

Writing a Linear Inequality from a Graph

by Sophia



WHAT'S COVERED

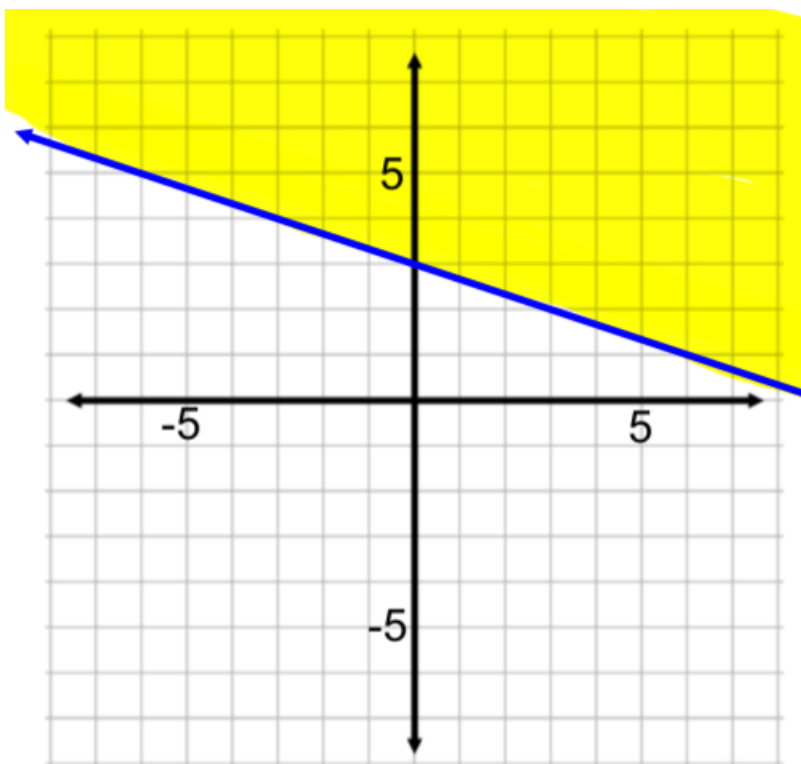
In this lesson, you will learn how to select a linear inequality in slope-intercept form using a graph. Specifically, this lesson will cover:

1. Writing a Linear Inequality from a Graph

Writing a linear inequality from a graph is similar to writing a linear equation from a graph. The biggest difference is that with inequalities, a portion of the coordinate plane is highlighted to represent the solution region. Another thing to consider is how the line is drawn: whether a solid or a dashed line is used. These two characteristics, the highlighted solution region and the type of line drawn, will help us determine what inequality symbol to use when writing the inequality.

First, we'll start with determining the other parts of the inequality. To do this, we will somewhat ignore the fact that we're dealing with an inequality, at least for now, and focus on the boundary line to write an equation in the form $y =$.

➞ **EXAMPLE** Write the inequality that corresponds to the graph below:



We'll start by focusing on the line that we see, and we will deal with the solution region later. Let's write the equation to this line in slope-intercept form. Right away, we notice that the y-intercept of the line is 3. We can also determine that the slope of the line is $-\frac{1}{3}$, because there is a rise of -1 for every run of 3 to get from one point to the next.

So we have determined that the boundary line has the equation:

$$y = -\frac{1}{3}x + 3$$

Our next task is to turn this equation into an inequality. To do this, we will take note of two things: the type of line used to graph the inequality, and the highlighted solution region. The graph uses a solid line, which means that the inequality symbol is either \leq or \geq (it includes "or equal to"). To decide between \leq and \geq , we look to see if the region above the line or below the line is highlighted. Since the region above the line is highlighted, we know the inequality symbol will be "greater than or equal to" or \geq .

So we have determined that the graph represents the inequality:

$$y \geq -\frac{1}{3}x + 3$$

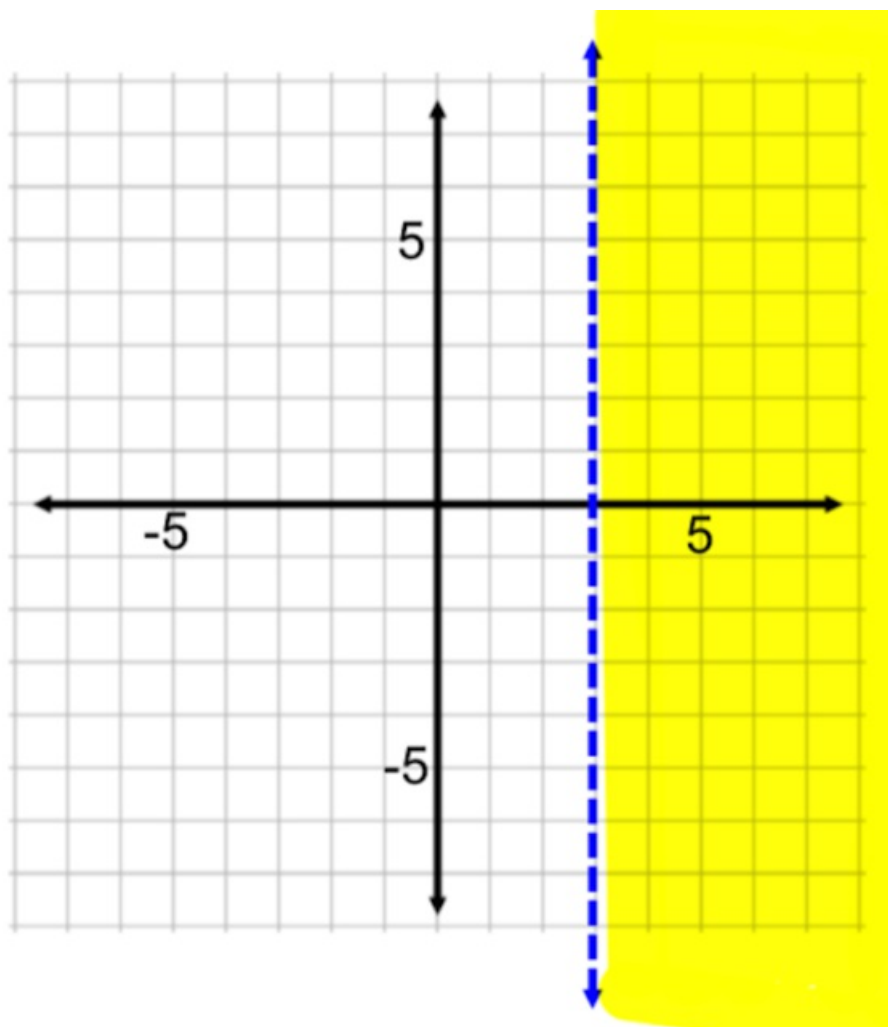
2. Vertical Boundary Lines

If a boundary line is a vertical line, this can be presented by the equation $x = a$. The inequality that we will write to represent this graph has no y-component at all. This simply highlights all x-values on one side of the

boundary line, no matter what the value of y is.

Once again, we look at the type of line used in the graph to determine if our inequality symbol will be strict or non-strict. However, we interpret "above the line" or "below the line" a bit differently. Think about the values of x that run along the x -axis. As we read the graph from left to right, our x -values go from negative infinity to positive infinity. Thus, "above the line" should be interpreted as "to the right" and "below the line" should be interpreted as "to the left."

➞ EXAMPLE Write the inequality that corresponds to the graph below:



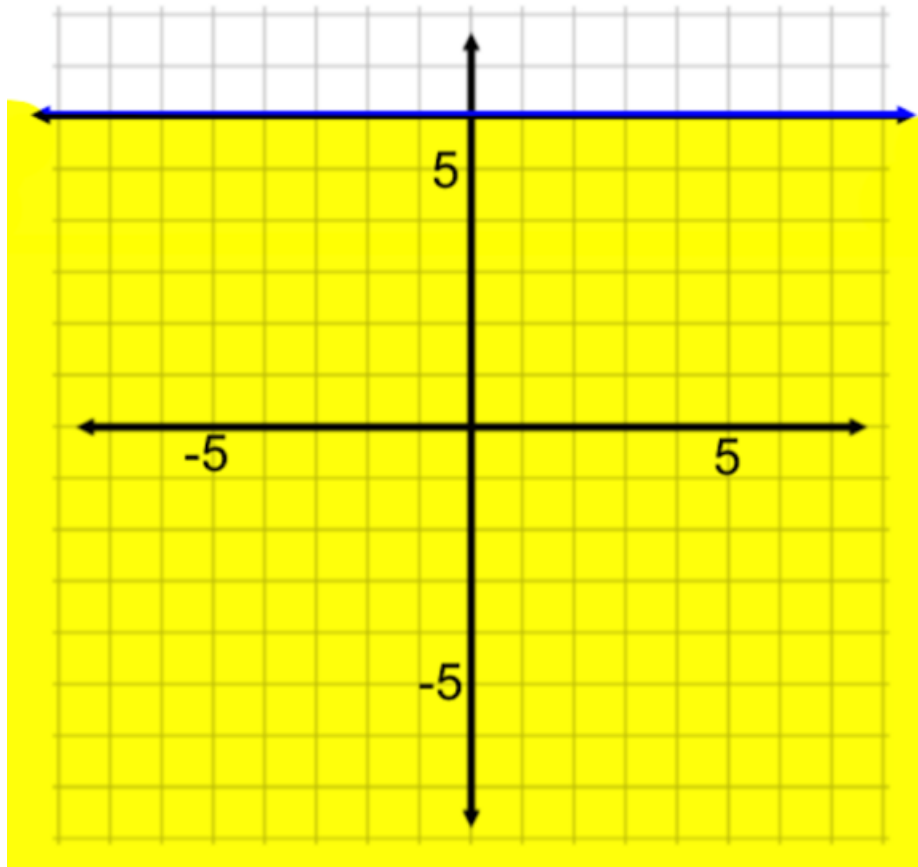
Here, we see a dashed line as our boundary line at $x = 3$, and the area to the right of the boundary line is shaded as the solution region. This means that our inequality symbol will indicate values greater than 3, but not including 3 (because of the dashed line). Thus, our inequality is:

$$x > 3$$

3. Horizontal Boundary Lines

If a boundary line is a horizontal line, this can be presented by the equation $y = a$. In contrast to our vertical boundary lines, this has no x -component in the equation or inequality. This means that all values either greater than or less than a certain value for y are in the solution region, no matter what the value of x is.

→ EXAMPLE Write the inequality that corresponds to the graph below:



To write the inequality for this type of graph, we start by writing the equation of the boundary line. Here, we see the boundary line is represented by the equation $y = 6$. Now, we just need to determine an inequality symbol.

We'll begin by looking at the solid line. This tells us that the inequality symbol is non-strict, so it will include "or equal to." Next, we look at the solution region. Is the solution region above the boundary line, or below the boundary line? Since the solution region is below the non-strict boundary line, we know that the inequality symbol will be "less than or equal to" or \leq . Thus, our inequality is:

$$y \leq 6$$



SUMMARY

Writing a linear inequality from a graph is similar to writing a linear equation from a graph. The biggest difference is that with inequalities, a portion of the coordinate plane is highlighted to represent the solution region. Remember, the symbols less than and greater than indicate using a dashed line. The symbols less than or equal to and greater than or equal to indicate using a solid line. When determining the region to shade on the graph, the symbols less than and less than or equal to indicate shading below the line. The symbols greater than and greater than or equal to indicate shading above the line.

A **vertical boundary line** is represented with an equation x equals a , where a is the value on the x -axis that the line crosses. A **horizontal boundary line** is represented with the equation y equals a , where a is the value on the y -axis that the line crosses.

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