Notes Section 2.1 – Equations of Lines

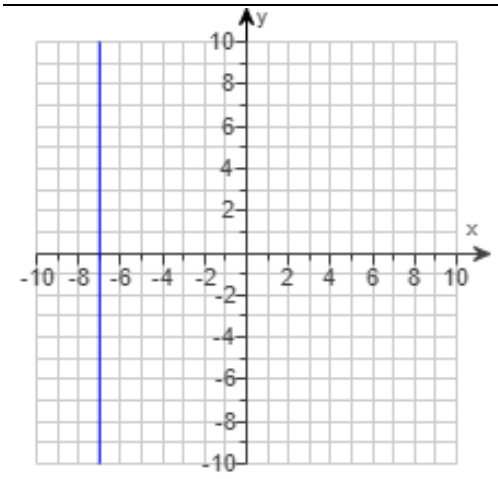
Lesson Objectives

1. Vertical and Horizontal Lines
2. Find equation of a line given its slope and a point (not *y*-intercept)
3. Find equation of a line given two points
4. Find equation of a line through a given point that is parallel or perpendicular to a given line

A. Vertical and Horizontal Lines

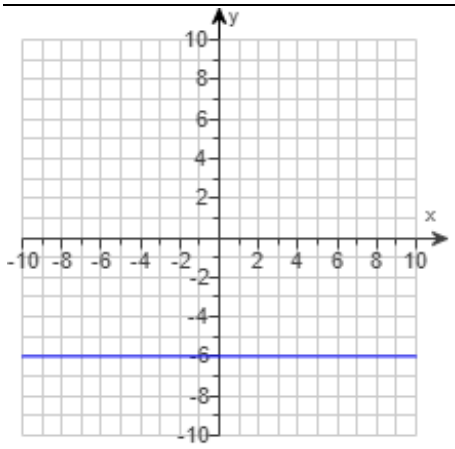
1. Vertical Lines

- Have _____ slope
- Pass through the ___**-AXIS**
- Are written in the form: _____, where *a* is some constant (number)
- *a* is the *x*-intercept, located at $(a, 0)$.
- **EXAMPLE:** Find the slope of the line in the figure. If the slope is undefined, so state. Then write an equation of the given line. [*Woodbury 3.3.37]
  This is a VERTICAL line, so the slope of the line is _____.
  Since it passes through the ***x*-AXIS** at **– 7**, then the equation is _____



2. Horizontal Lines

- Have _____ slope
- Pass through the _____**-AXIS**
- Are written in the form: _____, where *b* is some constant (number)
- *b* is the *y*-intercept, located at $(0, b)$
- **EXAMPLE:** Determine the equation of the given line, as well as the slope of the line. If the slope is undefined, state this. [*Woodbury 3.3.39]
  This line passes through the ***y*-AXIS** at **– 6**, so the equation of the line is _____.
  Since this is a **HORIZONTAL** line, the slope is _____.



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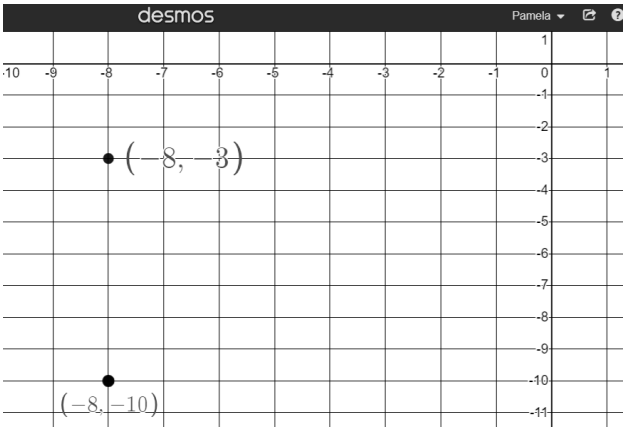
3. Other examples with horizontal and vertical lines

- **EXAMPLE:** Write an equation for the line passing through the given pair of points.
  $(-8,-3)$ and $(-8,-10)$. [2.1-14]

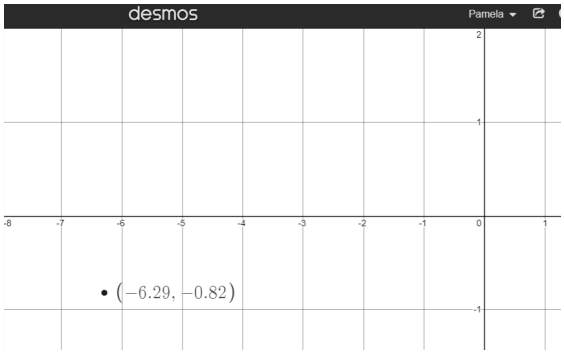
  Always examine your given points before you do any math with them.
  What do you notice? The **___-coordinates** are _____.
  The equation of the line, therefore, is simply _____.
  Recommend you make a quick _____ of this situation to help you understand it better.



Notice that the **red** line through those points
passes through the *x*-axis at $\boldsymbol{x = -8}$.

- **EXAMPLE:** Find the equation of the line satisfying the following conditions.
  If possible, write the equation in slope-intercept form.
  Vertical, passing through $(-6.29,-0.82)$ [2.1-24]

  Vertical lines are of the form _____
  Simply use the ____-coordinate of the through-point, so the equation is _____.
  Recommend you make a quick SKETCH of this situation to help you understand it better.



Notice that the **red** vertical line passes through
the *x*-axis at the SAME *x*-coordinate: $\boldsymbol{x = -6.29}$.

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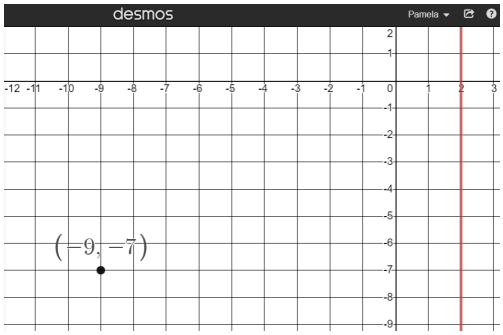
- **EXAMPLE:** Determine the equation of the line described. Put the answer in slope-intercept form, if possible. Through $(-9, -7)$ perpendicular to $x = 2$. [2.1-35]

  A line perpendicular to $x = a$ (vertical line) is a line of the form _____ (horizontal line).
  So, use the ____**-coordinate** of the through-point. The equation is: _____**.**
  Recommend you make a quick SKETCH of this situation to help you understand it better.



Notice that the line $x = 2$ is shown in **red**.
The line perpendicular to it that passes through $(-9, -7)$
is the **purple** line passing through the *y*-axis at $y = -7$.

B. Find equation of a line given its slope and a point (not y-intercept)

- **EXAMPLE:** Find an equation of the line that has the given slope and contains the given point. If possible, write the equation in slope-intercept form. Check that the ordered pair that represents the given point satisfies the equation. $m = \frac{7}{4}, (3, -4)$ [*Lehmann 5.4.7]

  [SOLUTION] Use the _____ _____ formula: _____
  In words, this also means: ***y*-coordinate = slope (*x*-coordinate) + *y*-intercept**

  Substitute all the given values: $y = mx + b$

  Simplify:

  Solve for *b*:

  Update:

  So, the equation is: $y =$

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C. Find Equation of Line Given Two Points

- **EXAMPLE:** Write an equation in slope-intercept form for the line described.
  x-intercept $(-4, 0)$, *y*-intercept $(0,5)$ [2.1.9]

  First, you need the _____, so use the slope formula.
  $m = \frac{y_2 - y_1}{x_2 - x_1} =$

  Next, you need the ____-_____, which is given $(0,5)$, so _____

  So the equation of the line is: $\boldsymbol{y} =$ _____

- **EXAMPLE:** Find an equation of the line containing the given pair of points.
  $(-1, -4)$ and $(-7, -8)$ [2.1.23]

  First, you need the _____, so use the slope formula.
  $m = \frac{y_2 - y_1}{x_2 - x_1} =$ _____ $=$ — $=$ — Equation so far: $y =$
  Next, you need the ___-_____, which is _____ one of the two given points.
  Use the **SLOPE-INTERCEPT** formula: $\boldsymbol{y} =$ _____, and choose _____ point.

Either way works - you'll get the same value for *b* choosing either point.	
Using $(-1, -4)$ and $m = \frac{2}{3}$	**Using $(-7, -8)$ and $m = \frac{2}{3}$**
$y = mx + b$	$y = mx + b$

Finally, write your equation using your *m* and *b*: $\boldsymbol{y} =$

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D. Parallel or Perpendicular Lines

1. Parallel lines have _____ slope (m), different y-intercept (b)

- **EXAMPLE:** Find the slope-intercept form of the line parallel to $-2x + 3y = 6$ and passing through the point $(-3, -4)$. [2.1.45]

Given line: $-2x + 3y = 6$. This is in _____ form: _____

We need it in **SLOPE-INTERCEPT** form: $y = mx + b$, so we can know its SLOPE (m).

We need to convert the given equation. This is a VERY important skill you need to know how to do – it will occur in later sections as well!

Given line: $-2x + 3y = 6$ The goal is to get y by itself: y = (all the other stuff)
Add $2x$:
Simplify:
Divide by 3:

Simplified: This is *still* the *original* line – not the answer!

Slope of *GIVEN* line: $\boldsymbol{m} =$

Need _____ (same slope), so slope of *NEW* line: $\boldsymbol{m} =$

Equation so far: $y =$ We still need the y-intercept, b.

Use through-point (,) with slope $\boldsymbol{m} =$ ___ and plug into $y = mx + b$:
$y = mx + b$ (x , y)

Finally, write your equation using your m and b:
The equation of the new PARALLEL line is: $\boldsymbol{y} =$

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2. Perpendicular Lines have _____ _____ slopes
   "switch" sign **&** **"flip" fraction**

- **EXAMPLE:** Write the equation of the line containing the given point and perpendicular to the given line. Express your answer in the form $y = mx + b$. [2.1.43]
  $(4, 6)$; $4x + y = 5$

  Given line: $4x + y = 5$ is in standard form.
  Convert to slope-intercept form to know its slope.

  Given line: $4x + y = 5$ The goal is to get *y* by itself: *y* = (all the other stuff)
  Subtract 4*x*:
  Simplified: $y =$_____ This is *still* the *original* line – not the answer!

  Slope of given line: $\boldsymbol{m} =$ _____ Not done – don't use this slope in the *NEW* equation!

  Need: _____ (OPPOSITE RECIPROCAL)

  _____ sign and _____ fraction.

  Convert given slope $= -\mathbf{4}$:
  Opposite (**Switch**): $m =$ _____ now do reciprocal (**Flip**): $m =$ —

  Slope of the **NEW** line is $m =$ Equation so far: $y =$

  Use through-point (,) with slope $\boldsymbol{m} =$ ___ and plug into $y = mx + b$:
  $y = mx + b$ (x , y)

_____ $= \boldsymbol{b}$ Finally, write your equation using your *m* and *b*:
The equation of the PERPENDICULAR line is: $\boldsymbol{y} =$

Sources used:
1. Desmos website: www.desmos.com
2. Pearson MyLab Math *College Algebra with Modeling and Visualization, 6th Edition*, Rockswold
3. Pearson MyLab Math *Elementary and Intermediate Algebra: Functions and Authentic Apps, 2nd Edition*, Lehmann
4. Pearson MyLab Math *Elementary and Intermediate Algebra, 3rd Edition*, Woodbury.
5. Wabbitemu calculator emulator version 1.9.5.21 by Revolution Software, BootFree ©2006-2014 Ben Moody, Rom8x ©2005-2014 Andree Chea. Website https://archive.codeplex.com/?p=wabbit