

Vocabulary and Core Concept Check

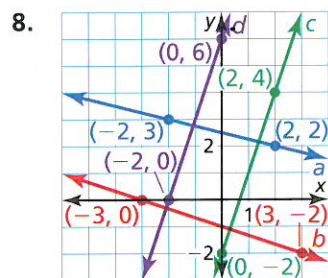
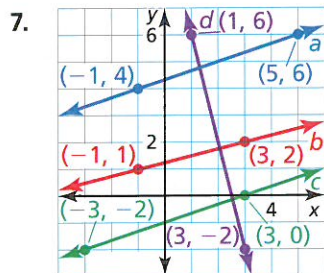
- COMPLETE THE SENTENCE** A _____ line segment AB is a segment that represents moving from point A to point B .
- WRITING** How are the slopes of perpendicular lines related?

Monitoring Progress and Modeling with Mathematics

In Exercises 3–6, find the coordinates of point P along the directed line segment AB so that AP to PB is the given ratio. (See Example 1.)

- $A(8, 0)$, $B(3, -2)$; 1 to 4
- $A(-2, -4)$, $B(6, 1)$; 3 to 2
- $A(1, 6)$, $B(-2, -3)$; 5 to 1
- $A(-3, 2)$, $B(5, -4)$; 2 to 6

In Exercises 7 and 8, determine which of the lines are parallel and which of the lines are perpendicular. (See Example 2.)



In Exercises 9–12, tell whether the lines through the given points are *parallel*, *perpendicular*, or *neither*. Justify your answer.

- Line 1: $(1, 0)$, $(7, 4)$
Line 2: $(7, 0)$, $(3, 6)$

- Line 1: $(-3, 1)$, $(-7, -2)$
Line 2: $(2, -1)$, $(8, 4)$

- Line 1: $(-9, 3)$, $(-5, 7)$
Line 2: $(-11, 6)$, $(-7, 2)$

- Line 1: $(10, 5)$, $(-8, 9)$
Line 2: $(2, -4)$, $(11, -6)$

In Exercises 13–16, write an equation of the line passing through point P that is parallel to the given line. Graph the equations of the lines to check that they are parallel. (See Example 3.)

- $P(0, -1)$, $y = -2x + 3$
- $P(3, 8)$, $y = \frac{1}{5}(x + 4)$
- $P(-2, 6)$, $x = -5$
- $P(4, 0)$, $-x + 2y = 12$

In Exercises 17–20, write an equation of the line passing through point P that is perpendicular to the given line. Graph the equations of the lines to check that they are perpendicular. (See Example 4.)

- $P(0, 0)$, $y = -9x - 1$
- $P(4, -6)$, $y = -3$
- $P(2, 3)$, $y - 4 = -2(x + 3)$
- $P(-8, 0)$, $3x - 5y = 6$

In Exercises 21–24, find the distance from point A to the given line. (See Example 5.)

- $A(-1, 7)$, $y = 3x$
- $A(-9, -3)$, $y = x - 6$
- $A(15, -21)$, $5x + 2y = 4$
- $A(-\frac{1}{4}, 5)$, $-x + 2y = 14$

25. **ERROR ANALYSIS** Describe and correct the error in determining whether the lines are parallel, perpendicular, or neither.



Line 1: $(3, -5), (2, -1)$
 Line 2: $(0, 3), (1, 7)$

$$m_1 = \frac{-1 - (-5)}{2 - 3} = -4 \quad m_2 = \frac{7 - 3}{1 - 0} = 4$$

Lines 1 and 2 are perpendicular.

26. **ERROR ANALYSIS** Describe and correct the error in writing an equation of the line that passes through the point $(3, 4)$ and is parallel to the line $y = 2x + 1$.



$$y = 2x + 1, (3, 4)$$

$$4 = m(3) + 1$$

$$1 = m$$

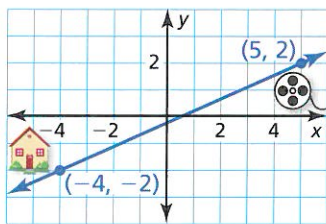
The line $y = x + 1$ is parallel to the line $y = 2x + 1$.

In Exercises 27–30, find the midpoint of \overline{PQ} . Then write an equation of the line that passes through the midpoint and is perpendicular to \overline{PQ} . This line is called the *perpendicular bisector*.

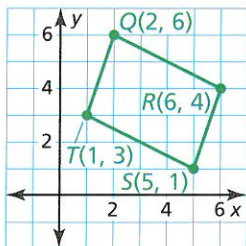
27. $P(-4, 3), Q(4, -1)$ 28. $P(-5, -5), Q(3, 3)$

29. $P(0, 2), Q(6, -2)$ 30. $P(-7, 0), Q(1, 8)$

31. **MODELING WITH MATHEMATICS** Your school lies directly between your house and the movie theater. The distance from your house to the school is one-fourth of the distance from the school to the movie theater. What point on the graph represents your school?

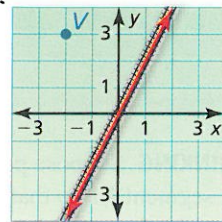


32. **REASONING** Is quadrilateral $QRST$ a parallelogram? Explain your reasoning.



33. **REASONING** A triangle has vertices $L(0, 6), M(5, 8)$, and $N(4, -1)$. Is the triangle a right triangle? Explain your reasoning.

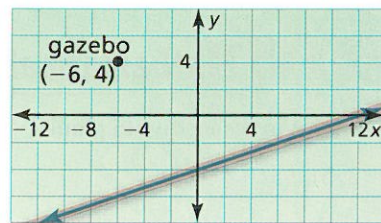
34. **MODELING WITH MATHEMATICS** A new road is being constructed parallel to the train tracks through point V . An equation of the line representing the train tracks is $y = 2x$. Find an equation of the line representing the new road.



35. **MODELING WITH MATHEMATICS** A bike path is being constructed perpendicular to Washington Boulevard through point $P(2, 2)$. An equation of the line representing Washington Boulevard is $y = -\frac{2}{3}x$. Find an equation of the line representing the bike path.

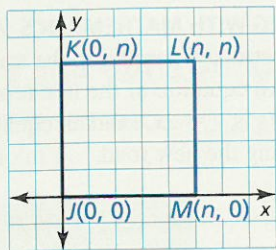


36. **PROBLEM SOLVING** A gazebo is being built near a nature trail. An equation of the line representing the nature trail is $y = \frac{1}{3}x - 4$. Each unit in the coordinate plane corresponds to 10 feet. Approximately how far is the gazebo from the nature trail?



37. **CRITICAL THINKING** The slope of line ℓ is greater than 0 and less than 1. Write an inequality for the slope of a line perpendicular to ℓ . Explain your reasoning.

38. **HOW DO YOU SEE IT?** Determine whether quadrilateral $JKLM$ is a square. Explain your reasoning.



39. **CRITICAL THINKING** Suppose point P divides the directed line segment XY so that the ratio of XP to PY is 3 to 5. Describe the point that divides the directed line segment YX so that the ratio of YP to PX is 5 to 3.
40. **MAKING AN ARGUMENT** Your classmate claims that no two nonvertical parallel lines can have the same y -intercept. Is your classmate correct? Explain.
41. **MATHEMATICAL CONNECTIONS** Solve each system of equations algebraically. Make a conjecture about what the solution(s) can tell you about whether the lines intersect, are parallel, or are the same line.
- $y = 4x + 9$
 $4x - y = 1$
 - $3y + 4x = 16$
 $2x - y = 18$
 - $y = -5x + 6$
 $10x + 2y = 12$

42. **THOUGHT PROVOKING** Find a formula for the distance from the point (x_0, y_0) to the line $ax + by = 0$. Verify your formula using a point and a line.

MATHEMATICAL CONNECTIONS In Exercises 43 and 44, find a value for k based on the given description.

43. The line through $(-1, k)$ and $(-7, -2)$ is parallel to the line $y = x + 1$.
44. The line through $(k, 2)$ and $(7, 0)$ is perpendicular to the line $y = x - \frac{28}{5}$.
45. **ABSTRACT REASONING** Make a conjecture about how to find the coordinates of a point that lies beyond point B along \overline{AB} . Use an example to support your conjecture.
46. **PROBLEM SOLVING** What is the distance between the lines $y = 2x$ and $y = 2x + 5$? Verify your answer.

PROVING A THEOREM In Exercises 47 and 48, use the slopes of lines to write a paragraph proof of the theorem.

47. Lines Perpendicular to a Transversal Theorem (Theorem 3.12): In a plane, if two lines are perpendicular to the same line, then they are parallel to each other.
48. Transitive Property of Parallel Lines Theorem (Theorem 3.9): If two lines are parallel to the same line, then they are parallel to each other.
49. **PROOF** Prove the statement: If two lines are vertical, then they are parallel.
50. **PROOF** Prove the statement: If two lines are horizontal, then they are parallel.
51. **PROOF** Prove that horizontal lines are perpendicular to vertical lines.

Maintaining Mathematical Proficiency

Reviewing what you learned in previous grades and lessons

Plot the point in a coordinate plane. (*Skills Review Handbook*)

52. $A(3, 6)$

53. $B(0, -4)$

54. $C(5, 0)$

55. $D(-1, -2)$

Copy and complete the table. (*Skills Review Handbook*)

56.

x	-2	-1	0	1	2
$y = x + 9$					

57.

x	-2	-1	0	1	2
$y = x - \frac{3}{4}$					