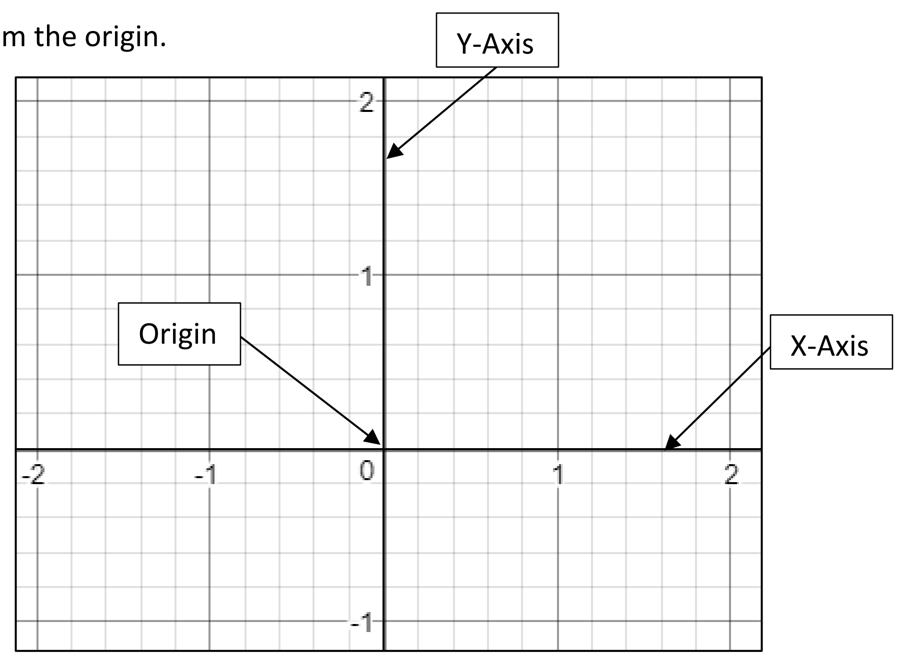
Graphing Linear Equations

Linear equations are used to form straight lines on a graph. The ability to graph a linear equation is essential to understanding and analyzing information. This handout will discuss the coordinate plane, how to plot points on the coordinate plane, and how to graph a linear equation in slope-intercept form.

You can navigate to specific sections of this handout by clicking the links below.

The Coordinate Plane

The coordinate plane is a two-dimensional tool used to graph linear equations. It consists of a vertical line called the y-axis and a horizontal line called the x-axis. The point where the two lines intersect is called the origin, and all vertical and horizontal distances are plotted by counting units from the origin.



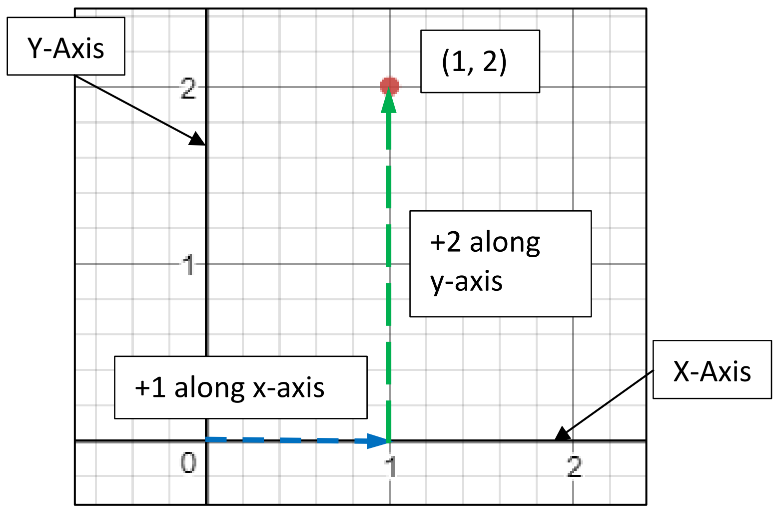
Once a coordinate system is established, points can be plotted that will provide the basis for graphing a line. A point is written in the format (x-value, y-value), which is known as an ordered pair. The x-value is the point's distance from the origin in the x direction (horizontally), and the y-value is the point's distance from the origin in the y direction (vertically).

Example: Plot the point (1, 2).

Step 1: Find the distance from the origin along the x axis.

Step 2: Find the distance from the origin along the y axis.

Step 3: Plot the point +1 horizontally and +2 vertically.



Graphing Linear Equations Using Points

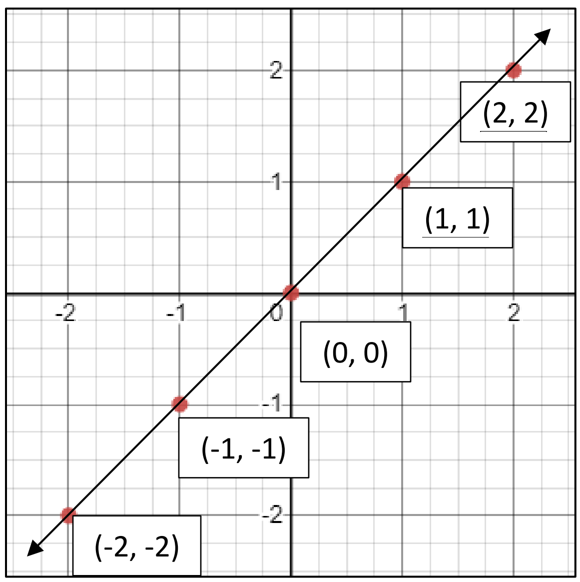
In order to graph a linear equation, at least two points on the line must be found. By plugging in the x-value and solving for the y-value, a chart of ordered pairs can be created.

Example: Graph the linear equation $y = x$

Step 1: To find points on the line, begin by substituting a value for x to obtain a value for y; these two values create an ordered pair. It is typically easier to work with small integers. For instance, in this example, when the x-value equals -2 in the equation, the y-value equals -2. Therefore, the first ordered pair is (-2, -2). Substituting in the x-values -1, 0, 1, and 2 will result in the following table of ordered pairs:

X	Y
-2	-2
-1	-1
0	0
1	1
2	2

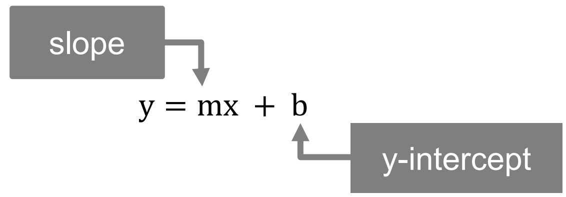
Step 2: Plot the points of the table found in the previous step, and draw a line through them.



Notice that a line drawn through any two graphed points will also go through the rest of the graphed points. This means that only two points are needed to graph a line. If it is known that the points (0, 1) and (2, 2) are solutions to the linear equation $y = \frac{1}{2}x + 1$, then the rest of the equation's solutions can be graphed by drawing a line that passes through these two points.

Slope-Intercept Form

Slope-intercept form is one way to graph linear equations and is represented with the formula $\mathrm{y = mx + b}$. In the equation, the "m" represents the slope, and the "b" represents the y-intercept.

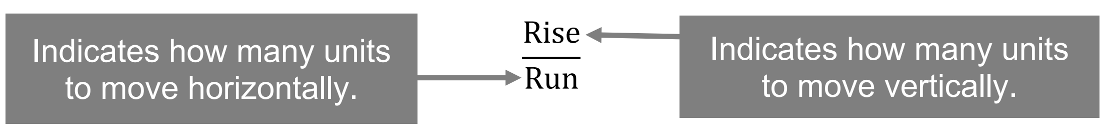


Y-Intercept

The y-intercept is useful when graphing a linear equation because it provides a starting point to begin graphing. In order to plot the y-intercept point, it must be written as the ordered pair (0, b), where b is the value taken from the given slope-intercept equation.

Slope

The slope value of a linear equation indicates vertical and horizontal movement from a known point in order to plot a second point. The slope must be written as a fraction with the numerator corresponding to a vertical movement and the denominator corresponding to a horizontal movement on the coordinate plane. Instructors and textbooks often use the terminology "Rise over Run" as shown below:



Example 1: Graph the linear equation $y = 2x + 3$.

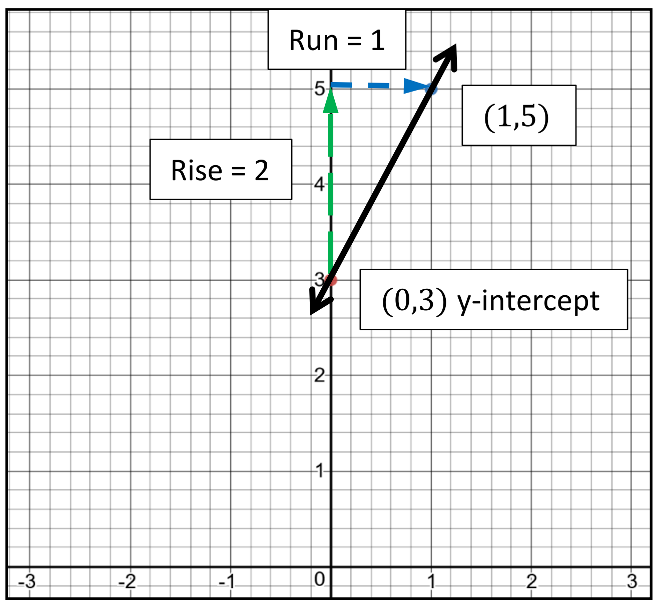
Step 1: Identify the ordered pair for the y-intercept. Since the given y-intercept value (b) in this equation is 3, the ordered pair for the y-intercept is (0, 3).

Step 2: Identify the slope value, and translate it into its fractional form. The slope value in this equation is the whole number 2, so it must be written as a fraction:

$$2 = \frac{2}{1}$$

Following the terminology “Rise over Run,” the 2 is the “rise,” and the 1 is the “run.”

Step 3: Plot the y-intercept, and use the slope to plot a second point. After plotting the y-intercept (0, 3), rise 2 units in the positive y direction, and run one unit in the positive x direction to plot the next point (1, 5). Then, connect the points with a line.



In the example, the slope value is positive; therefore, the position of the second point is plotted vertically on the y-axis and to the right on the x-axis.

Example 2: Graph the linear equation:

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

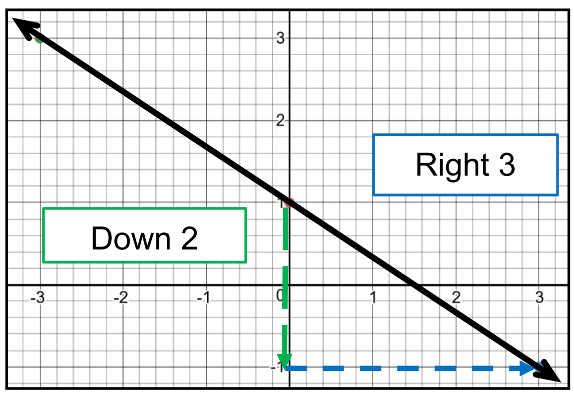
Step 1: Find the y-intercept, which is (0, 1).

Step 2: Identify the slope value, and translate it into its fractional form. The slope value in this equation is the fraction $-\frac{2}{3}$. When dealing with a negative slope, the negative must be applied to the numerator of the fraction:

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

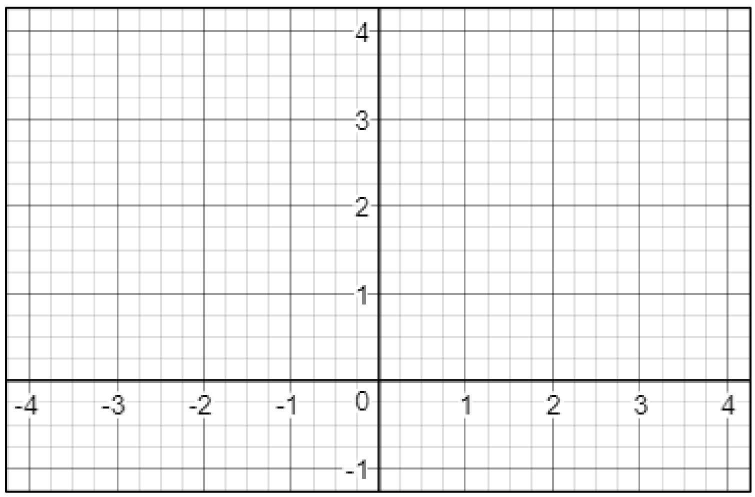
Step 3: Plot the y-intercept, then proceed 2 units down in the negative y direction, and 3 units right in the positive *x* direction. This gives the second point: (3,-1).

Slope $\frac{-2}{3}$

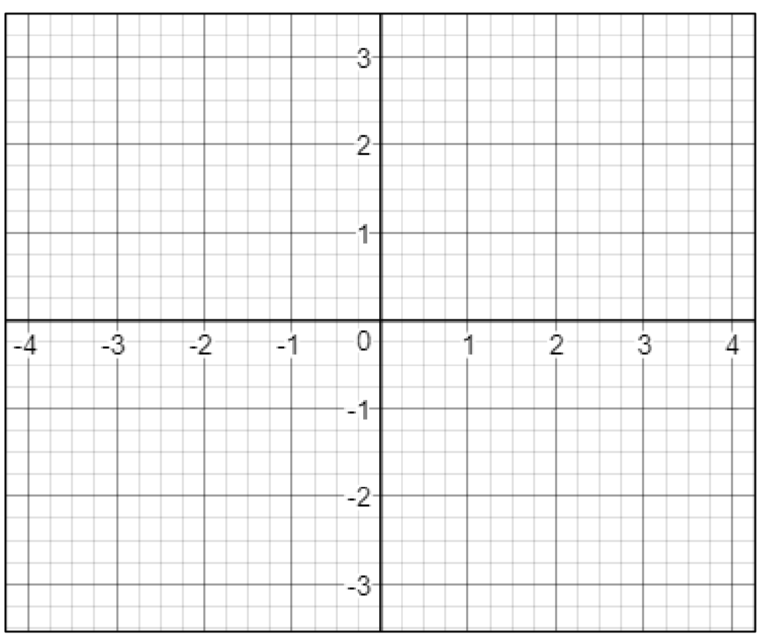


Practice Problems

Problem 1: Graph the Linear Equation $y = \frac{1}{2}x + 1$.



Problem 2: Graph the Linear Equation $y = -2x$.



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Practice Problems Solutions

Problem 1: Graph the Linear Equation $y = \frac{1}{2}x + 1$.

Step 1: Obtain the y-intercept.

$y = \frac{1}{2}x + \boxed{1}$

(0, 1)

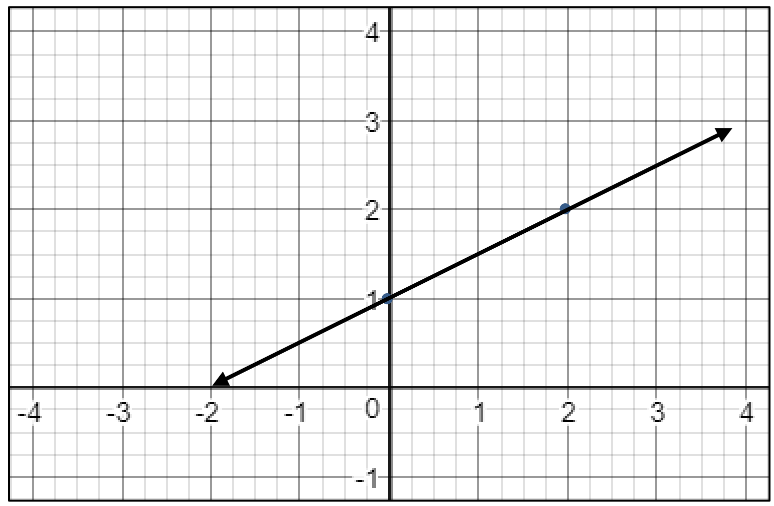
Step 2: Plot the y-intercept.

Step 3: Obtain the slope.

Slope = $\frac{1}{2}$

Step 4: Rise 1 and Run 2 from the y-intercept to plot the next point.

Step 5: Connect both points with a line.



Problem 2: Graph the Linear Equation $y = -2x$.

Step 1: Obtain the y-intercept.

$y = -2x + \boxed{0}$

(0, 0)

Step 2: Plot the y-intercept.

Step 3: Obtain the slope.

Slope = -2

Step 4: Use the slope to determine the rise. and run.

Rise = -2 and Run = 1

Step 5: Connect both points with a line.