Graphing Linear Inequalities

Like linear equations, linear inequalities start by graphing as a line. Unlike linear equalities this line is a border between two regions that may contain more values that make the original statement equation true. To further complicate matters the border itself may or may not be true. The following examples will demonstrate these ideas.

Example 1: Graph $x + y > 3$.

Solution

Step 1: Find the border.

The dividing line is found by setting the equation equal to zero and then plotting several points to establish it.

X intercept	**Y intercept**	**Check point**
$x + y = 3$	$x + y = 3$	$x + y = 3$
Let $y = 0$	Let $x = 0$	Let $x = -1$
$x + 0 = 3$	$0 + y = 3$	$-1 + y = 3$
$x = 3$	$y = 3$	$y = 4$
(3, 0)	(0, 3)	(-1, 4)

Since the problem states that the equation is greater than but *not* equal to three, this results in the line being "broken" and indicates that the line itself is not part of the true solutions.

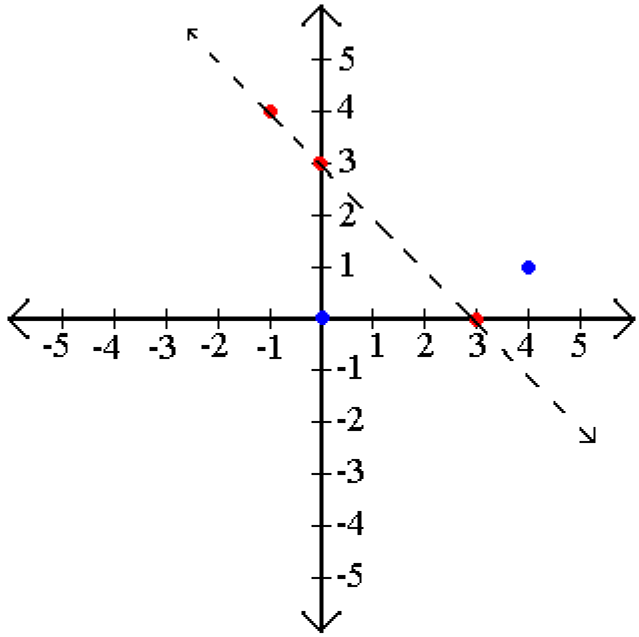
Step 2: Test points on both sides of the barrier.

Select a point that is not on the line and substitute its values into the equation. If the answer is TRUE all the points in that region are true. If the answer is FALSE all of the points in that region are false. Even if you find a true point to start with, test a point from the opposite region to confirm your findings. For this problem the origin (0, 0) is the easiest value to test. The point (1, 4) will be used to confirm.

$x + y > 3$	$x + y > 3$
Let x & $y = 0$	Let $x = 1$ & Let $y = 4$
$0 + 0 > 3$	$1 + 4 > 3$
$0 > 3$ (FALSE)	$5 > 3$ (TRUE)

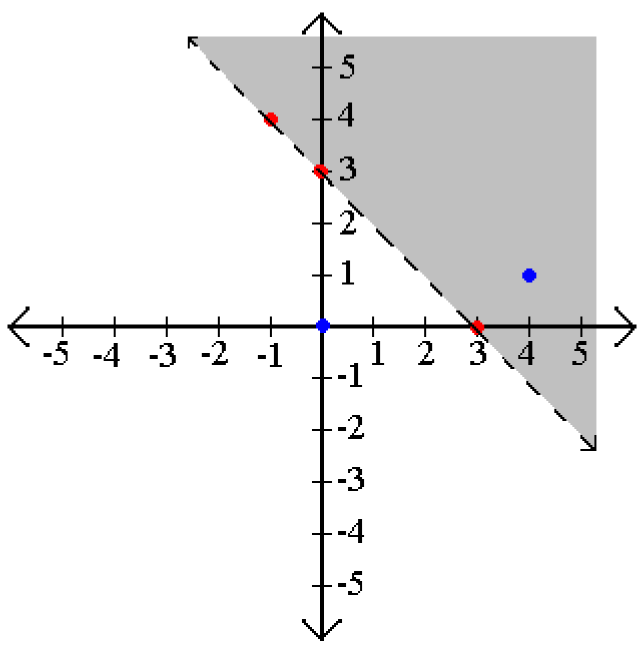
Now we graph the line for $x + y = 3$ and our two test points. Remember to use a dashed line since the original equation was $x + y > 3$.

Example 1 (Continued):



Step 3: Shade the true areas

Since (0, 0) yielded a false answer and (1, 4) yielded a true answer, the region that contained (1, 4) is shaded to indicate that any point in the region will give you a true answer.



Example 2: Graph x + 2y ≤ 3.

Solution

Step 1: Find the barrier.

This problem is solved in the same manner as Ex. 1, but notice the equation is looking for values less than _or_ equal to 3. This allows the border to be included as part of the solution, so in this case the border line will be solid, not broken. The line will be solved for by using the x and y intercepts and x = -3, (-3, 3) as a check point.

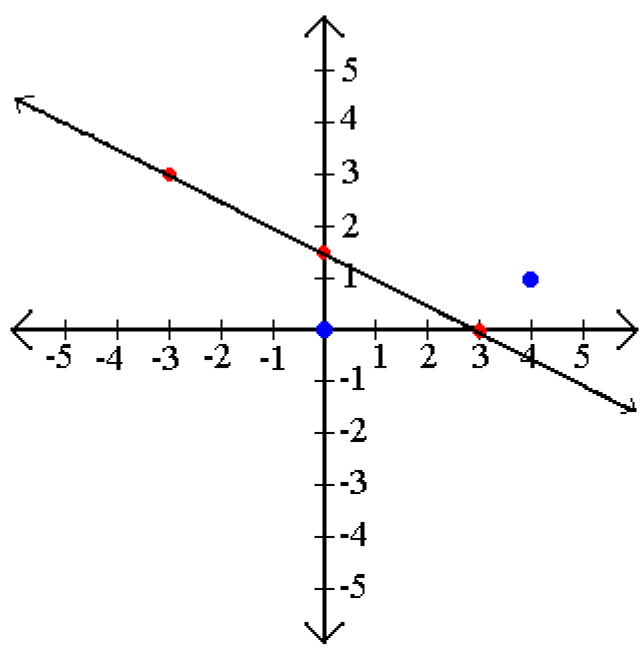
X int.	**Y int.**	**Check Pt.**
x + 2y = 3	x + 2y =3	x + 2y = 3
Let y = 0	Let x = 0	Let x = -3
x + 2 (0) =3	0 + 2y =3	(-3) + 2y = 3
x + 0 = 3	2y =3	-3 + 2y = 3
x = 3	y =	2y = 6
(3, 0)	(0,)	(-3, 3)

Step 2: Test points on both sides of the barrier.

In this problem (0, 0) and (1, 4) will be tested.

x + 2y ≤ 3
0 + 2 (0) ≤ 3
0 ≤ 3 (TRUE)

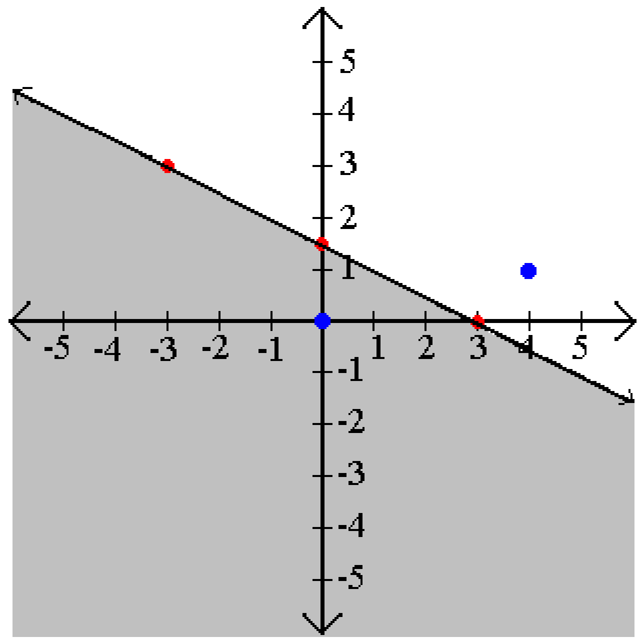
x + 2y ≤ 3
1 + 2(4) ≤ 3
9 ≤ 3 (FALSE)



Example 2 (Continued):

Step 3: Shade the true areas

Since (0, 0) is true and (1, 4) is false, the region containing (0, 0) is shaded.



Example 3: Graph y < 4 .

Solution

Step 1: Find the barrier.

Recall that this equation represents a horizontal line. This means that the region to be shaded will be above or below the line. Since the equation indicates that the values are less than 4 and not equal to 4 the line is broken and not solid.

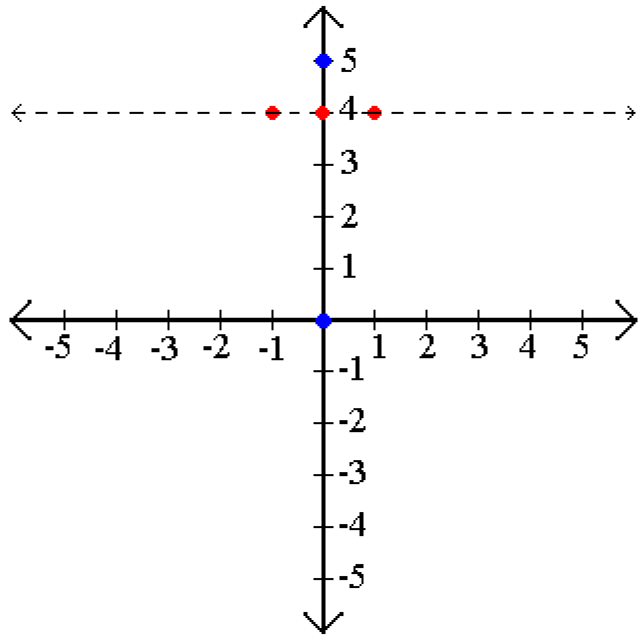
y = 4	y = 4	y = 4
Let x = 0	Let x = 1	Let x = - 1
(0, 4)	(1, 4)	(-1, 4)

Step 2: Test points on both sides of the barrier.

For this problem (0, 0) and (0, 5) will be tested.

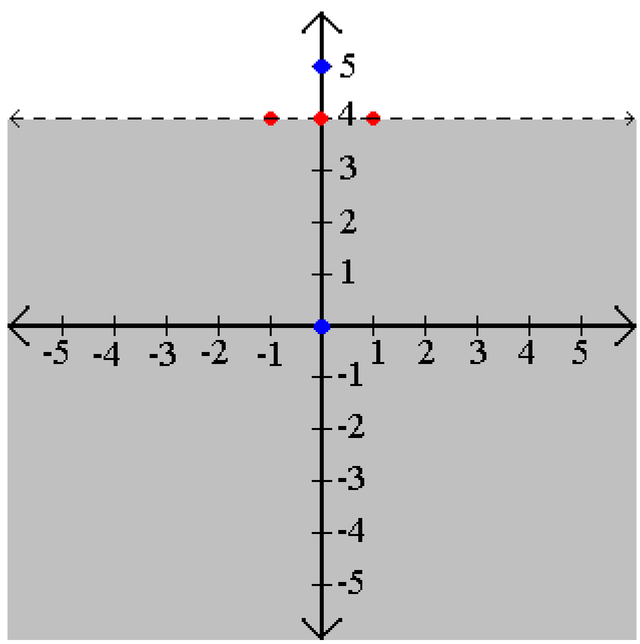
y < 4	y < 4
Let y = 0	Let y = 5
0 < 4 (TRUE)	5 < 4 (FALSE)

Example 3: (Continued)



Step 3: Shade the true areas.

Since (0, 0) lies in the true area and (0, 5) does not, the area with (0, 0) is shaded.



Example 4: Graph x ≥ 2

Solution

Step 1: Find the barrier.

Like the last example, this line is a special case, graphing as a vertical line. This means that the true values will be either on the left or right side of the line.

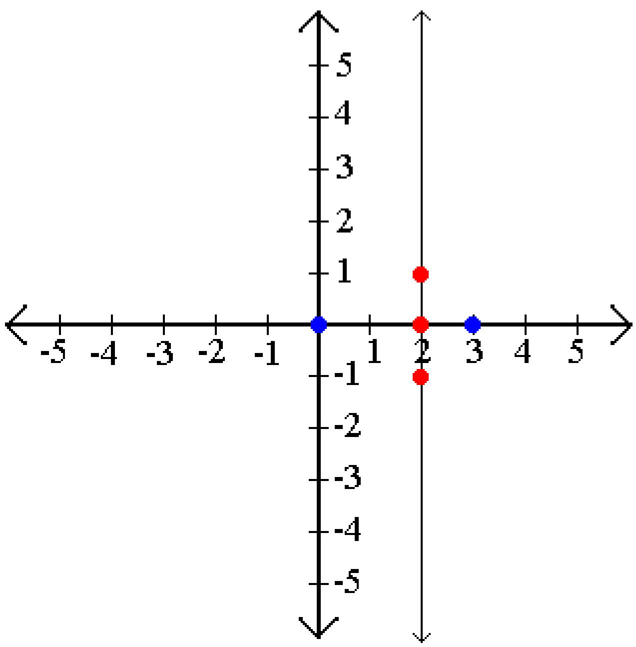
x = 2	x = 2	x = 2
Let y = 0	Let y = - 1	Let y = 1
(2, 0)	(2, -1)	(2, 1)

Step 2: Test points on both sides of the barrier.

In this example (0, 0) and (3, 0) will be the test points.

x ≥ 2
Let x = 0
0 ≥ 2
(False)

x ≥ 2
Let x = 3
3 ≥ 2
(TRUE)



Example 4 (Continued):

Step 3: Shade the true areas.

Since (0, 0) is false and (3, 0) is true, the area containing (3, 0) is shaded.