Key Vocabulary 🔊
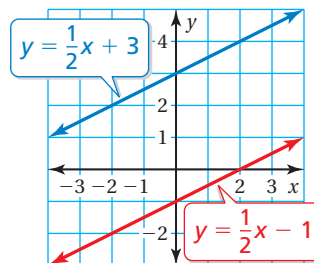perpendicular lines,
 p. 57

Study Tip ✏️
Vertical lines have
undefined slopes.

🔑 **Key Idea**

Parallel Lines and Slopes

Two different lines in the same plane
that never intersect are parallel lines.
Nonvertical parallel lines have the
same slope.

All vertical lines are parallel.

$y = \frac{1}{2}x + 3$

$y = \frac{1}{2}x - 1$

EXAMPLE ① **Identifying Parallel Lines**

Which two lines are parallel? How do you know?
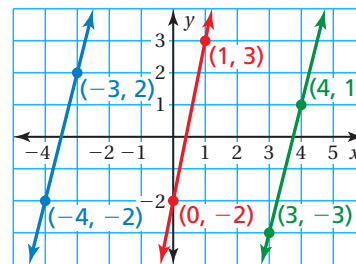
Find the slope of each line.

Blue Line

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{-2 - 2}{-4 - (-3)}$$

$$= \frac{-4}{-1}, \text{ or } 4$$

Red Line

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{-2 - 3}{0 - 1}$$

$$= \frac{-5}{-1}, \text{ or } 5$$

Green Line

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{-3 - 1}{3 - 4}$$

$$= \frac{-4}{-1}, \text{ or } 4$$

(1, 3) (−3, 2) (4, 1) (−4, −2) (0, −2) (3, −3)

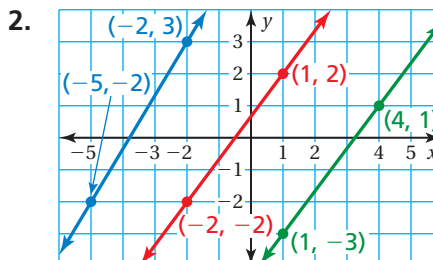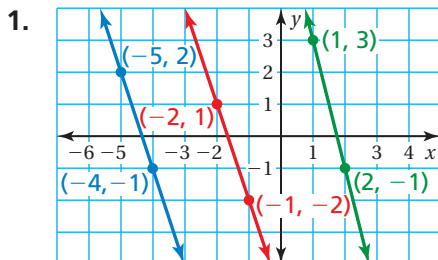The slope of the blue and green lines is 4. The slope of the red line is 5.

∴ The blue and green lines have the same slope, so they are parallel.

🟢 **Practice**

Which lines are parallel? How do you know?

1.

(−5, 2) (1, 3) (−2, 1) (−4, −1) (−1, −2) (2, −1)

2.

(−2, 3) (−5, −2) (1, 2) (4, 1) (−2, −2) (1, −3)

Are the given lines parallel? Explain your reasoning.

3. $y = -5, y = 3$

4. $y = 0, x = 0$

5. $x = -4, x = 1$

6. **GEOMETRY** The vertices of a quadrilateral are $A(-5, 3)$, $B(2, 2)$, $C(4, -3)$, and
$D(-2, -2)$. How can you use slope to determine whether the quadrilateral is
a parallelogram? Is it a parallelogram? Justify your answer.

🔊 **Multi-Language Glossary at BigIdeasMath√com**

Parallel and Perpendicular Lines

In this extension, you will
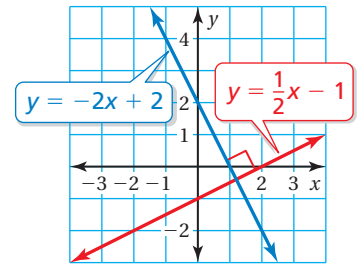- identify parallel and perpendicular lines.

Preparing for Standards
F.IF.4
F.IF.6

Key Idea

Perpendicular Lines and Slope

Two lines in the same plane that intersect to form right angles are **perpendicular lines**. Two nonvertical lines are perpendicular if and only if the product of their slopes is -1.

Vertical lines are perpendicular to horizontal lines.

$y = -2x + 2$ $y = \frac{1}{2}x - 1$

EXAMPLE 2 Identifying Perpendicular Lines

Which two lines are perpendicular? How do you know?
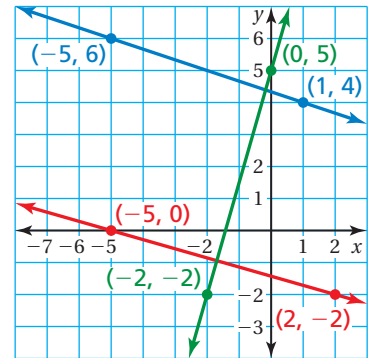
Find the slope of each line.

Blue Line

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{4 - 6}{1 - (-5)}$$

$$= \frac{-2}{6}, \text{ or } -\frac{1}{3}$$

Red Line

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{-2 - 0}{2 - (-5)}$$

$$= -\frac{2}{7}$$

Green Line

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{5 - (-2)}{0 - (-2)}$$

$$= \frac{7}{2}$$

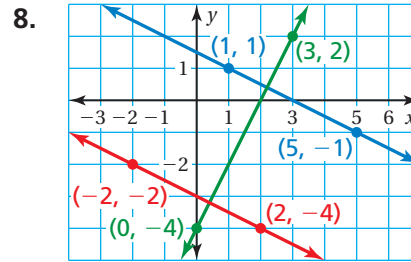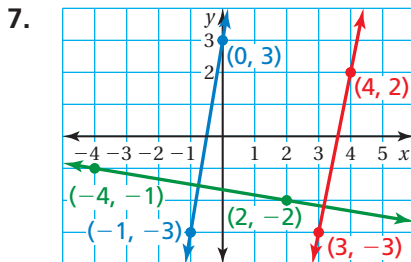$(-5, 6)$ $(0, 5)$ $(1, 4)$ $(-5, 0)$ $(-2, -2)$ $(2, -2)$

The slope of the red line is $-\frac{2}{7}$. The slope of the green line is $\frac{7}{2}$.

∴ Because $-\frac{2}{7} \cdot \frac{7}{2} = -1$, the red and green lines are perpendicular.

Practice

Which lines are perpendicular? How do you know?

7.

$(0, 3)$ $(4, 2)$ $(-4, -1)$ $(2, -2)$ $(-1, -3)$ $(3, -3)$

8.

$(1, 1)$ $(3, 2)$ $(5, -1)$ $(-2, -2)$ $(2, -4)$ $(0, -4)$

Are the given lines perpendicular? Explain your reasoning.

9. $x = -2, y = 8$

10. $x = -8, x = 7$

11. $y = 0, x = 0$

12. GEOMETRY The vertices of a parallelogram are $J(-5, 0)$, $K(1, 4)$, $L(3, 1)$, and $M(-3, -3)$. How can you use slope to determine whether the parallelogram is a rectangle? Is it a rectangle? Justify your answer.