## Standard Form

$$Ax + By = C$$

Every point on the y-axis has an x-value of 0.

To find the y-intercept, plug-in 0 for x.
(cover the x and solve)

$$(0, \underline{\quad})$$

Every point on the x-axis has a y-value of 0.

To find the x-intercept plug-in 0 for y.
(cover the y and solve.)

$$(\underline{\quad}, 0)$$

## Slope - Intercept Form

$$y = mx + b$$

Start with (0, b)
* y - intercept *

Use the slope for more points

$$\frac{\Delta y}{\Delta x}$$

## Lesson 19: The Graph of a Linear Equation in Two Variables Is a Line

### Classwork

**Exercises**

**THEOREM:** The graph of a linear equation $y = mx + b$ is a non-vertical line with slope $m$ and passing through $(0, b)$, where $b$ is a constant.

1. Prove the theorem by completing parts (a)–(c). Given two distinct points, $P$ and $Q$, on the graph of $y = mx + b$ and let $l$ be the line passing through $P$ and $Q$. You must show the following:

   (1) Any point on the graph of $y = mx + b$ is on line $l$, and

   (2) Any point on the line $l$ is on the graph of $y = mx + b$.

   a. Proof of (1): Let $R$ be any point on the graph of $y = mx + k$. Show that $R$ is on $l$. Begin by assuming it is not. Assume the graph looks like the diagram below where $R$ is on $l'$.
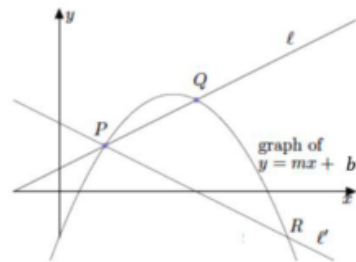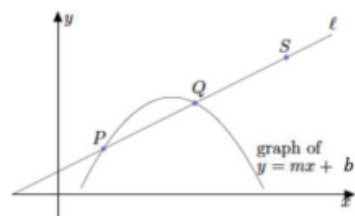


   What is the slope of line $l$?

What is the slope of line $l'$?

What can you conclude about lines $l$ and $l'$?  Explain.

b.　Proof of (2):  Let $S$ be any point on line $l$, as shown.



Show that $S$ is a solution to $y = mx + b$.  Hint:  Use the point $(0, b)$.

c.  Now that you have shown that any point on the graph of $y = mx + b$ is on line $l$ in part (a), and any point on line $l$ is on the graph of $y = mx + b$ in part (b), what can you conclude about the graphs of linear equations?

2.  Use $x = 4$ and $x = -4$ to find two solutions to the equation $x + 2y = 6$. Plot the solutions as points on the coordinate plane, and connect the points to make a line.

a.  Identify two other points on the line with integer coordinates. Verify that they are solutions to the equation $x + 2y = 6$.
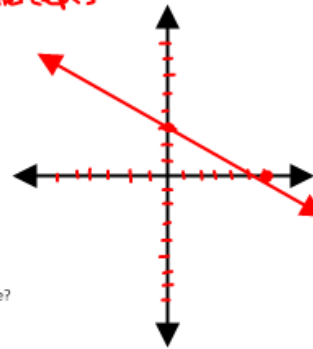
Standard Form → Look for Intercepts

x-Int.
$x = 6$
$(6, 0)$

y-Int.
$2y = 6$
$y = 3$
$(0, 3)$



b.  When $x = 1$, what is the value of $y$? Does this solution appear to be a point on the line?

c.  When $x = -3$, what is the value of $y$? Does this solution appear to be a point on the line?

d.  Is the point $(3, 2)$ on the line?

e.  Is the point $(3, 2)$ a solution to the linear equation $x + 2y = 6$?

3.  Use $x = 4$ and $x = 1$ to find two solutions to the equation $3x - y = 9$.  Plot the solutions as points on the coordinate plane, and connect the points to make a line.

   a.  Identify two other points on the line with integer coordinates.  Verify that they are solutions to the equation $3x - y = 9$.  **Standard Form - Intercepts**

   **x-int**
   $3x = 9$
   $x = 3$
   **(3, 0)**

   **y-int.**
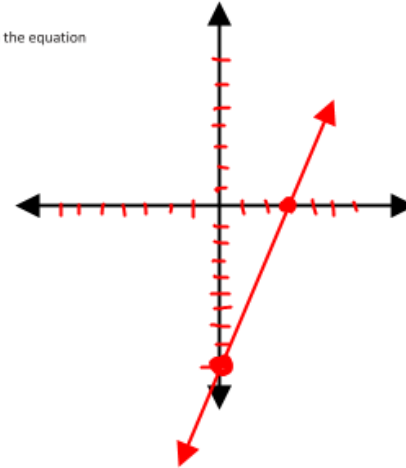   $-y = 9$
   $y = -9$
   **(0, -9)**

   b.  When $x = 4.5$, what is the value of $y$?  Does this solution appear to be a point on the line?

   c.  When $x = \frac{1}{2}$, what is the value of $y$?  Does this solution appear to be a point on the line?

   d.  Is the point $(2, 4)$ on the line?

   e.  Is the point $(2, 4)$ a solution to the linear equation $3x - y = 9$?

4.  Use $x = 3$ and $x = -3$ to find two solutions to the equation $2x + 3y = 12$.  Plot the solutions as points on the coordinate plane, and connect the points to make a line.

   a.  Identify two other points on the line with integer coordinates.  Verify that they are solutions to the equation $2x + 3y = 12$.

   b.  When $x = 2$, what is the value of $y$?  Does this solution appear to be a point on the line?

c.  When $x = -2$, what is the value of $y$?  Does this solution appear to be a point on the line?

d.  Is the point $(8, -3)$ on the line?

e.  Is the point $(8, -3)$ a solution to the linear equation $2x + 3y = 12$?

5.  Use $x = 4$ and $x = -4$ to find two solutions to the equation $x - 2y = 8$.  Plot the solutions as points on the coordinate plane and connect the points to make a line.

a.  Identify two other points on the line with integer coordinates.  Verify that they are solutions to the equation $x - 2y = 8$.

b.  When $x = 7$, what is the value of $y$?  Does this solution appear to be a point on the line?

c.  When $x = -3$, what is the value of $y$?  Does this solution appear to be a point on the line?

   d.   Is the point $(-2, -3)$ on the line?

   e.   Is the point $(-2, -3)$ a solution to the linear equation $x - 2y = 8$?

6.   Based on your work in Exercises 2–5, what conclusions can you draw about the points on a line and solutions to a linear equation?

7.   Based on your work in Exercises 2–5, will a point that is not a solution to a linear equation be a point on the graph of a linear equation?  Explain.

8.   Based on your work in Exercises 2–5, what conclusions can you draw about the graph of a linear equation?

9.  Graph the equation $-3x + 8y = 24$ using intercepts.

10.  Graph the equation $x - 6y = 15$ using intercepts.

11.  Graph the equation $4x + 3y = 21$ using intercepts.

### Lesson Summary

The graph of a linear equation is a line.  A linear equation can be graphed using two-points:  the $x$-intercept and the $y$-intercept.

Example:

Graph the equation: $2x + 3y = 9$.

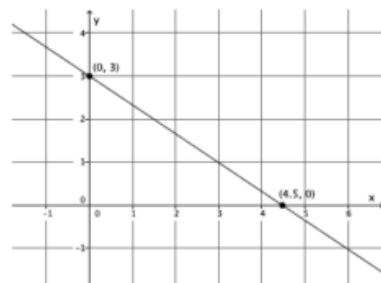Replace $x$ with zero and solve for $y$ to determine the $y$-intercept.

$$2(0) + 3y = 9$$
$$3y = 9$$
$$y = 3$$

The $y$-intercept is at $(0, 3)$.

Replace $y$ with zero and solve for $x$ to determine the $x$-intercept.

$$2x + 3(0) = 9$$
$$2x = 9$$
$$x = \frac{9}{2}$$

The $x$-intercept is at $\left(\frac{9}{2}, 0\right)$.

## Problem Set

Graph each of the equations in the Problem Set on a different pair of $x$ and $y$ axes.

1. Graph the equation: $y = -6x + 12$.    Slope–Intercept

2. Graph the equation: $9x + 3y = 18$.    Standard

3. Graph the equation: $y = 4x + 2$.    Slope–Intercept

4. Graph the equation: $y = -\frac{5}{7}x + 4$.    Slope–Intercept

5. Graph the equation: $\frac{3}{4}x + y = 8$.    Standard

6. Graph the equation: $2x - 4y = 12$.    Standart

7. Graph the equation: $y = 3$. What is the slope of the graph of this line?    HOY

8. Graph the equation: $x = -4$. What is the slope of the graph of this line?    VUX

9. Is the graph of $4x + 5y = \frac{3}{7}$ a line? Explain.

10. Is the graph of $6x^2 - 2y = 7$ a line? Explain.