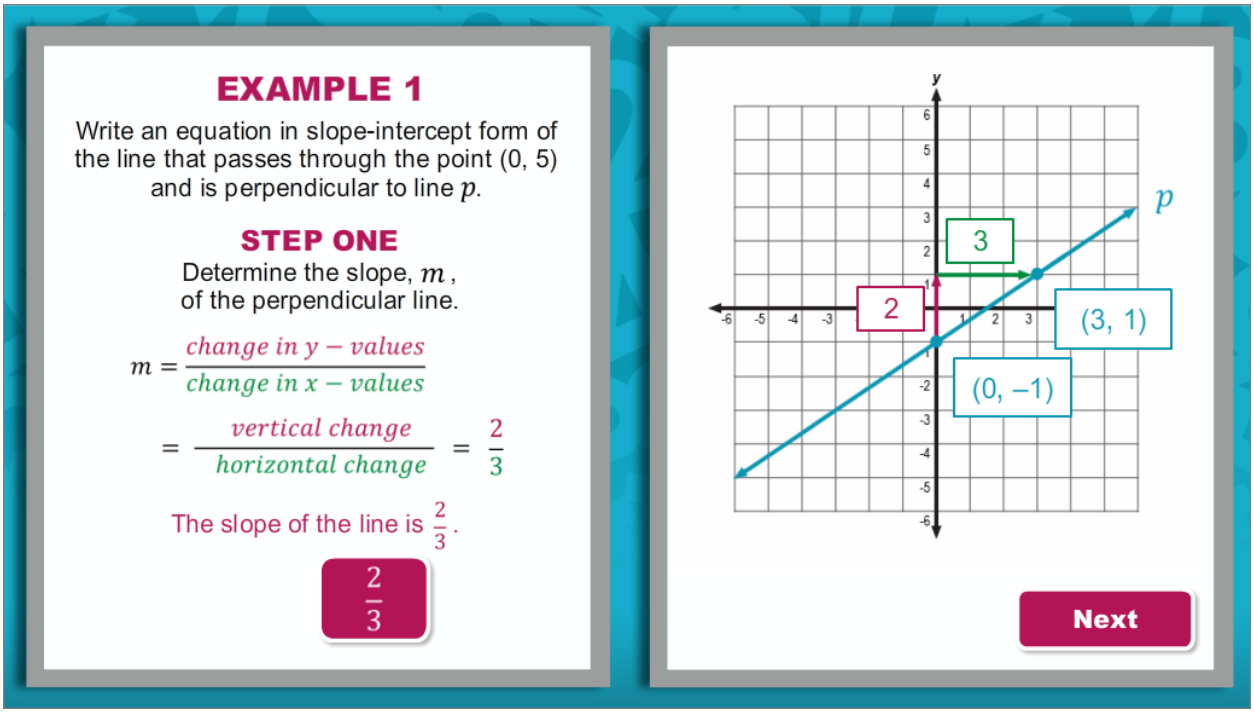
Recall that perpendicular lines have opposite reciprocal slopes. You must find the slope of line p in order to determine the slope of the line perpendicular to line p.

Begin by locating two points on line p with integral coordinates. You can choose the points $(0, -1)$ and $(3, 1)$.

The slope of line p is …

A) $-\frac{3}{2}$
B) $-\frac{2}{3}$
C) $\frac{2}{3}$
D) $\frac{3}{2}$

Example 1 (continued)



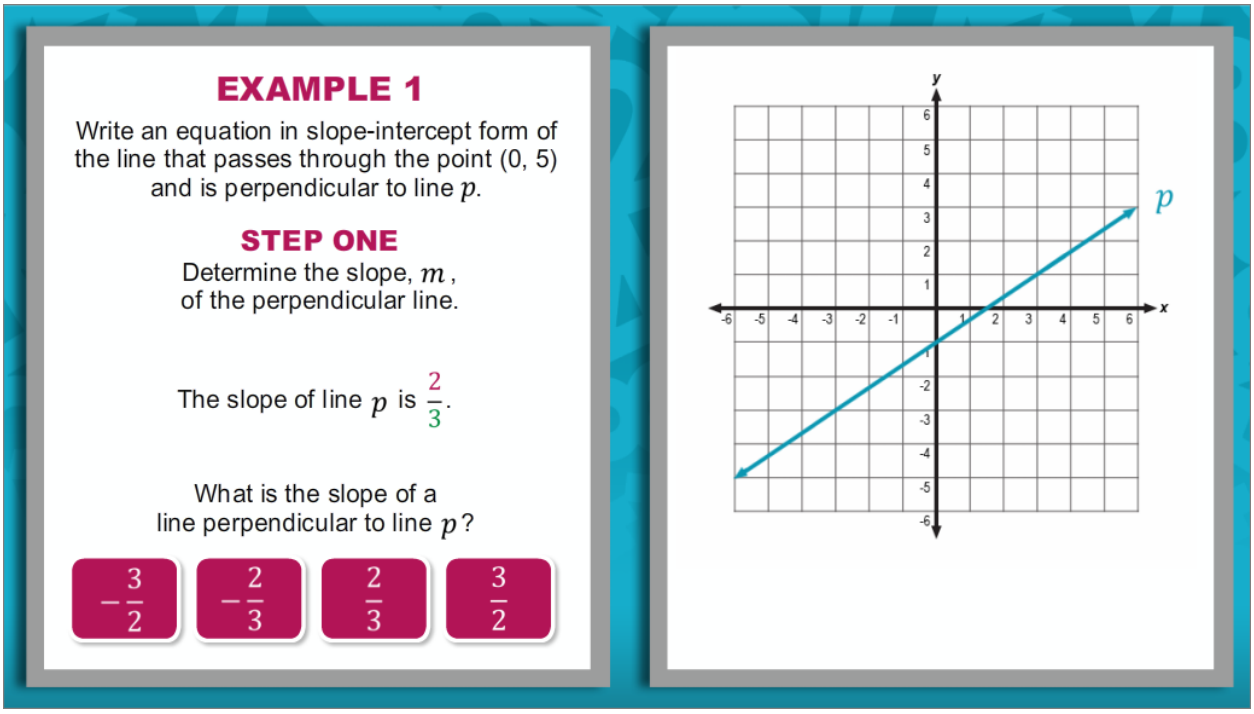
Write an equation in slope-intercept form of the line that passes through the point $(0, 5)$ and is perpendicular to line p.

Step 1: Determine the slope, m, of the perpendicular line.

$$m = \frac{change\ in\ y - values}{change\ in\ x - values} = \frac{vertical\ change}{horizontal\ change} = \frac{2}{3}$$

The slope of the line is $\frac{2}{3}$.

Example 1 (continued)



Write an equation in slope-intercept form of the line that passes through the point $(0, 5)$ and is perpendicular to line p.

Step 1: Determine the slope, m, of the perpendicular line.

Now that you know the slope of line p is $\frac{2}{3}$, you can find the slope of a line perpendicular to line p.

Recall that perpendicular lines have opposite reciprocal slopes.

What is the slope of a line perpendicular to line p?

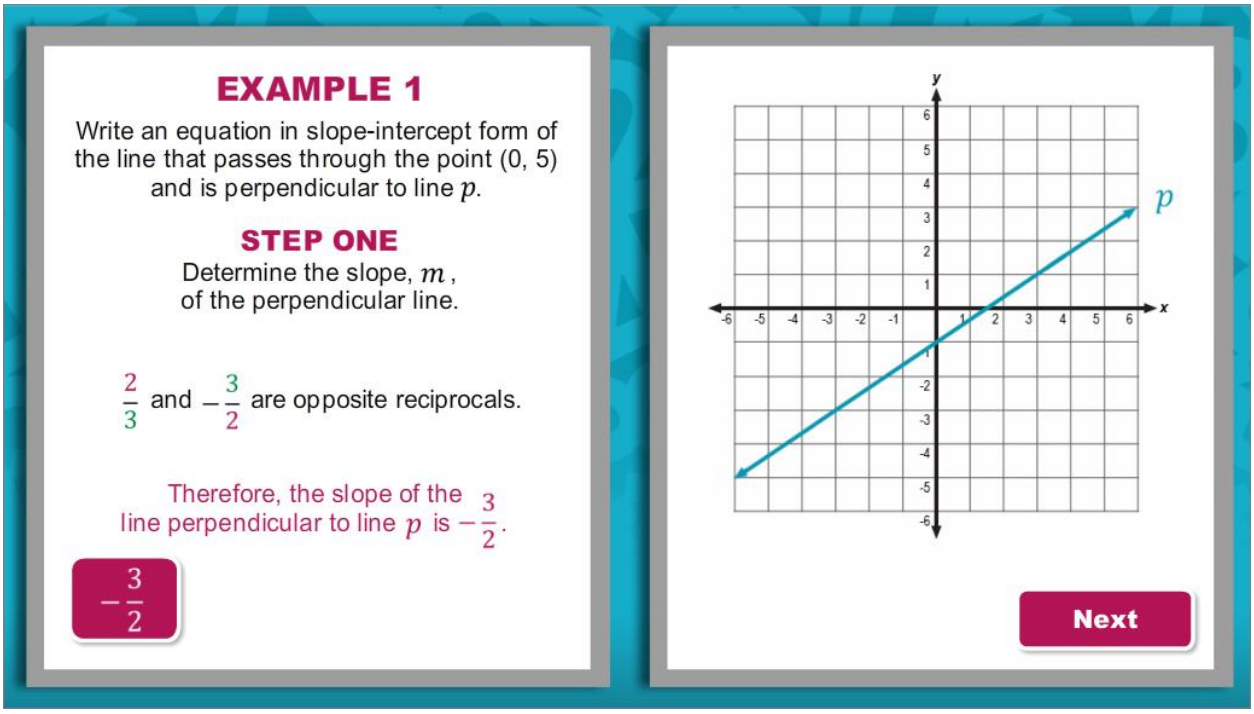
A) $-\frac{3}{2}$

B) $-\frac{2}{3}$

C) $\frac{2}{3}$

D) $\frac{3}{2}$

Example 1 (continued)



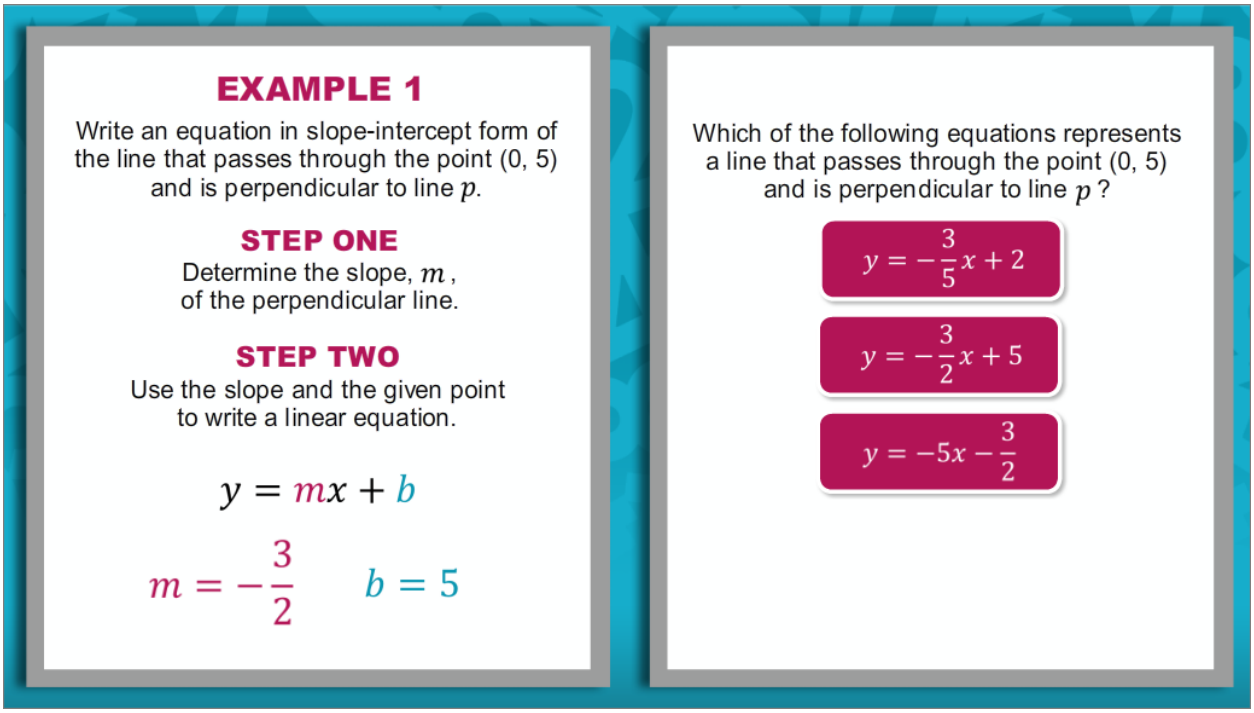
Write an equation in slope-intercept form of the line that passes through the point $(0, 5)$ and is perpendicular to line p.

Step 1: Determine the slope, m, of the perpendicular line.

$\frac{2}{3}$ and $-\frac{3}{2}$ are opposite reciprocals.

Therefore, the slope of a line perpendicular to line p is $-\frac{3}{2}$.

Example 1 (continued)



Write an equation in slope-intercept form of the line that passes through the point $(0, 5)$ and is perpendicular to line p.

Step 2: Use the slope and the given point to write a linear equation.

$$y = mx + b$$
$$m = -\frac{3}{2} \qquad b = 5$$

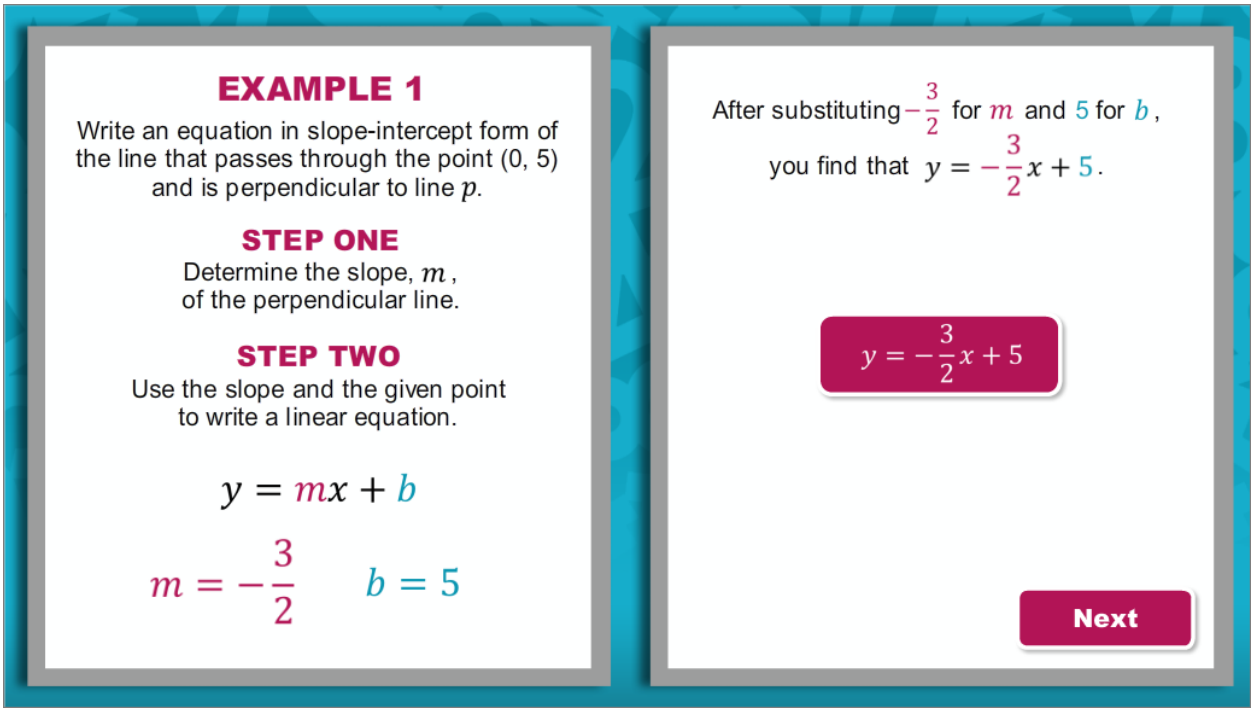
In this example, you are asked to write an equation in the form $y = mx + b$. Now that Step 1 is complete, you know that the slope, m, is $-\frac{3}{2}$.

The given point $(0, 5)$ is the y-intercept of the perpendicular line. So you can conclude that $b = 5$. You have enough information to write the equation of the perpendicular line.

Which of the following equations represents the line that passes through $(0, 5)$ and is perpendicular to line p?

A) $y = -\frac{3}{5}x + 2$
B) $y = -\frac{3}{2}x + 5$
C) $y = 5x - \frac{3}{2}$

Example 1 (continued)



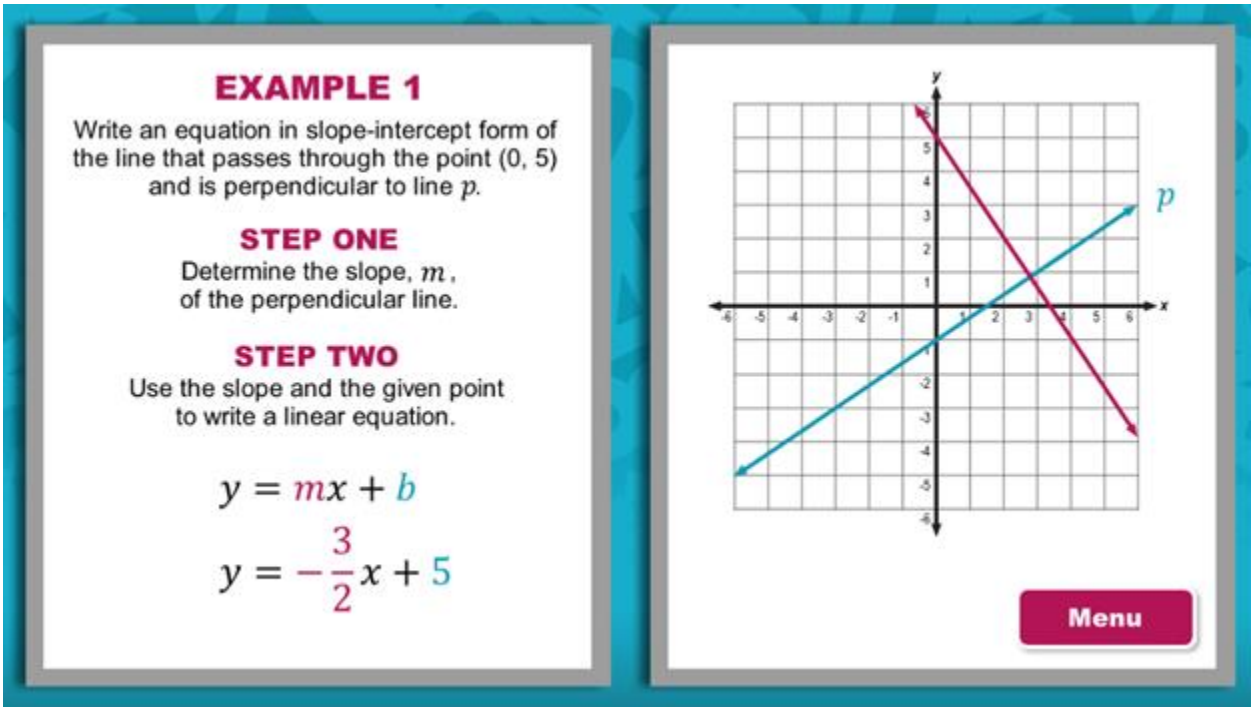
Write an equation in slope-intercept form of the line that passes through the point $(0, 5)$ and is perpendicular to line p.

Step 2: Use the slope and the given point to write a linear equation.

$$y = mx + b$$
$$m = -\frac{3}{2} \qquad b = 5$$

After substituting $-\frac{3}{2}$ for m and 5 for b, you find that $y = -\frac{3}{2}x + 5$.

Example 1 (continued)



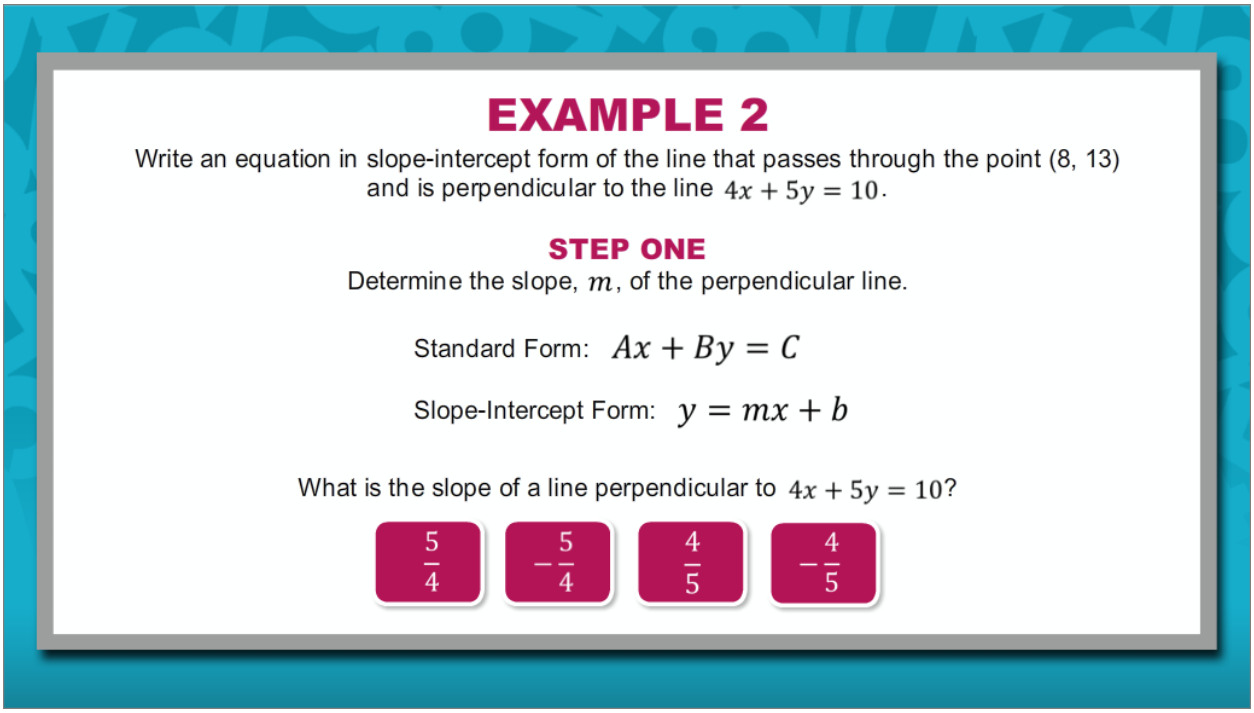
Write an equation in slope-intercept form of the line that passes through the point $(0, 5)$ and is perpendicular to line p.

Step 2: Use the slope and the given point to write a linear equation.

$$y = mx + b$$
$$y = -\frac{3}{2}x + 5$$

Your work is complete. You have written the equation of a line that passes through $(0, 5)$ and is perpendicular to line p.

Example 2



Write an equation in slope-intercept form of the line that passes through the point $(8, 13)$ and is perpendicular to the line $4x + 5y = 10$.

Step 1: Determine the slope, m, of the perpendicular line.

Standard form: $Ax + By = C$

Slope-intercept form: $y = mx + b$

Recall that when given a linear equation in standard form, you can determine the slope by representing the equation in slope-intercept form. Keep in mind that perpendicular lines have opposite reciprocal slopes.

What is the slope of a line perpendicular to $4x + 5y = 10$?

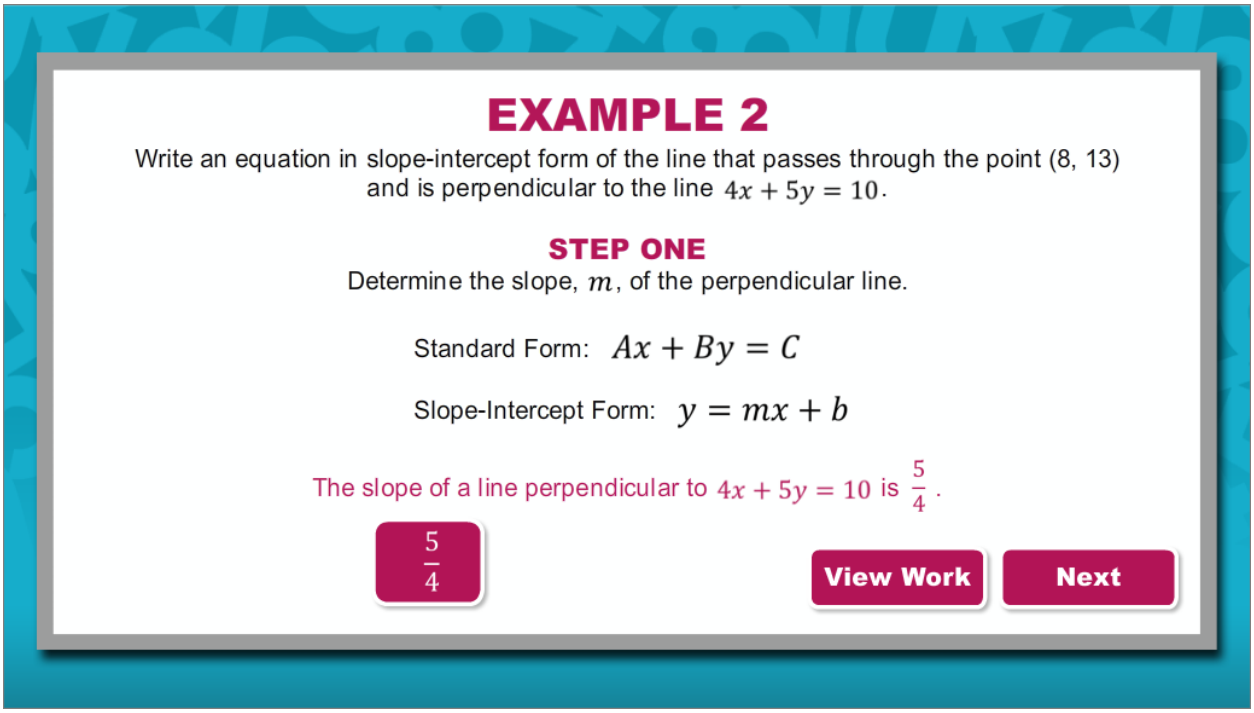
A) $\frac{5}{4}$

B) $-\frac{5}{4}$

C) $\frac{4}{5}$

D) $-\frac{4}{5}$

Example 2 (continued)



Write an equation in slope-intercept form of the line that passes through the point $(8, 13)$ and is perpendicular to the line $4x + 5y = 10$.

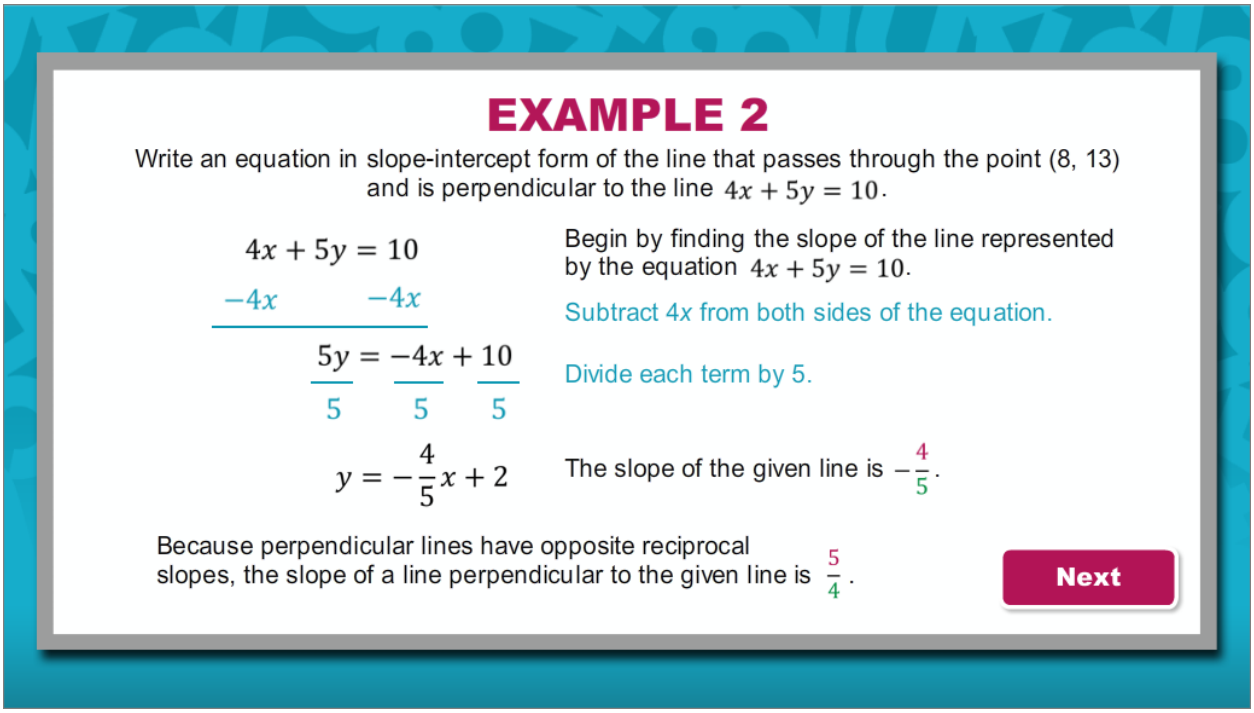
Step 1: Determine the slope, m, of the perpendicular line.

Standard form: $Ax + By = C$

Slope-intercept form: $y = mx + b$

The slope of a line perpendicular to $4x + 5y = 10$ is $\frac{5}{4}$.

Example 2 (continued)



Write an equation in slope-intercept form of the line that passes through the point $(8, 13)$ and is perpendicular to the line $4x + 5y = 10$.

Begin by finding the slope of the line represented by the equation $4x + 5y = 10$.

$4x + 5y = 10$

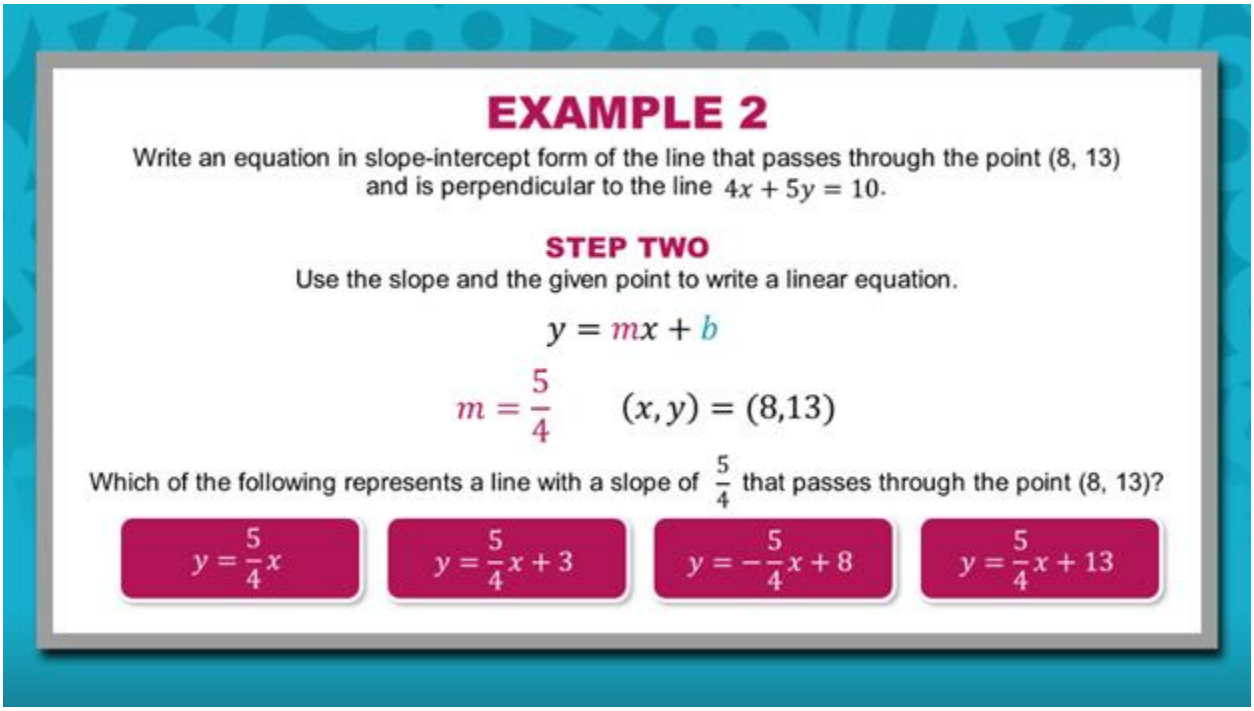
$-4x \quad -4x$ Subtract $4x$ from both sides of the equation.

$\frac{5y}{5} = \frac{-4x}{5} + \frac{10}{5}$ Divide each term by 5.

$y = -\frac{4}{5}x + 2$ The slope of the given line is $-\frac{4}{5}$.

Because perpendicular lines have opposite reciprocal slopes, the slope of a line perpendicular to the given line is $\frac{5}{4}$.

Example 2 (continued)



Write an equation in slope-intercept form of the line that passes through the point $(8, 13)$ and is perpendicular to the line $4x + 5y = 10$.

Step 2: Use the slope and the given point to write a linear equation.

$$y = mx + b$$
$$m = \frac{5}{4} \quad (x, y) = (8, 13)$$

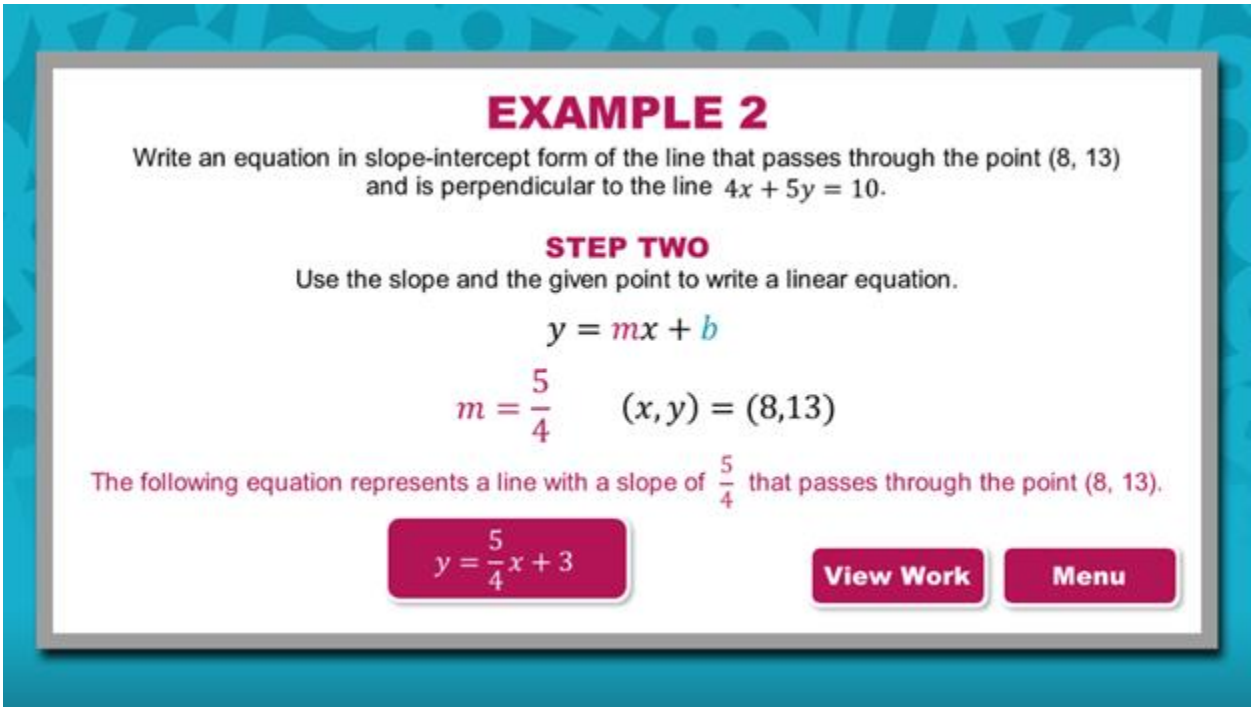
In this example, you are asked to write an equation in the form $y = mx + b$. Now that Step 1 is complete, you know that the slope, m, is $\frac{5}{4}$.

To find b, substitute $\frac{5}{4}$, for m and the coordinates of the given point $(8, 13)$ for x and y. Then, solve for b.

Which of the following represents a line with a slope of $\frac{5}{4}$ that passes through the point $(8, 13)$?

A) $y = \frac{5}{4}x$
B) $y = \frac{5}{4}x + 3$
C) $y = -\frac{5}{4}x + 8$
D) $y = \frac{5}{4}x + 13$

Example 2 (continued)



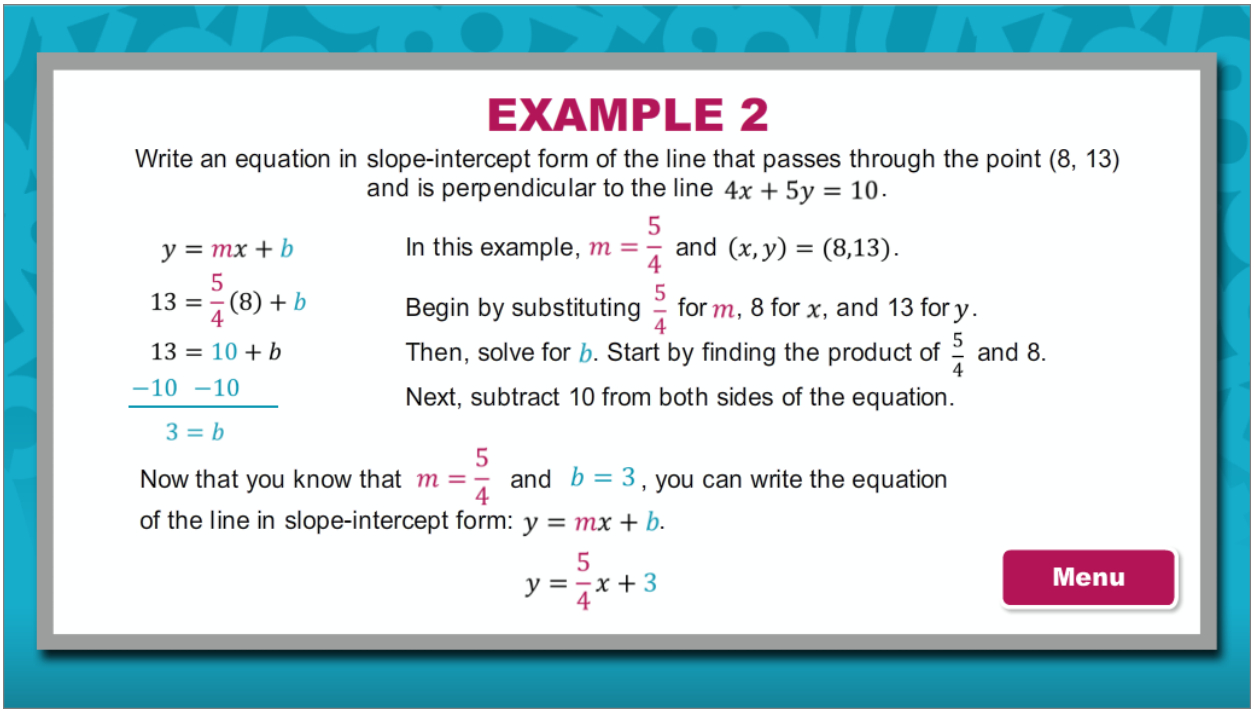
Write an equation in slope-intercept form of the line that passes through the point $(8, 13)$ and is perpendicular to the line $4x + 5y = 10$.

Step 2: Use the slope and the given point to write a linear equation.

$$y = mx + b$$
$$m = \frac{5}{4} \quad (x, y) = (8, 13)$$

The following equation represents a line with a slope of $\frac{5}{4}$ that passes through the point $(8, 13)$.

Example 2 (continued)



Write an equation in slope-intercept form of the line that passes through the point $(8, 13)$ and is perpendicular to the line $4x + 5y = 10$.

$y = mx + b$ — In this example, $m = \frac{5}{4}$ and $(x, y) = (8, 13)$.

$13 = \frac{5}{4}(8) + b$ — Begin by substituting $\frac{5}{4}$ for m, 8 for x, and 13 for y.

$13 = 10 + b$ — Then, solve for b. Start by finding the product of $\frac{5}{4}$ and 8.

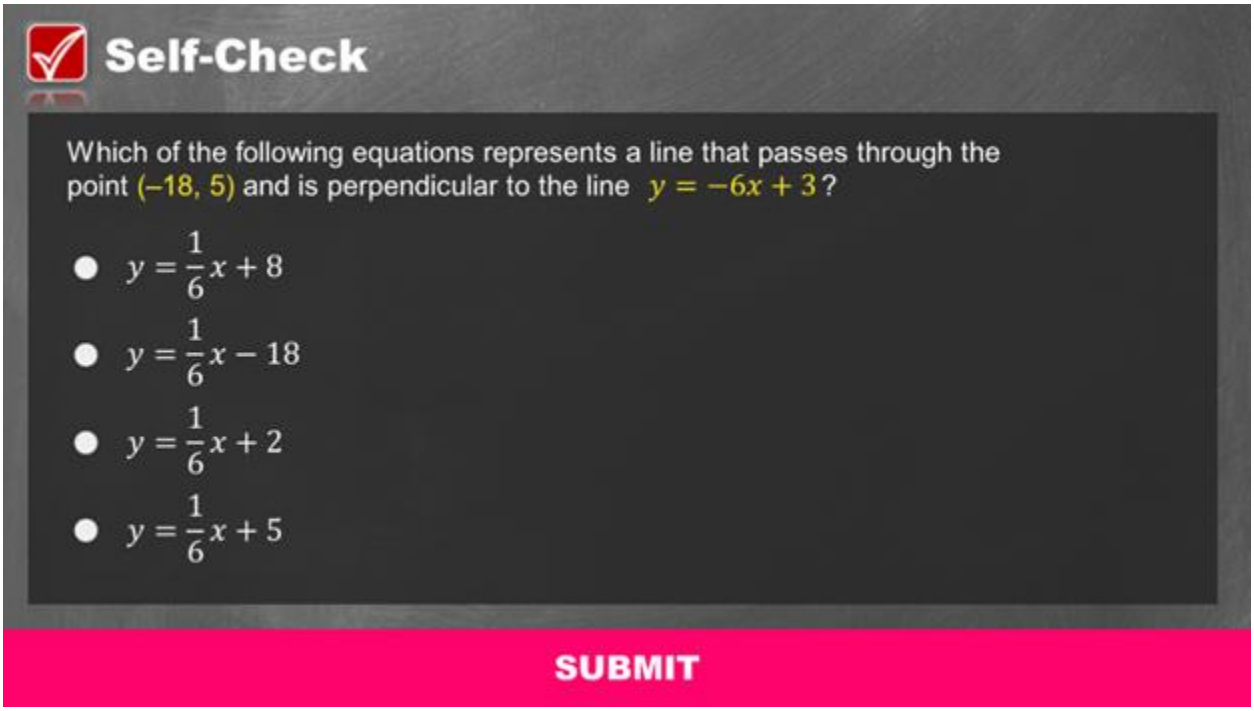
$-10 \quad -10$ — Next, subtract 10 from both sides of the equation.

$3 = b$

Now that you know that $m = \frac{5}{4}$ and $b = 3$, you can write the equation of the line in slope-intercept form: $y = mx + b$.

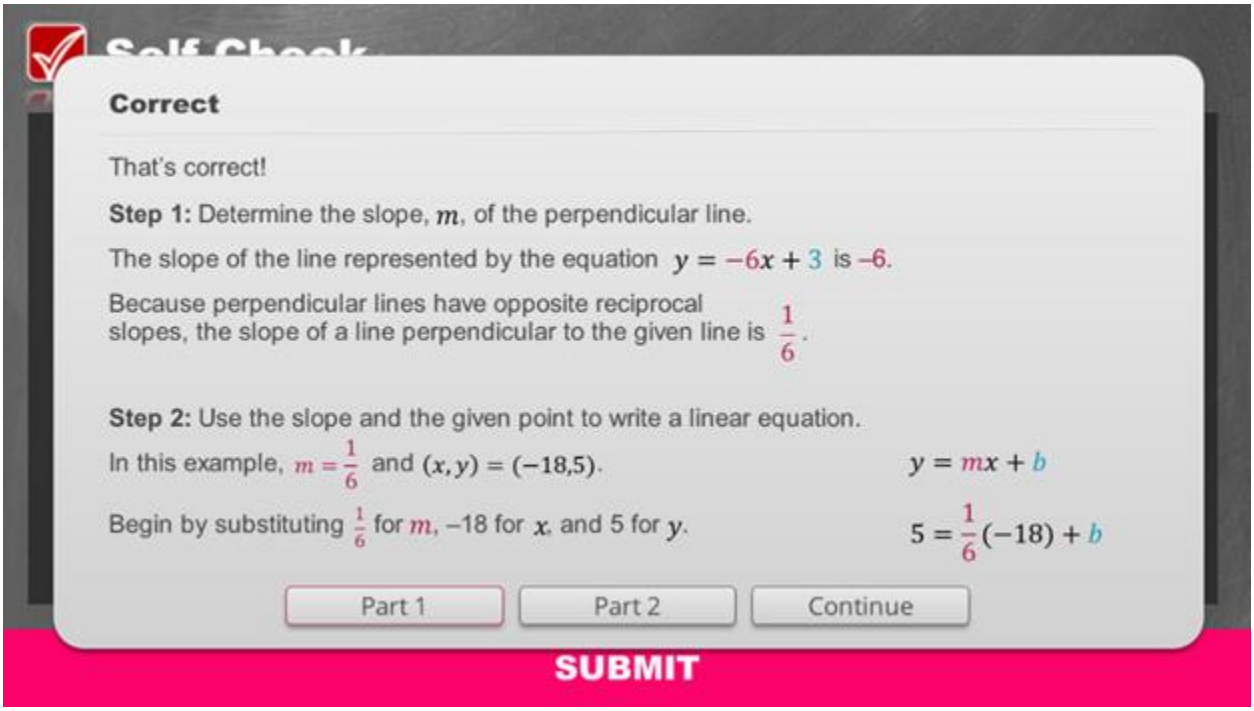
$$y = \frac{5}{4}x + 3$$

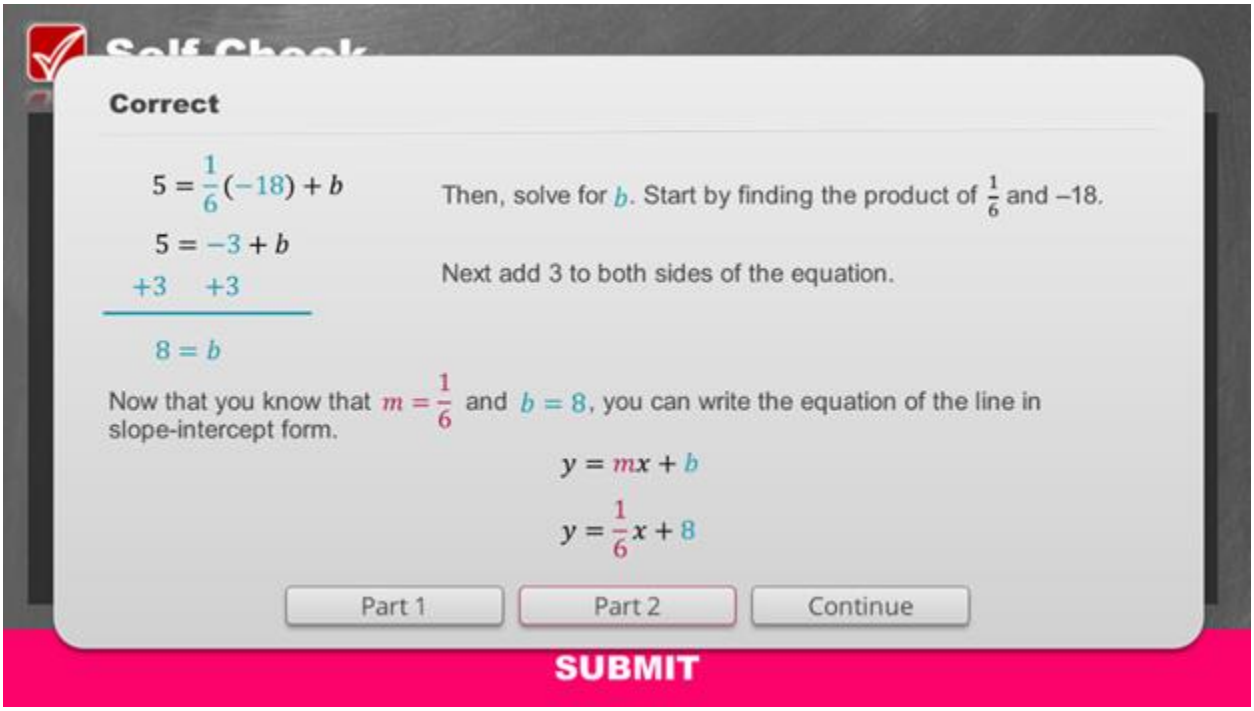
Self-Check



Solve the problem in the image above to check your understanding of the content.

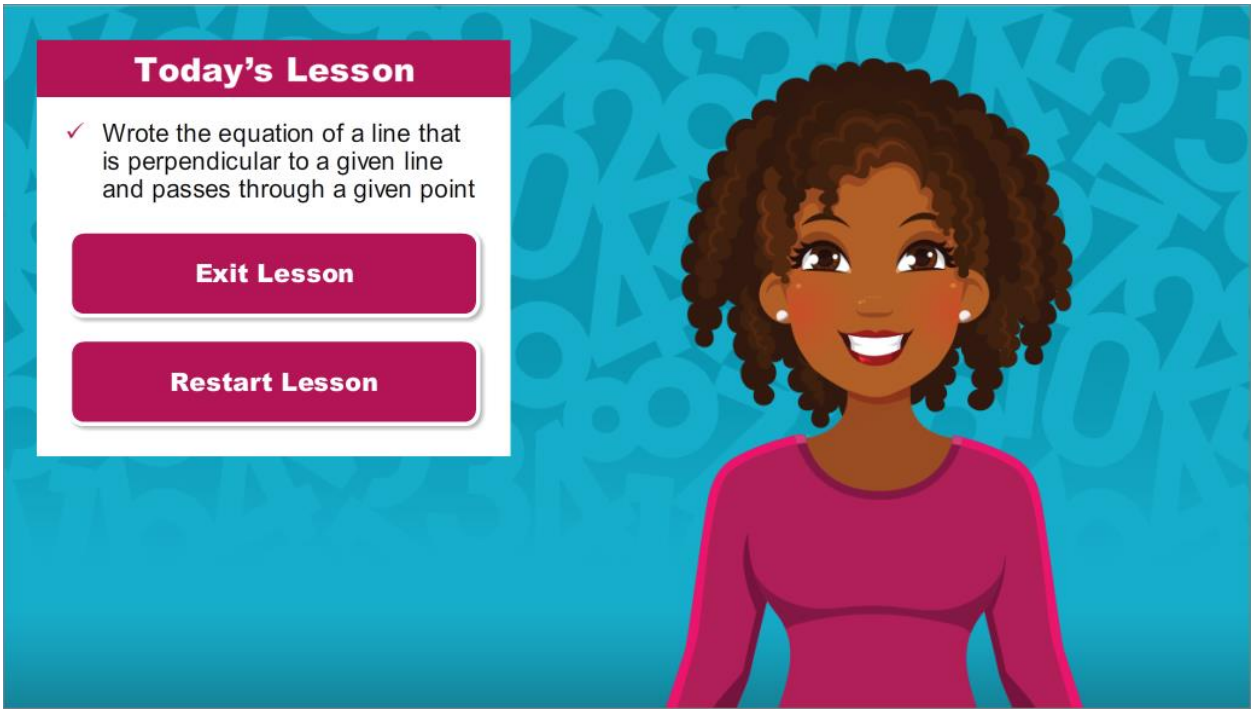
Self-Check: Answer





For your reference, the images above show the correct solution to the self-check problem.

Conclusion



You have reached the conclusion of this lesson where you learned how to write the equation of a line that is perpendicular to a given line and passes through a given point.