

# SECTION 3.7 PERPENDICULAR LINES

Name: Key

Date: \_\_\_\_\_

Period: \_\_\_\_\_

## Vocabulary

DEFINITION	EXAMPLE
<p>slopes of perpendicular lines</p> <p>The line with the equation <math>y = mx + b</math> with <math>m \neq 0</math> is perpendicular to any line with slope of <math>-\frac{1}{m}</math></p>	<p><math>y = 2x + 3</math> and <math>y = -\frac{1}{2}x - 5</math></p>

## Lines Through the Origin

### EXPLORATION 1

- Find the equation of the line passing through the origin and the point  $(1, 3)$ . Also find the equation of the line passing through the origin and the point  $(-3, 1)$ . Plot the points and the two lines on the same coordinate grid. What are slopes of the two lines?

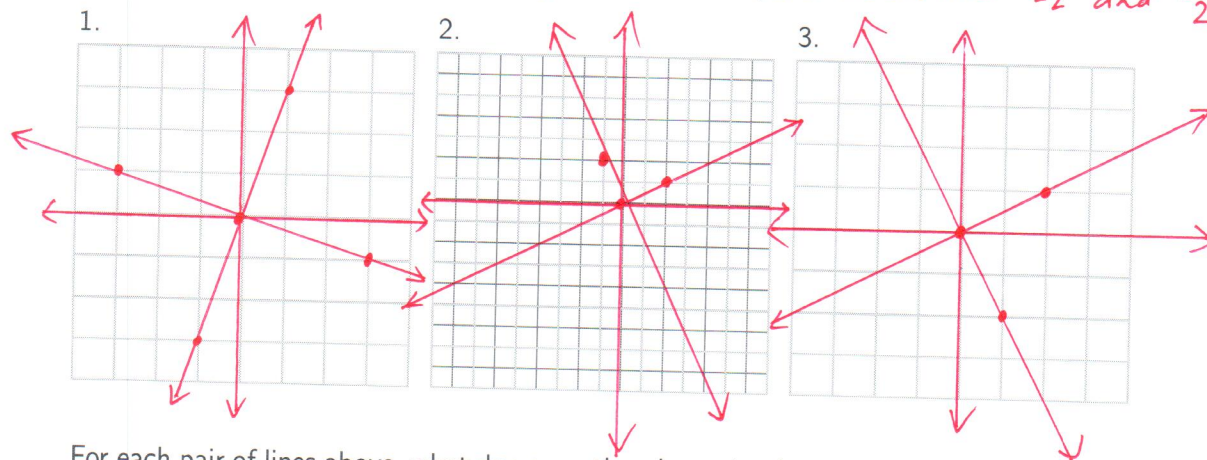
$3$  and  $-\frac{1}{3}$

- Find the equation of the line passing through the origin and the point  $(1, \frac{1}{2})$ . Also find the equation of the line passing through the origin and the point  $(-\frac{1}{2}, 1)$ . Plot the points and the two lines on the same coordinate grid. What are slopes of the two lines?

$\frac{1}{2}$  and  $-2$

- Find the equation of the line passing through the origin and the point  $(1, -2)$ . Also find the equation of the line passing through the origin and the point  $(2, 1)$ . Plot the points and the two lines on the same coordinate grid. What are slopes of the two lines?

$-2$  and  $\frac{1}{2}$



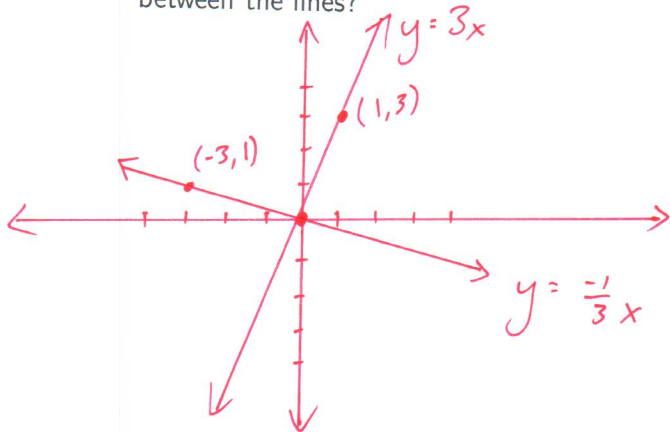
For each pair of lines above, what do you notice about the slopes of the lines. What do you notice about the angle between the lines?

slopes are negative reciprocals, angles are  $90^\circ$  (right angles)

EXPLORATION 2

*Answers will vary.*

1. Pick a point  $(1, m)$  for some positive  $m$  and plot it. Yes, you can choose any nonzero  $m$  that you want. Find the equation of the line passing through the origin and the point  $(1, m)$ . What is the slope of the line?  *$(y = mx)$   $y = 3x$  (slope is  $m$ ) slope is 3*
2. Locate the point  $(-m, 1)$  on the coordinate grid from part 1. Find the equation of the line passing through the origin and the point  $(-m, 1)$ . What is the slope of the line? Plot the line on the same coordinate grid.  *$y = -\frac{1}{3}x$  slope =  $-\frac{1}{3}$  ( $y = \frac{1}{m}x$ ) ( $-\frac{1}{m}$ )*
3. What do you notice about the slopes of the lines? What do you notice about the angle between the lines?

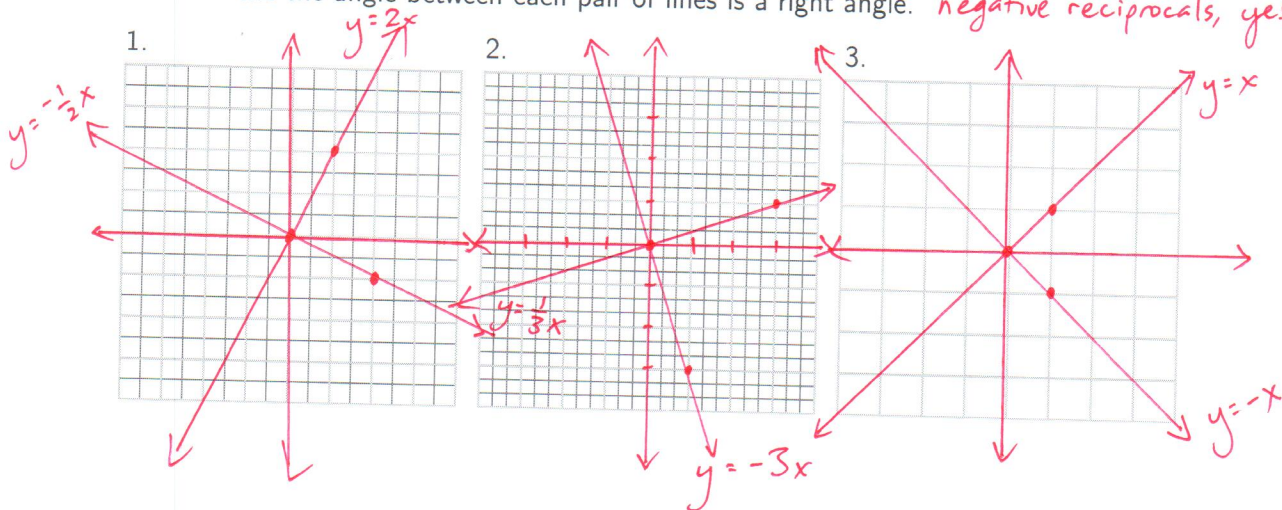


*slopes are negative reciprocals.*

*Angles are  $90^\circ$  (right angles)*

PROBLEM 1

1. Graph the lines given by the equations  $y = 2x$  and  $y = -\frac{1}{2}x$  on the same coordinate grid.
2. Graph the lines given by the equations  $y = \frac{1}{3}x$  and  $y = -3x$  on the same coordinate grid.
3. Graph the lines given by the equations  $y = -x$  and  $y = x$  on the same coordinate grid.
4. What do you notice about the slopes of the lines? Use the corner of a piece of paper to check that the angle between each pair of lines is a right angle. *negative reciprocals, yes.*



## PROBLEM 2

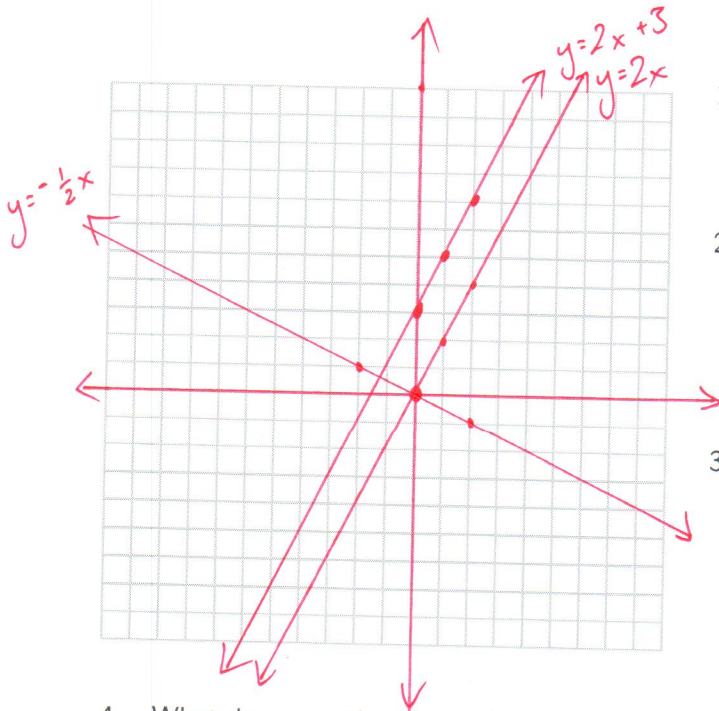
Find the equation of the line through the origin which is perpendicular to lines given by each of the following equations

1.  $y = 5x$   $y = -\frac{1}{5}x$  since  $-\frac{1}{5}$  is the negative reciprocal of 5
2.  $y = -\frac{1}{3}x$   $y = 3x$
3.  $y = -4x$   $y = \frac{1}{4}x$

## Lines Perpendicular to a Given Line and Through a Given Point

## EXPLORATION 5

Use a single coordinate grid for the following:



1. Graph the line given by the equation  $y = 2x + 3$ . What is its slope?  $m = 2$
2. Find the equation of the line parallel to the line given by  $y = 2x + 3$  which goes through the origin? What is its slope?  
 $y = 2x$   $m = 2$
3. Find the equation of the line which goes through the origin and is perpendicular to line you found in part 2? Graph the line. What is its slope?  $m = -\frac{1}{2}$   
 $y = -\frac{1}{2}x$
4. What do you notice about the graph of the line given by  $y = 2x + 3$  and the line you found in 3? What do you notice about the slopes?

They are perpendicular & the slopes are negative reciprocals.



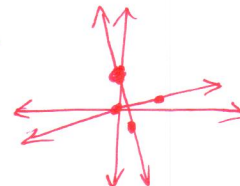
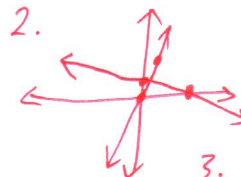
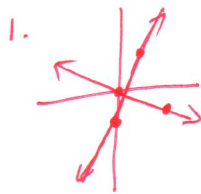
**PROBLEM 3**

Find the equation of the line through the origin which is perpendicular to lines given by each of the following equations. Make a graph of each pair of perpendicular lines.

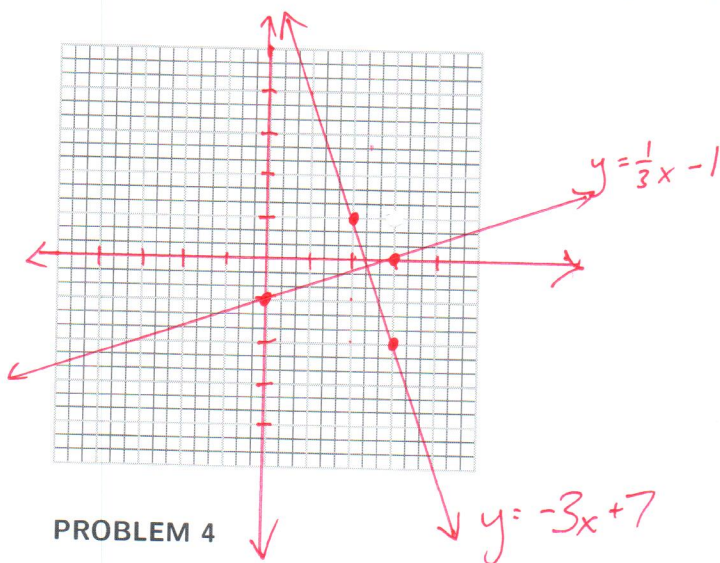
1.  $y = 5x - 2$   $y = -\frac{1}{5}x$

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

3.  $y = -4x + 3$   $y = \frac{1}{4}x$

**EXAMPLE 1**

Find the equation of the line which is perpendicular to the line given by  $y = \frac{1}{3}x - 1$  and passes through the point  $(2, 1)$ . Make a graph of the pair of perpendicular lines.



point:  $(2, 1)$   $m = -3$

point-slope form:  
 $(y - 1) = -3(x - 2)$

$$y - 1 = -3x + 6$$

$$y - 1 + 1 = -3x + 6 + 1$$

$$y = -3x + 7$$

**PROBLEM 4**

Find the equation of the lines which are perpendicular to the line given by  $y = -\frac{1}{2}x + 3$  and passes through the point:

1.  $(0, 0)$

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

2.  $(0, 3)$

3.  $(-2, 5)$

2.  $(y - 3) = 2(x - 0)$   
 $y - 3 = 2x$   
 $y = 2x + 3$

4.  $(3, 6)$

3.  $(y - 5) = 2(x - (-2))$

$$y - 5 = 2x + 4$$

$$y = 2x + 9$$

4.  $(y - 6) = 2(x - 3)$

$$y - 6 = 2x - 6$$

$$y - 6 + 6 = 2x - 6 + 6$$

$$y = 2x$$

**SUMMARY (What I learned today)**

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