

# Equations of Lines

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## WHAT'S COVERED

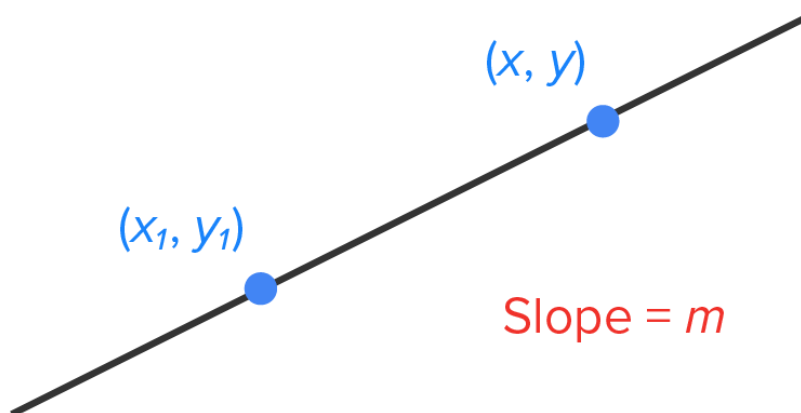
In this lesson, you will be able to write the equation of a line when given the appropriate information. Specifically, this lesson will cover:

1. Point-Slope Form
2. Slope-Intercept Form

## 1. Point-Slope Form

A line has the property that the slope between any two points on that line is always the same (we call it  $m$ ).

Let  $(x, y)$  represent any point on a line and  $(x_1, y_1)$  a specific point on the line.



Using the slope formula, we know  $m = \frac{y - y_1}{x - x_1}$ . If we multiply both sides by  $x - x_1$  this gives us the point-slope form of a linear equation:



#### FORMULA TO KNOW

##### Point-Slope Form

$$y - y_1 = m(x - x_1)$$



#### HINT

Typically, the point  $(x_1, y_1)$  and the slope  $m$  are substituted into this equation, then the final answer is solved for  $y$ .

⇒ **EXAMPLE** Use point-slope form to write the equation of the line that contains the point  $(-1, 4)$  and has slope 3.

$$y - y_1 = m(x - x_1) \quad \text{Point-Slope Form}$$

$$y - 4 = 3(x - (-1)) \quad \text{Substitute the value for } m \text{ and the known point for } x_1 \text{ and } y_1.$$

$$y - 4 = 3(x + 1) \quad \text{Simplify the subtraction inside the parentheses.}$$

$$y - 4 = 3x + 3 \quad \text{Use the distributive property to simplify the right-hand side.}$$

$$y = 3x + 7 \quad \text{Add 4 to both sides.}$$

The equation of the line is  $y = 3x + 7$ .

## 2. Slope-Intercept Form

Another form of a line you may be familiar with is  $y = mx + b$ , which is the slope-intercept form of a line. The variable  $m$  is the slope, where the variable  $b$  is the y-coordinate of the y-intercept. Thus, another way to think about the line in the previous section is that it has slope 3 and y-intercept  $(0, 7)$ .



#### FORMULA TO KNOW

##### Slope-Intercept Form

$$y = mx + b$$

⇒ **EXAMPLE** Write the equation of the line that contains the points  $(1, 5)$  and  $(4, 7)$  in slope-intercept form.

First, label the variables:  $x_1 = 1, y_1 = 5, x_2 = 4, y_2 = 7$ .

Then, the slope of the line is  $m = \frac{7-5}{4-1} = \frac{2}{3}$ .

You can then use point-slope form, along with either given point and the slope you just found. In this example, the point  $(1, 5)$  is used.

$$y - y_1 = m(x - x_1) \quad \text{Point-Slope Form}$$

$$y - 5 = \frac{2}{3}(x - 1) \quad \text{Substitute the value for } m \text{ and the known point for } x_1 \text{ and } y_1.$$

$$y - 5 = \frac{2}{3}x - \frac{2}{3} \quad \text{Distribute the right-hand side.}$$

$$y = \frac{2}{3}x + \frac{13}{3} \quad \text{Add 5 to both sides.}$$

Thus, the equation of the line is  $y = \frac{2}{3}x + \frac{13}{3}$ . This tells us that the line has a slope of  $\frac{2}{3}$  and a y-intercept  $(0, \frac{13}{3})$ .



WATCH

The following video illustrates how to write the equation of a line.



#### SUMMARY

In this lesson, you learned that a line has the property that the slope between any two points on that line is always the same ( $m$ ). You learned that given the slope and a point on the line (or two points contained on the line), you can use the **point-slope form** to write its equation. You also learned how to write the equation of a line using the **slope-intercept form**.

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#### FORMULAS TO KNOW

##### Point-Slope Form

$$y - y_1 = m(x - x_1)$$

##### Slope-Intercept Form

$$y = mx + b$$