# **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

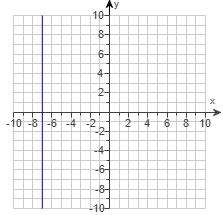
# Vertical and Horizontal Lines

## **Vertical** Lines

* Have **UNDEFINED** slope
* Pass through the ***x*-AXIS**
* Are written in the form: where *a* is some constant (number)
* *a* is the *x*-intercept, located at .
* **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 **UNDEFINED**.

Since it passes through the ***x*-AXIS** at **– 7**, then the equation is

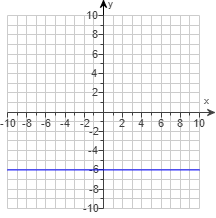


## **Horizontal** Lines

* Have **ZERO** slope
* Pass through the ***y*-AXIS**
* Are written in the form: , where *b* is some constant (number)
* *b* is the *y*-intercept, located at
* **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 **ZERO**.



## Other examples with horizontal and vertical lines

* **EXAMPLE:** Write an equation for the line passing through the given pair of points.

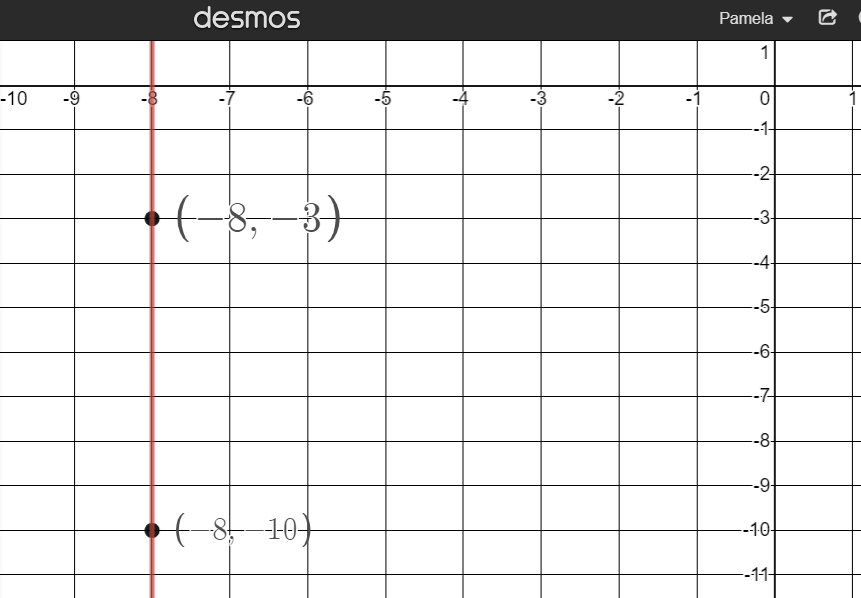
and . [2.1-14]

Always examine your given points before you do any math with them.

What do you notice? The ***x*-coordinates** are **the same**.

The equation of the line, therefore, is simply .

Recommend you make a quick SKETCH of this situation to help you understand it better.



Notice that the **red** line through those points

passes through the *x*-axis at .

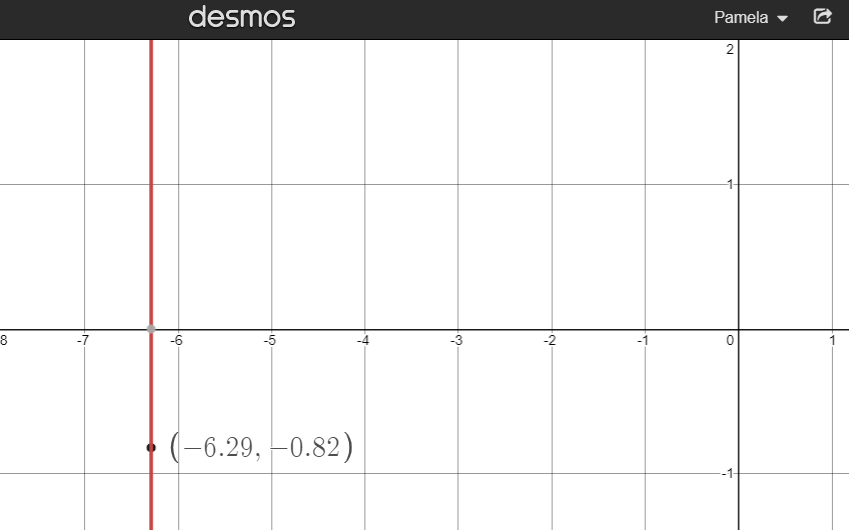
* **EXAMPLE:** Find the equation of the line satisfying the following conditions.  
  If possible, write the equation in slope-intercept form.

Vertical, passing through [2.1-24]

Vertical lines are of the form

Simply use the ***x***-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

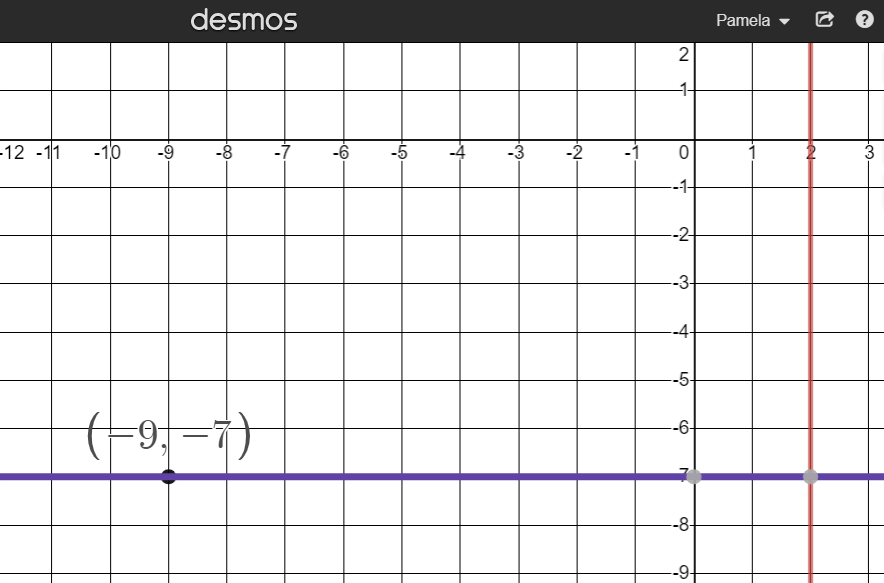
the *x*-axis at the SAME *x*-coordinate: .

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

A line perpendicular to (vertical line) is a line of the form (horizontal line)

So, use the ***y*-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 is shown in **red**.

The line perpendicular to it that passes through

is the **purple** line passing through the *y*-axis at **.**

# 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. [\*Lehmann 5.4.7]

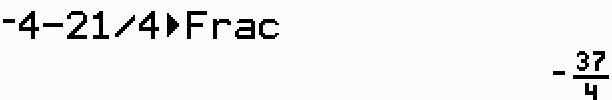
[SOLUTION] Use the **SLOPE-INTERCEPT** formula:

In words, this also means: ***y*-coordinate = slope (*x*-coordinate) + *y*-intercept**

Substitute all the given values:

Simplify:

Solve for *b*:



Update:

So, the equation is:

# Find Equation of Line Given Two Points

* **EXAMPLE:** Write an equation in slope-intercept form for the line described.

*x*-intercept , *y*-intercept [2.1.9]

First, you need the **SLOPE**, so use the slope formula.

Next, you need the ***y*-INTERCEPT**, which is given , so

So the equation of the line is:

* **EXAMPLE:** Find an equation of the line containing the given pair of points.

and [2.1.23]

First, you need the **SLOPE**, so use the slope formula.

Equation so far:

Next, you need the ***y*-intercept**, which is not one of the two given points.

Use the **SLOPE-INTERCEPT** formula: , and choose either point.

|  |  |
| --- | --- |
| Either way works - you’ll get the same value for *b* choosing either point. | |
| **Using and** | **Using and** |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

Finally, write your equation using your *m* and *b*:

# Parallel or Perpendicular Lines

## **Parallel** lines have **SAME** slope (*m*)

* **EXAMPLE:** Find the slope-intercept form of the line parallel to   
  and passing through the point . [2.1.45]

Given line: . This is in **STANDARD** form: .

We need it in **SLOPE-INTERCEPT** form: , 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: The goal is to get *y* by itself: *y* = (all the other stuff)

Add 2*x*:

Simplify:

Divide by 3:

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

Slope of *GIVEN* line:

Need **PARALLEL** (same slope), so slope of *NEW* line:

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

Use through-point with slope and plug into :

Finally, write your equation using your *m* and *b*:

The equation of the new PARALLEL line is:

## **Perpendicular Lines** have **OPPOSITE RECIPROCAL** 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 . [2.1.43]

;

Given line: is in standard form.

Convert to slope-intercept form to know its slope.

Given line: The goal is to get *y* by itself: *y* = (all the other stuff)

Subtract 4*x*:

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

Slope of *GIVEN* line: Not done – don’t use this slope in the *NEW* equation!

Need: **PERPENDICULAR** (OPPOSITE RECIPROCAL)

**Switch** signand **Flip** fraction.

Convert given slope :

Opposite (**Switch**): now do reciprocal (**Flip**):

Slope of the *NEW* line is **.** Equation so far:

Use through-point with slope and plug into

Finally, write your equation using your *m* and *b*:

The equation of the PERPENDICULAR line is: .

Sources used:

1. Desmos website: [www.desmos.com](http://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>