

Module 1e: Right Angles in a Plane

Math Practice(s):

- Use appropriate tools strategically
- Attend to precision

Learning Target(s):

- Understand the relationship between and determine the slopes of perpendicular lines.

Homework:

HW #5: 1e #1-4

Warm-up

The slope of a line measures its steepness, and it can be computed by knowing only two points on the line.

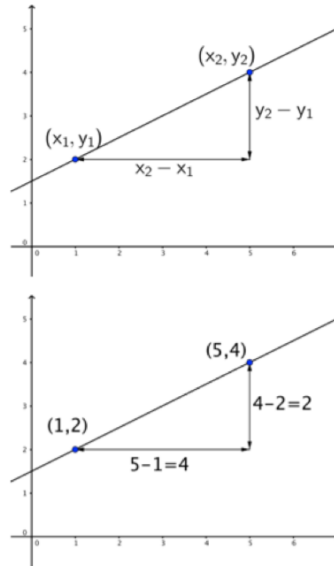
Slope (usually represented by m) is given by $m = \frac{\text{change in } y}{\text{change in } x}$

When given two points, (x_1, y_1) and (x_2, y_2) by $m = \frac{y_2 - y_1}{x_2 - x_1}$

For example, to determine the slope of the line containing the points $(1, 2)$ and $(5, 4)$, we compute the following ratio:

$$m = \frac{4 - 2}{5 - 1} = \frac{2}{4} = \frac{1}{2}$$

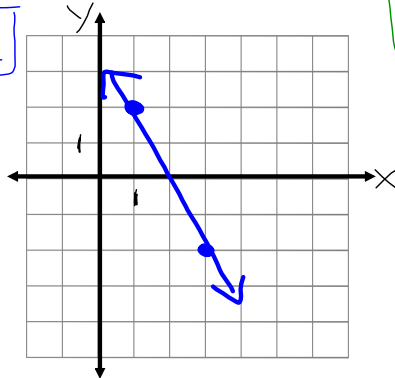
For each pair of points given, draw the line containing the two points, then determine its slope. Show how you used the slope formula to compute the slope. Be sure to draw and label the axes and scale used to create your graph.



1. $(1, 2)$ and $(3, -2)$
 $x_1, y_1 \quad x_2, y_2$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2 - 2}{3 - 1} = \frac{-4}{2}$$

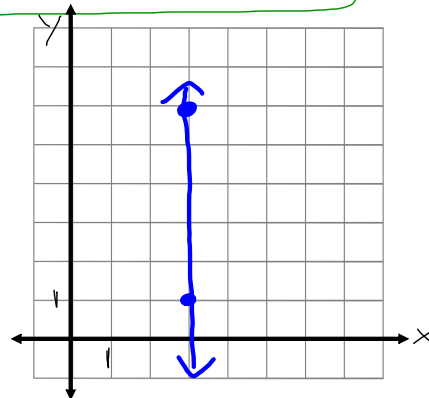
$m = -2$



2. $(3, 5)$ and $(3, 1)$
 $x_1, y_1 \quad x_2, y_2$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - 5}{3 - 3} = \frac{-4}{0}$$

slope is undefined

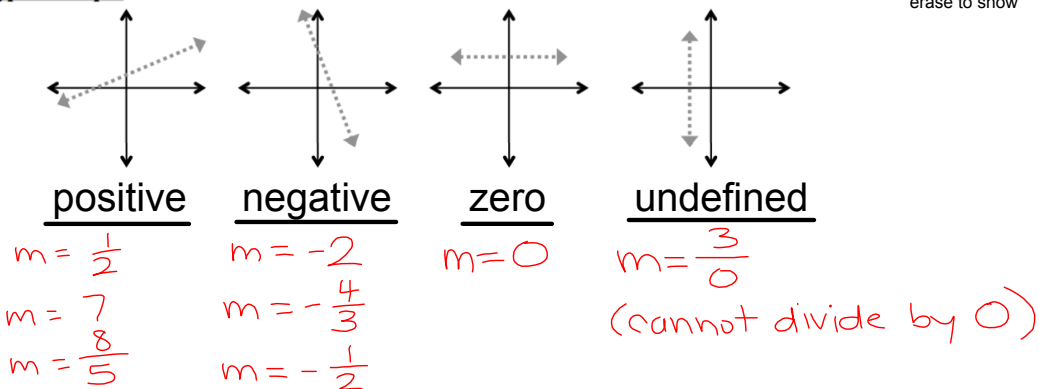


3. If a line has a slope of zero, what must be true about the line (i.e., what will the line look like)?

horizontal lines have zero slope

Types of Slopes

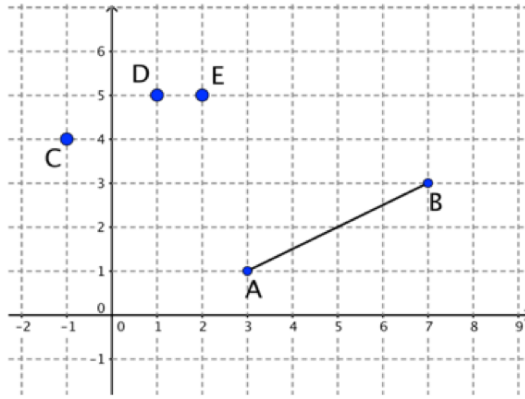
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Exploring the Slopes of Perpendicular Lines

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4. The coordinate plane shows a line segment, \overline{AB} , and three additional points: C , D , and E .



A. State the coordinates of the five points:

- A: $(3, 1)$
- B: $(7, 3)$
- C: $(-1, 4)$
- D: $(1, 5)$
- E: $(2, 5)$

B. Determine the slope of \overline{AB} .

$A(3, 1)$ $B(7, 3)$
 x_1, y_1 x_2, y_2

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - 1}{7 - 3} = \frac{2}{4} = \frac{1}{2}$$

C. In the coordinate plane above, use a straightedge to draw \overline{AC} , \overline{AD} , and \overline{AE} . Then, compute the slope of each segment.

Slope of \overline{AC} : -1	Slope of \overline{AD} : -2	Slope of \overline{AE} : -4
$A(3, 1) \quad C(-1, 4)$	$A(3, 1) \quad D(1, 5)$	$A(3, 1) \quad E(2, 5)$
$m = \frac{4 - 1}{-1 - 3}$	$m = \frac{5 - 1}{1 - 3}$	$m = \frac{5 - 1}{2 - 3}$
$m = \frac{3}{-4}$	$m = \frac{4}{-2}$	$m = \frac{4}{-1}$
$m = -\frac{3}{4}$	$m = -2$	$m = -4$

D. Which segment is perpendicular to \overline{AB} ? After measuring each $\angle A$ formed $\overline{AD} \perp \overline{AB}$ because they form a right \angle .

E. Compare the slope of \overline{AB} to the slope of the segment that is perpendicular to \overline{AB} . What do you notice about slopes of these two lines?

- rise & run are switched
- one is positive & the other is negative
- opposite, reciprocals.

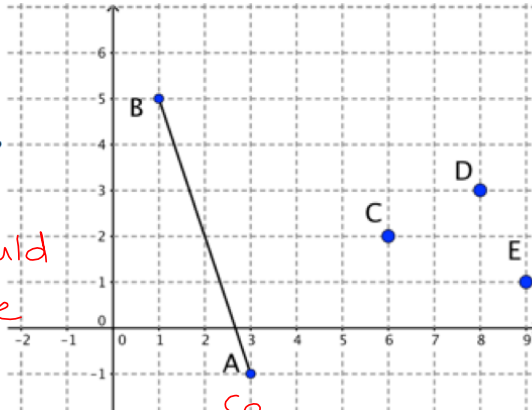
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If two lines in the coordinate plane are perpendicular, then their slopes are negative reciprocals.

Ex: $\frac{7}{4} \rightarrow -\frac{4}{7}$ $-5 = \frac{1}{\frac{1}{5}}$

Also, if one of the lines is horizontal (has a slope of 0), then the line perpendicular to it will be vertical (having an undefined slope).

5. The coordinate plane shows a line segment, \overline{AB} , and three additional points: C , D , and E .



- a. Using what you learned about the slope of perpendicular lines, determine which segment, \overline{AC} , \overline{AD} , or \overline{AE} will be perpendicular to \overline{AB} . Show how you determined your answer.

$m_{\overline{AB}} = -3$ (\perp line should have slope of $\frac{1}{3}$)

① Determine the slope of each segment, & identify which has a negative, reciprocal slope to -3 .

$m = \frac{6}{-2} = -3$

\overline{AE} has a slope of $\frac{1}{3}$, so $\overline{AE} \perp \overline{AB}$.

- b. State the vertices that form a right triangle, then name the triangle using appropriate symbols.

$B, A, \& E \rightarrow \triangle BAE$

6. If \overline{KL} is graphed in a coordinate plane such that its slope is $m = 4$, what is the slope of any line that is perpendicular to \overline{KL} ?

negative, reciprocal of 4 \rightarrow $\left(\frac{1}{4}\right)$

7. If \overline{GR} is graphed in a coordinate plane such that its slope is $m = -\frac{5}{6}$, what is the slope of any line that is perpendicular to \overline{GR} ?

negative, reciprocal of $-\frac{5}{6}$ \rightarrow $\left(\frac{6}{5}\right)$

8. If a line goes through the points $(-2, 1)$ and $(3, 8)$, what is the slope of a line that is perpendicular to it?

① Find slope of line given by $(-2, 1)$ & $(3, 8)$.

$$m = \frac{8-1}{3-(-2)} = \frac{7}{5}$$

② The negative reciprocal of $\frac{7}{5}$ is $-\frac{5}{7}$, so a perpendicular line will have a slope of $-\frac{5}{7}$.

9. What is the slope of a line that is perpendicular to the graph of $y = -4x + 3$?

Slope of line is -4 , so a \perp line will have a slope of $\frac{1}{4}$.

$$y = mx + b$$

$$m = \text{slope}$$

$$b = y\text{-int}$$

10. Is the triangle with vertices at the origin, $(-2, 3)$, and $(6, 4)$ a right triangle? Use slopes to justify your answer. *Grid provided is optional.

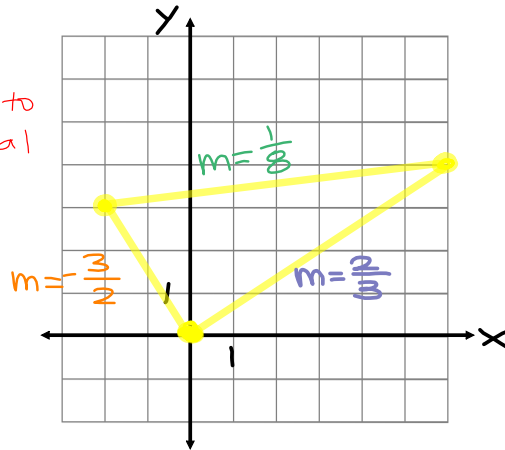
(to be a right Δ , 2 sides must be \perp , which means they need to have negative reciprocal slopes).

① Find slope of each side.

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

$$\frac{4-0}{6-0} = \frac{4}{6} = \frac{2}{3}$$

$$\frac{4-3}{6-(-2)} = \frac{1}{8}$$



② Compare slopes.

Since $-\frac{3}{2}$ & $\frac{2}{3}$ are negative reciprocals, those sides are \perp , & their intersection forms a right \angle .

Since this Δ has a right \angle , it is a right Δ .

