

4.4 Explain – Writing Equations of Parallel and Perpendicular Lines - Notes

Essential Question: How can you recognize lines that are parallel or perpendicular?

Main Ideas/ Questions	Notes/Examples
What You Will Learn	<ul style="list-style-type: none"> To identify and write equations of parallel lines. To identify and write equations of perpendicular lines.

Parallel and Perpendicular Lines

Parallel Lines: Lines in the same plane that never intersect.

- Same slope (m), different y-intercepts (b)

Examples of parallel lines:

1. $y = 2x + 3$ $\nearrow m=2$
 $y = 2x + 5$ $\searrow m=2$
 same slope

2. $y = \left(\frac{1}{2}\right)x - 2$ $\nearrow m=\frac{1}{2}$
 $3x - 6y = 18$
 $-3x \quad -6y \quad -3x$
 $-6y = -3x + 18$
 $\frac{-6y}{-6} = \frac{-3x + 18}{-6}$
 $y = \left(\frac{1}{2}\right)x - 3$

Perpendicular Lines: Two lines in the same plane that intersect to form right angles.

- The product of their slopes (m) is -1 (Opposite reciprocal)

Examples of opposite reciprocals:

3. $\frac{1}{2}$ and -2 \rightarrow Multiply: $\left(\frac{1}{2}\right)(-2) = -\frac{2}{2} = -1$

4. -4 and $+\frac{1}{4}$ \rightarrow Multiply: $(-4)\left(\frac{1}{4}\right) = -\frac{4}{4} = -1$

"flip & change sign"

Identifying Parallel and Perpendicular Lines: Find the slope for the following lines and then determine if the lines are parallel, perpendicular, or neither. Explain your answer.

5. $y = 4x + 5$ $\nearrow m$ $m = 4$
 $-4x + y = -13$ $m = 4$
 $y = 4x - 13$ $\searrow m$

The lines are parallel because the slopes are the same

6. $y = \frac{3}{4}x - 7$ $\nearrow m$ $m = \frac{3}{4}$
 $y = -\frac{3}{4}x + 12$ $\searrow m$ $m = -\frac{3}{4}$

The lines are Not parallel, Not perpendicular because slopes not same & not opposite reciprocals. So neither

7. Line 1: (2, 0), (-2, 2) $m = \frac{2-0}{-2-2} = \frac{2}{-4} = -\frac{1}{2}$
 Line 2: (1, -2), (4, 4) $m = \frac{4+2}{4-1} = 2$

The lines are perpendicular because slopes are opposite reciprocals

8. $y = -6x - 8$ $m = -6$
 $y - 8 = \left(\frac{1}{6}\right)(x - 12)$ $m = \frac{1}{6}$

The lines are perpendicular because slopes are opposite reciprocals

4.4 Explain – Writing Equations of Parallel and Perpendicular Lines - Notes

Writing Equations of Parallel Lines: Write the equation of a line in slope-intercept form that passes through the given point and is parallel to the given line.

7. $(3, -1); y = \frac{1}{3}x - 3$
 $\rightarrow m = \frac{1}{3}$

pt slope
 $y - y_1 = m(x - x_1)$

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

8. $(1, -2); 2x + y = 1$ $m = -2$
 $y = -2x + 1$

$y + 2 = -2(x - 1)$
 $y + 2 = -2x + 2$
 $y = -2x + 0$

Writing Equations of Perpendicular Lines: Write the equation of a line in slope-intercept form that passes through the given point and is perpendicular to the given line.

9. $(-2, 2); y = \frac{2}{3}x + 2$ $m = \frac{2}{3}$ so $\perp m = -\frac{3}{2}$

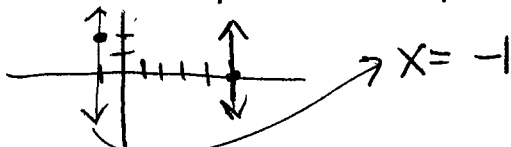
$y - 2 = -\frac{3}{2}(x + 2)$
 $y - 2 = -\frac{3}{2}x - 3$
 $y = -\frac{3}{2}x - 1$

10. $(3, 1); 2y = \frac{4x}{2} - \frac{3}{2}$ $m = 2$ so $\perp m = -\frac{1}{2}$
 $y = 2x - \frac{3}{2}$

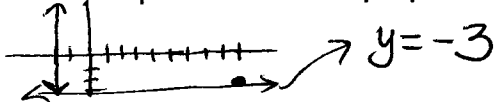
$y - 1 = -\frac{1}{2}(x - 3)$
 $y - 1 = -\frac{1}{2}x + \frac{3}{2}$
 $y = -\frac{1}{2}x + \frac{5}{2}$

- What is the slope of a line parallel to the x-axis? 0 Perpendicular to the x-axis? Und
- What is the slope of a line parallel to the y-axis? Und Perpendicular to the y-axis? 0

11. Write the equation of a line parallel to $x = 5$ that passes through $(-1, 2)$.



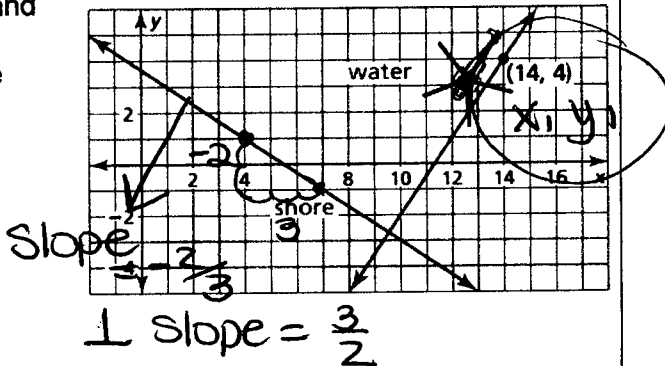
12. Write the equation of a line perpendicular to $x = -2$ that passes through $(9, -3)$.



Vertical lines are Perpendicular to horizontal lines.

13. **Application:** The position of a helicopter search and rescue crew is shown in the graph. The shortest flight path to the shoreline is one that is perpendicular to the shoreline. Write an equation that represents this path.

$(14, 4)$ $m = \frac{3}{2}$
 $y - 4 = \frac{3}{2}(x - 14)$
 $y - 4 = \frac{3}{2}x - 21$
 $y = \frac{3}{2}x - 17$



4.4

Writing Equations of Parallel and Perpendicular Lines

In exercises 1 – 4, identify the slope of each line and determine if the lines are parallel, perpendicular, or neither. Explain.

1. $y = \frac{1}{2}x - 9$ $m =$
 $y = -2x + 24$ $m =$

The lines are _____
 because _____

2. Line 1: $(-6, -10), (4, -2)$ $m =$
 Line 2: $(-8, -6), (0, 4)$ $m =$

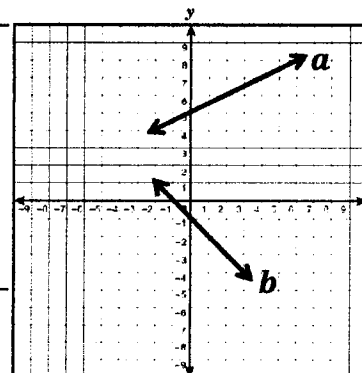
The lines are _____
 because _____

3. $2y = 3x + 10$ $m =$
 $3x - 2y = 16$ $m =$

The lines are _____
 because _____

4. Line a : $m =$
 Line b : $m =$

The lines are _____
 because _____



In Exercises 5 and 6, write the equation of a line in slope-intercept form that passes through the given point and is parallel to the given line.

5. $(1, 3); y = 2x - 5$

6. $(-2, 1); 4x + y = 3$

In Exercises 7 and 8, write the equation of a line in slope-intercept form that passes through the given point and is perpendicular to the given line.

7. $(2, -3); y = \frac{1}{3}x - 5$

8. $(6, 1); 3x + 5y = -25$

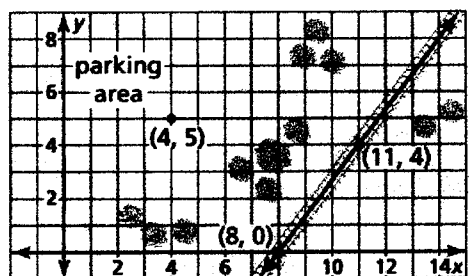
- 9. Write the equation of a horizontal line that passes through the point $(-2, 3)$.
- 10. Write the equation of a line that is perpendicular to the line $x = 12$ and passes through the point $(5, 4)$.
- 11. Write the equation of a line that is parallel to the x -axis and passes through the point $(-3, -4)$.
- 12. Which of the following equations is perpendicular to the y -axis?

- a. $y = x$
- b. $y = 2$
- c. $x = 2$
- d. $3y = 2x$

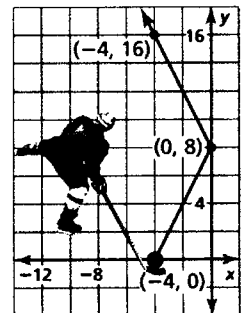
13. The vertices of a triangle are $A(1, 1)$, $B(0, 2)$, and $C(2, 4)$. Is triangle ABC a right triangle? Explain.

14. For what value of a are the graphs of $3y = 6x - 5$ and $9y = ax + 2$ parallel? perpendicular?

15. A parks and recreation department is constructing a new bike path. The path will be parallel to the railroad tracks shown and pass through the parking area at the point $(4, 5)$. Write an equation that represents the path.

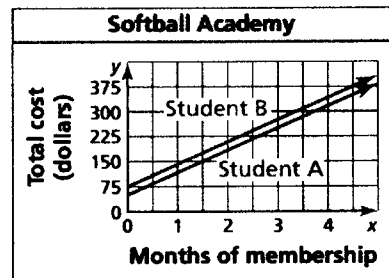


16. A hockey puck leaves the blade of a hockey stick, bounces off a wall, and travels in a new direction, as shown. Your friend claims the path of the puck forms a right angle. Is your friend correct? Explain.



17. A softball academy charges students an initial registration fee plus a monthly fee. The graph shows the total amounts paid by two students over a 4-month period. The lines are parallel.

- a. Did one of the students pay a greater registration fee? Explain.
- b. Did one of the students pay a greater monthly fee? Explain.



18. Some values for two linear equations are shown in the tables. Decide if the equations are parallel, perpendicular, or neither. Explain your answer.

x	y
-1	1
1	-5
3	-11
5	-17

x	y
-3	-1
0	0
3	1
6	2

The lines are _____ because

In Exercises 19 and 20, determine whether the relation is a function.

19. $(3, 6), (4, 8), (5, 10), (6, 9), (7, 14)$

20. $(-1, 6), (1, 4), (-1, 2), (1, 6), (-1, 5)$

YES/NO

YES/NO