

# 5.5

## Write Equations of Parallel and Perpendicular Lines

**Goal** • Write equations of parallel and perpendicular lines.

### Your Notes

#### VOCABULARY

Converse

Perpendicular lines

#### PARALLEL LINES

If two nonvertical lines have the same \_\_\_\_\_, then they are \_\_\_\_\_.

If two nonvertical lines are \_\_\_\_\_, then they have the same \_\_\_\_\_.

#### Example 1 Write an equation of a parallel line

Write an equation of the line that passes through (2, 4) and is parallel to the line  $y = 4x + 1$ .

#### Solution

**Step 1 Identify the slope.** The graph of the given equation has a slope of \_\_\_\_\_. So, the parallel line through (2, 4) has a slope of \_\_\_\_\_.

**Step 2 Find the y-intercept.** Use the slope and the given point.

$$y = mx + b$$

$$\underline{\hspace{1cm}} = \underline{\hspace{1cm}}(\underline{\hspace{1cm}}) + b$$

$$\underline{\hspace{1cm}} = b$$

Write slope-intercept form.

Substitute \_\_\_\_\_ for  $m$ , \_\_\_\_\_ for  $x$ , and \_\_\_\_\_ for  $y$ .

Solve for  $b$ .

**Step 3 Write an equation.** Use  $y = mx + b$ .

$$y = \underline{\hspace{1cm}}$$

Substitute \_\_\_\_\_ for  $m$  and \_\_\_\_\_ for  $b$ .

## Your Notes

### PERPENDICULAR LINES

If two nonvertical lines have the slopes that are \_\_\_\_\_, then the lines are \_\_\_\_\_.

If two nonvertical lines are \_\_\_\_\_, then their slopes are \_\_\_\_\_.

### Example 2 Determine parallel or perpendicular lines

Determine which of the following lines, if any, are parallel or perpendicular:

Line *a*:  $12x - 3y = 3$

Line *b*:  $y = 4x + 2$

Line *c*:  $4y + x = 8$

#### Solution

Find the slopes of the lines.

Line *b*: The equation is in slope-intercept form.  
The slope is \_\_\_\_\_.

Write the equations for lines *a* and *c* in slope-intercept form.

Line *a*:  $12x - 3y = 3$

$$-3y = \underline{\hspace{2cm}} + 3$$

$$y = \underline{\hspace{2cm}}$$

Line *c*:  $4y + x = 8$

$$4y = \underline{\hspace{1cm}} + 8$$

$$y = \underline{\hspace{2cm}}$$

Lines *a* and *b* have a slope of \_\_\_\_\_, so they are \_\_\_\_\_.

Line *c* has a slope of \_\_\_\_\_, the negative reciprocal of \_\_\_\_\_, so it is \_\_\_\_\_ to lines *a* and *b*.

## Your Notes

✔ **Checkpoint** Complete the following exercises.

1. Write an equation of the line that passes through  $(-4, 6)$  and is parallel to the line  $y = -3x + 2$ .

2. Determine which of the following lines, if any, are parallel or perpendicular.

Line a:  $4x + y = 2$

Line b:  $5y + 20x = 10$

Line c:  $8y = 2x + 8$

**Example 3** Determine whether lines are perpendicular

Determine if the following lines are perpendicular.

Line a:  $6y = 5x + 8$

Line b:  $-10y = 12x + 10$

### Solution

Find the slopes of the lines. Write the equations in slope-intercept form.

Line a:  $6y = 5x + 8$

$$y = \underline{\hspace{2cm}}$$

Line b:  $-10y = 12x + 10$

$$y = \underline{\hspace{2cm}}$$

The slope of line a is  $\underline{\hspace{1cm}}$ . The slope of line b is  $\underline{\hspace{1cm}}$ .

The two slopes  $\underline{\hspace{1cm}}$  negative reciprocals, so lines a and b  $\underline{\hspace{1cm}}$  perpendicular.

## Your Notes

### Example 4 Write an equation of a perpendicular line

Write an equation of the line that passes through  $(-3, 4)$  and is perpendicular to the line  $y = \frac{1}{3}x + 2$ .

#### Solution

**Step 1 Identify the slope.** The graph of the given equation has a slope of \_\_\_\_\_. Because the slopes of \_\_\_\_\_ perpendicular lines are negative reciprocals, the slope of the perpendicular line through  $(-3, 4)$  is \_\_\_\_\_.

**Step 2 Find the y-intercept.** Use the slope and the given point.

$$\begin{array}{ll} y = mx + b & \text{Write slope-intercept form.} \\ \underline{\quad} = \underline{\quad}(\underline{\quad}) + b & \text{Substitute } \underline{\quad} \text{ for } m, \underline{\quad} \\ & \text{for } x, \text{ and } \underline{\quad} \text{ for } y. \\ \underline{\quad} = b & \text{Solve for } b. \end{array}$$

**Step 3 Write an equation.**

$$\begin{array}{ll} y = mx + b & \text{Write slope-intercept form.} \\ y = \underline{\quad} & \text{Substitute } \underline{\quad} \text{ for } m \\ & \text{and } \underline{\quad} \text{ for } b. \end{array}$$

#### ✓ Checkpoint Complete the following exercises.

3. Determine whether line  $a$  through  $(1, 3)$  and  $(3, 4)$  is perpendicular to line  $b$  through  $(1, -3)$  and  $(2, -5)$ . Justify your answer using slopes.

4. Write an equation of the line that passes through  $(4, -2)$  and is perpendicular to the line  $y = 5x + 2$ .

### Homework