GOAL **Graph linear inequalities in two variables.**

Vocabulary

A **linear inequality in two variables,** such as $x - 3y < 6$, is the result of replacing the $=$ sign in a linear equation with $<$, $\leq$, $>$, or $\geq$.

In a coordinate plane, the **graph of an inequality in two variables** is the set of points that represent all solutions of the inequality.

Common Student Errors

- Always using (0, 0) as a test point

  Tip Remind students that the test point cannot be on the boundary line of the half-plane. Use an example where the boundary line passes through the origin to show students how to pick a test point.

Inequalities of the form $y > ax$, $y < ax$, $y \geq ax$, and $y \leq ax$, where a is a real number, have boundary lines that pass through the origin.

EXAMPLE 1 ## Checking solutions

Tell whether the ordered pair is a solution of the inequality.

a. $3x - y > 7$; (4, 3)

b. $\frac{1}{2}x - 3y \leq 8$; (10, −3)

Solution

a. Check whether the ordered pair is a solution of the inequality.

$3x - y > 7$ Write original inequality.

$3(4) - 3 \stackrel{?}{>} 7$ Substitute 4 for x and 3 for y.

$9 > 7$ ✓ Simplify.

So, (4, 3) is a solution of $3x - y > 7$.

b. $\frac{1}{2}x - 3y \leq 8$ Write original equation.

$\frac{1}{2}(10) - 3(-3) \stackrel{?}{\leq} 8$ Substitute 10 for x and −3 for y.

$14 \leq 8$ Simplify.

Because $14 \leq 8$ is not true, (10, −3) is *not* a solution of the inequality.

Exercises for Example 1

Tell whether the ordered pair is a solution of $-5x + 2y < 11$.

1. $(2, 6)$ **2.** $(-1, 4)$ **3.** $(-3, -4)$

Tell whether the ordered pair is a solution of $\frac{1}{3}x + 4y \geq 16$.

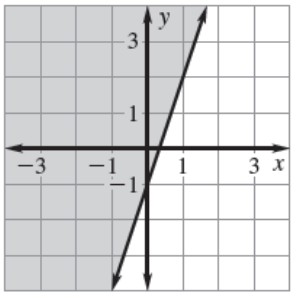
4. $(12, 4)$ **5.** $(3, 3)$ **6.** $(18, 2)$

EXAMPLE 2 Graph a linear inequality in two variables

Graph the inequality $3x - y \leq 1$.

Solution

STEP 1 **Graph** the equation $3x - y = 1$.
The inequality is $\leq$, so use a solid line.



STEP 2 **Test** $(0, 0)$ in $3x - y \leq 1$.

$$3(0) \stackrel{?}{\leq} 1$$

$$0 \leq 1 \checkmark$$

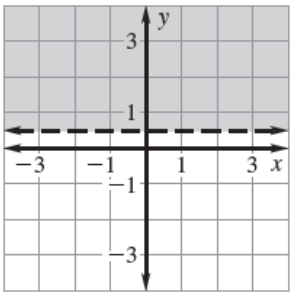
STEP 3 **Shade** the half-plane that contains $(0, 0)$, because $(0, 0)$ is a solution of the inequality.

EXAMPLE 3 Graph a linear inequality in one variable

Graph the inequality $y > \frac{1}{2}$.

Solution

STEP 1 **Graph** the equation $y = \frac{1}{2}$. The inequality is $>$ so use a dashed line.



STEP 2 **Test** $(0, 0)$ in $y > \frac{1}{2}$. You substitute only the y-coordinate because the inequality does not have the variable x.

$$0 \stackrel{?}{>} \frac{1}{2}$$

STEP 3 **Shade** the half-plane that does *not* contain $(0, 0)$, because $(0, 0)$ is a not a solution of the inequality.

Exercises for Examples 2 and 3

Graph the inequality.

7. $x + y \geq -2$

8. $5x - 2y < 6$

9. $x \leq 1$