

LESSON
4.5**Study Guide***For use with the lesson "Write Equations of Parallel and Perpendicular Lines"***GOAL** Write equations of parallel and perpendicular lines.**Vocabulary**

The **converse of a conditional statement** interchanges the hypothesis and conclusion.

Parallel Lines

If two nonvertical lines have the same slope, then they are **parallel**.

If two nonvertical lines are parallel, then they have the same slope.

Perpendicular Lines

Two lines in a plane are **perpendicular** if they intersect to form a right angle.

If two nonvertical lines have slopes that are negative reciprocals, then the lines are perpendicular.

If two nonvertical lines are perpendicular, then their slopes are negative reciprocals.

EXAMPLE 1 Write an equation of a parallel line

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

Solution

STEP 1 Identify the slope. The graph of the given equation has a slope of -1 . So, the parallel line through $(2, 6)$ has a slope of -1 .

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

$$y = mx + b \quad \text{Write slope-intercept form.}$$

$$6 = -1(2) + b \quad \text{Substitute } -1 \text{ for } m, 2 \text{ for } x, \text{ and } 6 \text{ for } y.$$

$$8 = b \quad \text{Solve for } b.$$

STEP 3 Write the equation. Use $y = mx + b$.

$$y = -x + 8 \quad \text{Substitute } -1 \text{ for } m \text{ and } 8 \text{ for } b.$$

Exercises for Example 1

Write an equation of the line that passes through the given point and is parallel to the given line.

1. $(9, 2), y = \frac{2}{3}x + 1$

2. $(-3, -4), y = -2x - 1$

LESSON
4.5
Study Guide *continued*
For use with the lesson "Write Equations of Parallel and Perpendicular Lines"
EXAMPLE 2 Determine whether lines are parallel or perpendicular

Determine which of the following lines, if any, are parallel or perpendicular: Line *a*: $4y - 6x = -8$, Line *b*: $y = -\frac{2}{3}x + 1$,
 Line *c*: $2x + 3y = -15$.

Solution

Find the slopes of the lines.

Line *b*: The equation is in slope-intercept form. The slope is $-\frac{2}{3}$.

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

$$\text{Line } a: 4y - 6x = -8$$

$$\text{Line } c: 2x + 3y = -15$$

$$4y = 6x - 8$$

$$3y = -2x - 15$$

$$y = \frac{3}{2}x - 2$$

$$y = -\frac{2}{3}x - 5$$

Lines *b* and *c* have a slope of $-\frac{2}{3}$, so they are parallel. Line *a* has a slope of $\frac{3}{2}$, the negative reciprocal of $-\frac{2}{3}$, so it is perpendicular to lines *b* and *c*.

EXAMPLE 3 Write an equation of a perpendicular line

Write an equation of the line that passes through $(-2, 1)$ 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 $-\frac{1}{3}$.

Because the slopes of perpendicular lines are negative reciprocals, the slope of the perpendicular line through $(-2, 1)$ is 3.

STEP 2 Find the *y*-intercept. Use the slope and the given point in $y = mx + b$.

$$1 = 3(-2) + b \quad \text{Substitute 3 for } m, -2 \text{ for } x, \text{ and 1 for } y.$$

$$7 = b \quad \text{Solve for } b.$$

STEP 3 Write the equation. Use $y = mx + b$.

$$y = 3x + 7 \quad \text{Substitute 3 for } m \text{ and 7 for } b.$$

Exercises for Examples 2 and 3

- Determine which of the following lines, if any, are parallel or perpendicular.
 Line *a*: $-3x - 12y = 36$ Line *b*: $x + 4y = 2$ Line *c*: $y = 4x$
- Write an equation of the line that passes through $(5, 3)$ and is perpendicular to the line $y = -5x + 3$.