

Activity

2-4

Parallel and Perpendicular Lines

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EXPLORE & REASON

Graph these three equations using a graphing calculator.

Plot1	Plot2	Plot3
$Y_1 = 3X + 1$		
$Y_2 = 3X + 2$		
$Y_3 = 3X + 4$		
$Y_4 =$		
$Y_5 =$		
$Y_6 =$		
$Y_7 =$		

A. Look for Relationships Choose any two of the lines you graphed. How are they related to each other? MP.7

Same Slope

B. Does your answer to Part A hold for any two lines? Explain.

Yes... all equations: same slope

C. Write another set of three or more equations that have the same relationships as the first three equations.

$$y = 3x - 1$$

$$y = 3x - 2$$

$$y = 3x - 3000000$$

HABITS OF MIND

Look for Relationships What concepts have you learned previously that were useful in analyzing this problem? MP.7

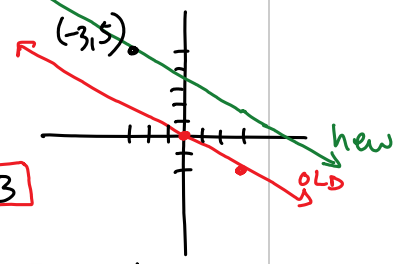
$$y = mx + b$$

LESSON 2-4 Parallel and Perpendicular Lines 45

ex 1) ... (8, 9) ...
 to $y = \frac{3}{4}x - 2$
 slope
 new $y = mx + b$
 $9 = \frac{3}{4}(8) + b$
 $9 = 6 + b$
 $3 = b$
 $\therefore y = \frac{3}{4}x + 3$

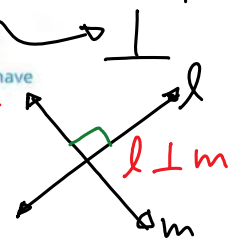
EXAMPLE 1 Try It! Write an Equation of a Parallel Line Parallel to a Given Line

1. Write the equation of the line in slope-intercept form that passes through the point $(-3, 5)$ and is parallel to $y = -\frac{2}{3}x$.
 new $y = mx + b$
 $y = -\frac{2}{3}x + b$
 $5 = -\frac{2}{3}(-3) + b$
 $5 = 2 + b$
 $3 = b$
 $\therefore y = -\frac{2}{3}x + 3$



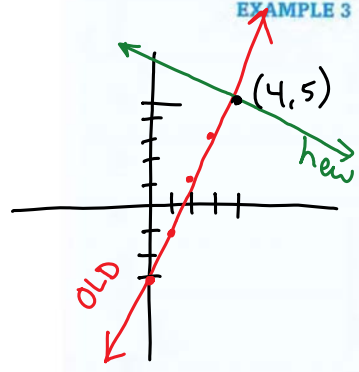
EXAMPLE 2 Try It! Understand the Slopes of Perpendicular Lines

2. Why does it make sense that the slopes of perpendicular lines have opposite signs?
 uphill vs. downhill ...
 $3x + 1$ vs \perp line
 Perpendicular Lines
 → negative reciprocal slopes
 "Opposite Flip"



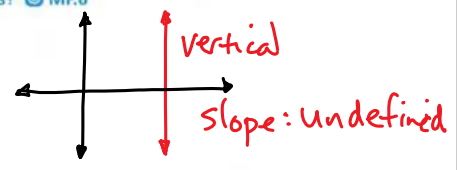
EXAMPLE 3 Try It! Write an Equation of a Line Perpendicular to a Given Line

3. Write the equation of the line that passes through the point $(4, 5)$ and is perpendicular to the graph of $y = 2x - 3$.
 new $y = mx + b$
 $y = -\frac{1}{2}x + b$
 $5 = -\frac{1}{2}(4) + b$
 $5 = -2 + b$
 $7 = b$
 $\therefore y = -\frac{1}{2}x + 7$



HABITS OF MIND

Communicate Precisely Why do you have to use the term "nonvertical" when working with parallel and perpendicular lines? MP.6



EXAMPLE 4 Try It! Classify Lines4. Are the graphs of the equations *parallel, perpendicular, or neither?*

a. $y = 2x + 6$ and $y = \frac{1}{2}x + 3$

slope: 2

slope: $\frac{1}{2}$

neither

b. $y = -5x$ and $25x + 5y = 1$

slope: -5

isolate

$$\begin{array}{r} -25x \\ \hline 25x + 5y = 1 \\ -25x \end{array}$$

$$\frac{5y}{5} = \frac{-25x + 1}{5}$$

$$y = -5x + \frac{1}{5}$$

parallel

EXAMPLE 5 Try It! Solve a Real-World Problem5. The equation $y = 2x + 7$ represents the North Path on a map.a. Find the equation for a path that passes through the point $(6, 3)$ and is parallel to the North Path.

b. Find the equation for a path that passes through the same point but is perpendicular to North Path.

HABITS OF MIND**Use Structure** Explain the advantages of using the slope-intercept form of an equation when determining if two lines are perpendicular or parallel to each other. © MP.7

Do You UNDERSTAND?

1. **ESSENTIAL QUESTION** How can the equations of lines help you identify whether the lines are *parallel*, *perpendicular*, or *neither*?

2. **Error Analysis** Dwayne stated that the slope of the line perpendicular to $y = -2x$ is 2. Describe Dwayne's error. **MP.3**

3. **Vocabulary** Describe the difference between the slopes of two parallel lines and the slopes of two perpendicular lines.

4. **Use Structure** Is there one line that passes through the point (3, 5) that is parallel to the lines represented by $y = 2x - 4$ and $y = x - 4$? Explain. **MP.7**

Do You KNOW HOW?

The equation $y = \frac{3}{4}x + 1$ represents a given line.

5. Write the equation for the line that passes through (-4, 9) and is parallel to the given line.

new

$$y = mx + b$$

$$y = -\frac{3}{4}x + b$$

$$9 = -\frac{3}{4}(-4) + b$$

$$9 = 3 + b$$

$$-3 \quad -3$$

$$\frac{6}{6} = \frac{b}{6}$$

$$\therefore y = -\frac{3}{4}x + 6$$

OLD

same slope

6. Write the equation for the line that passes through (6, 6) and is perpendicular to the given line.

new

$$y = mx + b$$

$$6 = \frac{4}{3}(6) + b$$

$$6 = 8 + b$$

$$-8 \quad -8$$

$$-2 = b$$

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

slope: neg recip-procal
 $-\frac{3}{4} \rightarrow \frac{4}{3}$

Are the graphs of the equations parallel, perpendicular, or neither?

7. $x - 3y = 6$ and $x - 3y = 9$

$$-3y = -x + 6$$

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

$$-3y = -x + 9$$

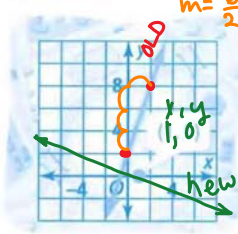
$$y = \frac{1}{3}x - 3$$

parallel

8. $y = \frac{4}{1}x + 1$ and $y = \frac{-4}{1}x - 2$

neither...

9. What equation represents the road that passes through the point shown and is perpendicular to the road represented by the red line?



OLD $m = \frac{6}{2} = \frac{3}{1}$

new $m = -\frac{1}{3}$

$$y = mx + b$$

$$0 = -\frac{1}{3}(1) + b$$

$$0 = -\frac{1}{3} + b$$

$$\frac{1}{3} = b$$

$$\therefore y = -\frac{1}{3}x + \frac{1}{3}$$