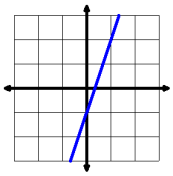
Section 4.4 Objectives

- Graph horizontal and vertical lines given the equation of the line.
- Graph linear equations given in slope-intercept form.
- Graph linear equations in standard form by rewriting them in slope-intercept form.
- Graph linear equations in standard form by determining and plotting the x and y intercepts.
- Solve systems of linear equations by graphing.

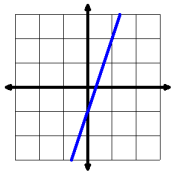
SECTION 4.4 Graph of a Line

INTRODUCTION

In the last section, you learned to write the equations of lines. If the problem showed the **graph** of a line, you were able to write the **equation** of the line as the answer to the problem. Recall this type of problem as shown below *(without work shown)*.

PROBLEM: Graph of Line	**ANSWER**: Equation of Line
	$y = 3x - 1$

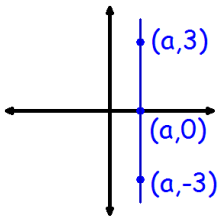
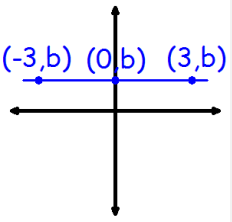
In this new section, you will do the opposite. In other words, the problem will give you the **equation** of the line, and you will be asked to **graph** the line as the answer. So, the "Problem" and "Answer" are reversed. Look at this new type of problem below *(without work shown.)*

PROBLEM: Equation of Line	**ANSWER**: Graph of Line
$y = 3x - 1$	

Now you will be given the equations of different types of lines and you will learn to produce the graphs of the lines. We begin with horizontal and vertical lines.

GRAPHING HORIZONTAL AND VERTICAL LINES

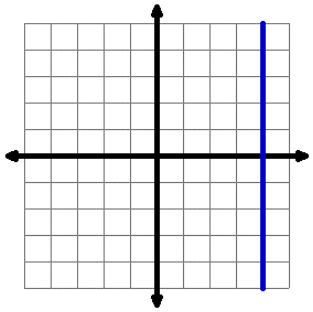
Recall that equations of horizontal and vertical lines contain only one variable and only one number. More specifically, the equations are in the form: **Variable = Constant**. If the variable is *x*, then the line is vertical. If the variable is *y*, then the line is horizontal.

VERTICAL LINE		**HORIZONTAL LINE**	
Equation of Line: $x = a$ Graph of Line: Vertical line that intersects the ***x***-axis at ***a***.	 All points have the same *x*-coordinate.	Equation of Line: $y = b$ Graph of Line: Horizontal line that intersects the ***y***-axis at ***b***.	 All points have the same *y*-coordinate.

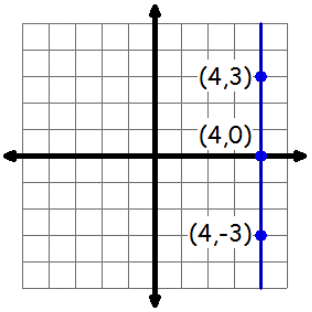
EXAMPLES: Graph each line.

1. $x = 4$

This is a vertical line that intersects the x-axis at 4.

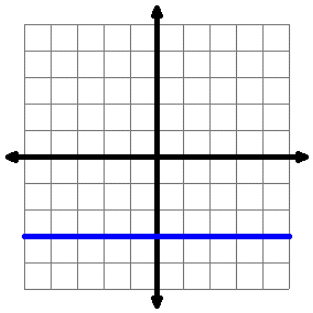


NOTE: It may help to first plot a few points that have an x-coordinate of 4. The y-coordinate can be any number. Then draw a line through the points.

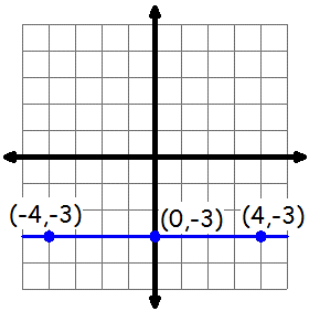


2. $y = -3$

This is a horizontal line that intersects the y-axis at –3.



NOTE: It may help to first plot a few points that have a y-coordinate of –3. The x-coordinate can be any number. Then draw a line through the points.

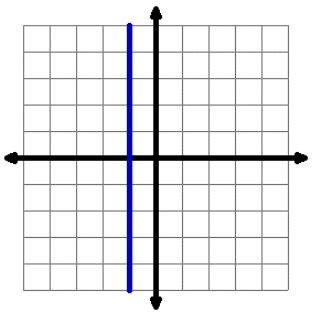


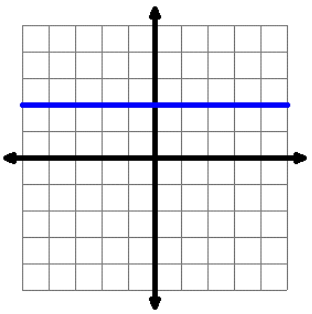
PRACTICE: Graph each line.

1. $x = -1$

2. $y = 2$

ANSWERS:

1. 

2. 

GRAPHING LINES THAT ARE NOT HORIZONTAL OR VERTICAL

Now you will learn to graph lines that are neither horizontal nor vertical. The equations of these lines will contain two variables, both x and y. Sometimes the equation will be given in ***slope-intercept form*** $y = mx + b$, and sometimes the equation will be given in ***standard form*** $Ax + By = C$. To graph an equation given in either form, we will need to find two points on the line. Once we plot two points, we can draw the line that passes through them.

GRAPHING A LINE WHOSE EQUATION IS IN SLOPE-INTERCEPT FORM

We will begin by working with equations that are written in slope-intercept form, $y = mx + b$. Graphing the lines of these equations is based on what you already learned. If you are given the equation of a line in slope-intercept form, first you identify the y-intercept (***b***) and the slope (***m***).

Then remember that you only need two points in order to draw a line. The y-intercept will be used to plot the first point. The b value shows where the line crosses the y-axis. Next, you will use the slope as a set of directions for the rise and run to move to and plot a second point. Last, you will draw a straight line through the two points. Place an arrow on each end of the line to indicate that the line extends in both directions. (*Note: You will not see arrows on the lines in this text due to the limitations of technology used to produce the graphs.)*

GRAPHING A LINE WHOSE EQUATION IS IN SLOPE-INTERCEPT FORM $y = mx + b$

1. ***m* and *b* Values**: Use the equation $y = mx + b$ to identify the values of ***m*** and ***b***.
2. ***y*-Intercept (*b*)**: Plot the b value on the y-axis.
3. **Slope (*m*)**: Start at the y-intercept and count $\frac{\text{rise}}{\text{run}}$ to plot another point.
4. **Graph**: Draw a line through the two points. Put an arrow on each end of the line.

   HINT: Compare the slope of the line with the direction of the line:

   - If the slope is positive, the line should slant up from left to right.
   - If the slope is negative, the line should slant down from left to right.

EXAMPLE 1: Graph the line given by the equation $y = -2x + 4$.

m and b Values

Use the equation in $y = mx + b$ form to identify the slope (***m***) and the y-intercept (***b***).

$y = \boxed{-2}x\boxed{+4}$

m b

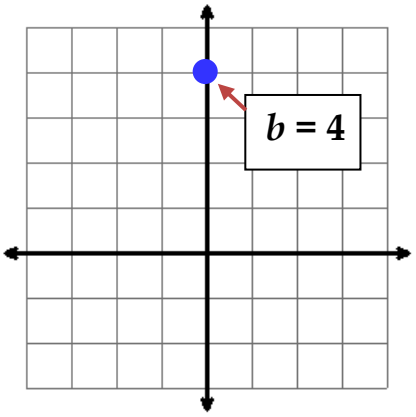
$m = -2$

$b = 4$

y-intercept

$b = 4$

Plot the ***b*** value on the y-axis.



Slope

$m = -2$

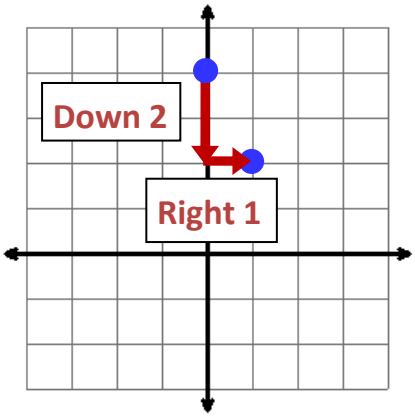
Express m as a fraction: $m = \frac{-2}{1}$.

Write directions for the rise and run:

$$m = \frac{-2}{1} = \frac{\text{Down 2}}{\text{Right 1}}$$

To find a second point on the graph:

Start at the y-intercept.
Count 2 units down.
Count 1 unit right.
Plot a point at this position.

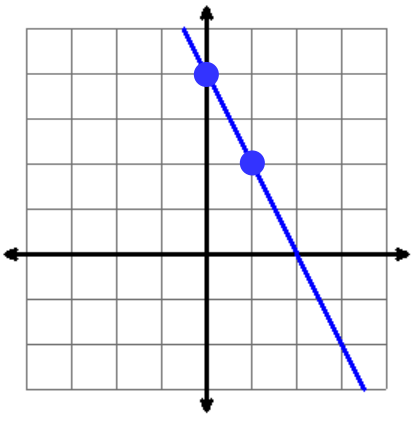


Graph of Line

Draw a line through the two points.

This is the graph of $y = -2x + 4$.

NOTE: The slope of the line is negative, and the graphed line slants down from left to right.



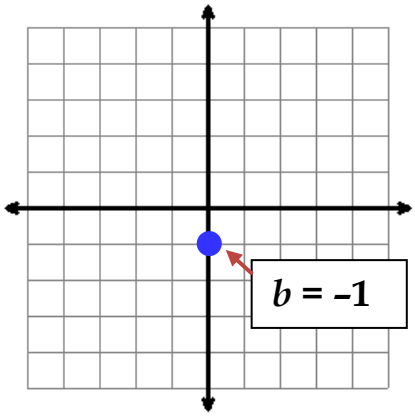
EXAMPLE 2: Graph the line given by the equation $y = -\frac{3}{4}x - 1$.

m and b Values Use the equation in $y = mx + b$ form to identify the slope (***m***) and the y-intercept (***b***).

$$y = \boxed{-\tfrac{3}{4}}x \boxed{-1} \qquad m = -\frac{3}{4}$$
$$\downarrow \quad \downarrow$$
$$m \quad b \qquad b = -1$$

y-intercept $b = -1$

Plot the ***b*** value on the y-axis.



Slope Rewrite m and assign the negative sign to the numerator. $m = -\frac{3}{4} = \frac{-3}{4}$

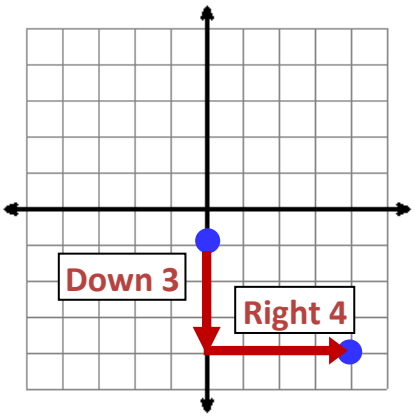
Write directions for the rise and run:

$$m = \frac{-3}{4} = \frac{\text{Down } 3}{\text{Right } 4}$$

To find a second point on the graph:

Start at the y-intercept.
Count 3 units down.
Count 4 units right.

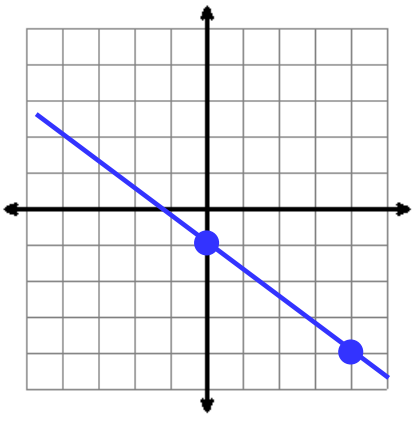
Plot a point at this position.



Graph of Line Draw a line through the two points.

This is the graph of $y = -\frac{3}{4}x - 1$.

NOTE: The slope of the line is negative, and the graphed line slants down from left to right.



EXAMPLE 3: Graph the line given by the equation $y = 4x$.

m and b Values

Use the equation in $y = mx + b$ form to identify the slope (***m***) and the y-intercept (***b***).

$y = \boxed{4}x\boxed{+0}$ (4 → m, 0 → b)

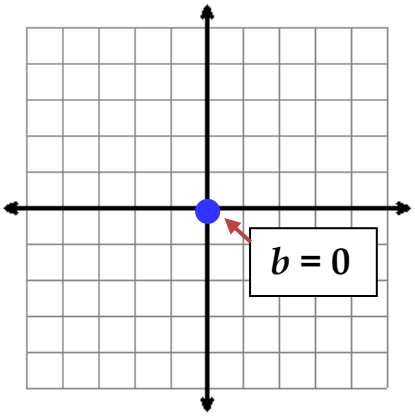
$m = 4$

$b = 0$

y-intercept

$b = 0$

Plot the ***b*** value on the y-axis.



Slope

$m = 4$

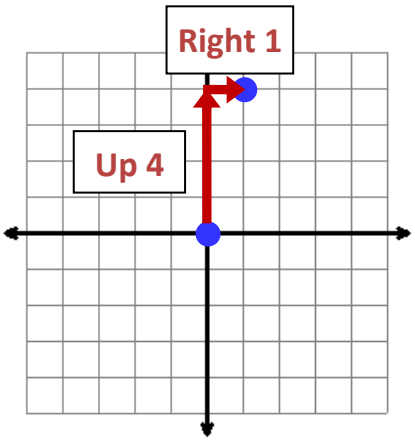
Express m as a fraction: $m = \frac{4}{1}$.

Write directions for the rise and run:

$$m = \frac{4}{1} = \frac{\text{Up } 4}{\text{Right } 1}$$

To find a second point on the graph:

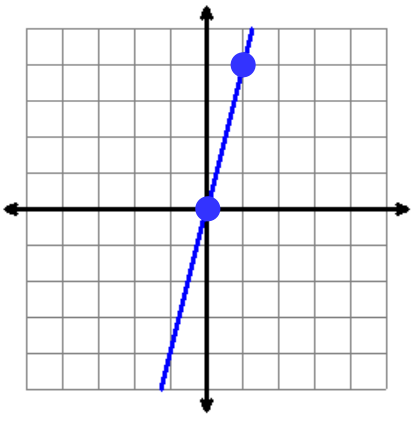
Start at the y-intercept.
Count 4 units up.
Count 1 unit right.
Plot a point at this position.



Graph of Line

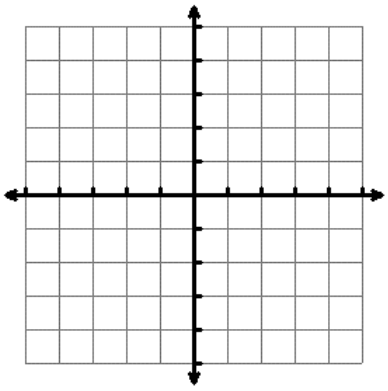
Draw a line through the two points.
This is the graph of $y = 4x$.

NOTE: The slope of the line is positive, and the graphed line slants up from left to right.

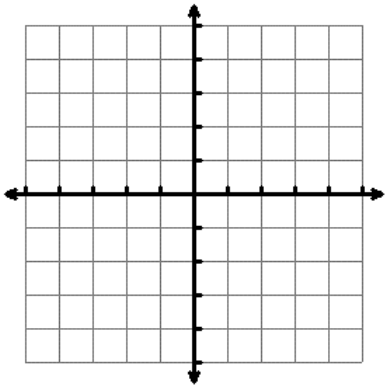


PRACTICE: Graph each line.

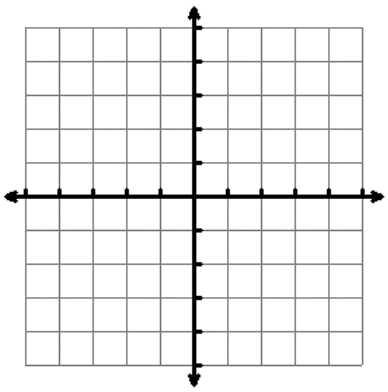
1. $y = -\frac{1}{2}x - 3$



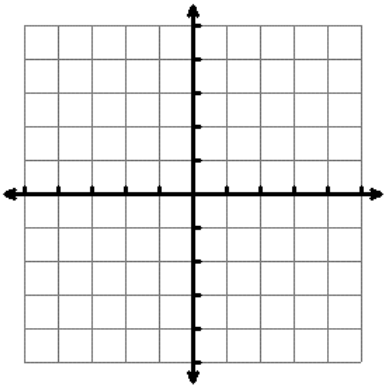
2. $y = 2x + 1$



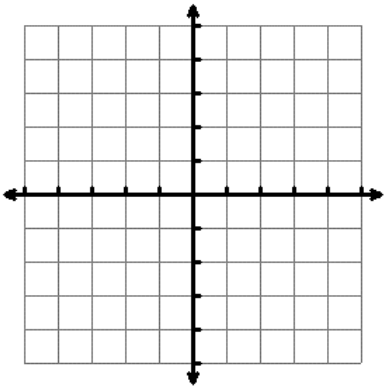
3. $y = 3x - 2$



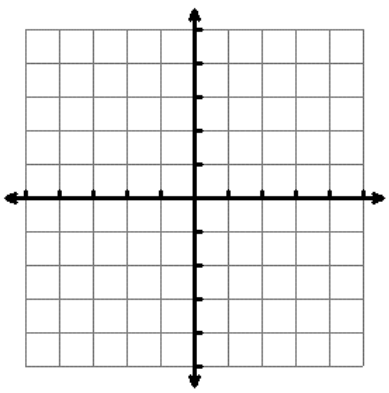
4. $y = -x + 1$



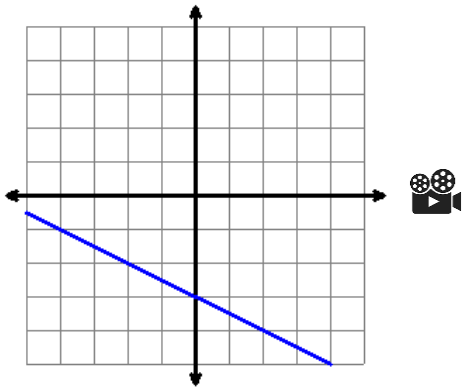
5. $y = \frac{2}{3}x$

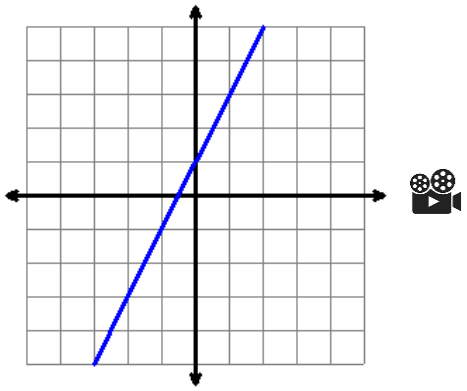


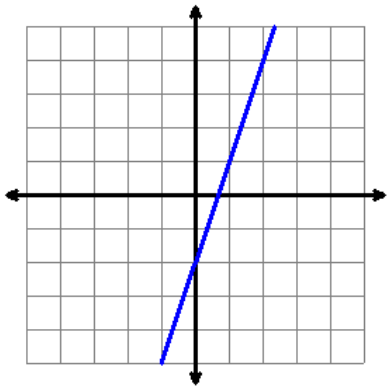
6. $y = -\frac{3}{4}x + 2$

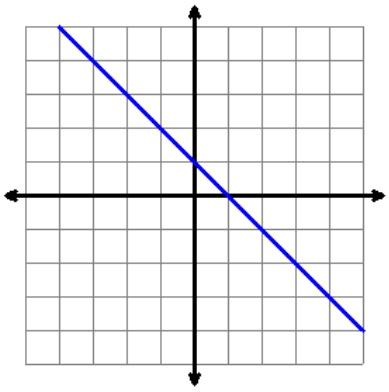


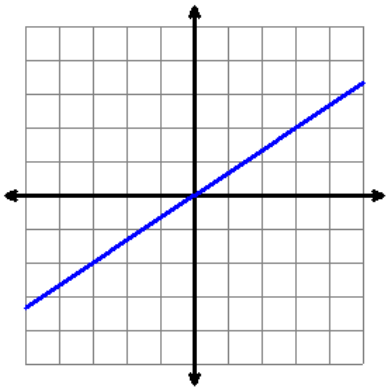
ANSWERS:

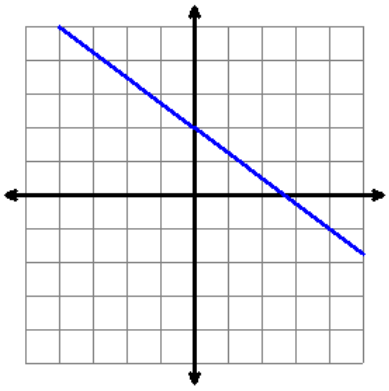
1. 

2. 

3. 

4. 

5. 

6. 

GRAPHING A LINE WHOSE EQUATION IS IN STANDARD FORM

In the previous problems, the equations of the lines were given in slope-intercept form, $y = mx + b$. But this will not always be the case. Sometimes, equations of lines will be given in standard form $Ax + By = C$. Now you will learn how to graph a line if the equation is given in standard form.

There are actually two methods that can be used with equations in standard form. One option is to use algebra to solve for y, and rewrite the equation in the form $y = mx + b$. Then we can proceed as we did in the previous problems. Another option is to find and graph the x and y intercepts. Once you have identified two points on the line, by either method, you simply connect the points. Both methods will produce the same line.

GRAPHING A LINE WHOSE EQUATION IS IN STANDARD FORM $Ax + By = C$

Slope – Intercept Method

1. $y = mx + b$: Use algebra to solve the equation for y and rewrite it as $y = mx + b$.
2. ***m* and *b* Values**: Use the equation $y = mx + b$ to identify the values of m and b.
3. ***y*-Intercept (*b*)**: Plot the b value on the y-axis.
4. **Slope (*m*)**: Start at the y-intercept and count $\frac{\text{rise}}{\text{run}}$ to plot another point.
   - If m is not a fraction, then write m as $\frac{m}{1}$.
   - If m is negative, write m with the negative sign in the numerator.
   - Rise: + move Up – move Down
   - Run: + move Right – move Left
5. **Graph:** Draw a line through the two points.

***x* and *y* Intercept Method**

1. ***x*-Intercept:** To get the x-intercept, set $y = 0$, and solve for x.
2. ***y*-Intercept:** To get the y-intercept, set $x = 0$, and solve for y.
3. **Points:** Plot the two points where the line crosses the axes.
4. **Graph:** Draw a line through the two points.

In the following examples, we will graph a line using both methods. We will show the Slope-Intercept Method first. Then we will redo the same problem using the x- and y- intercept Method. Notice that the resulting lines turn out exactly the same.

EXAMPLE 1a: *SLOPE – INTERCEPT METHOD* Graph the line given by the equation $3x+2y=6$.

$y = mx + b$

Solve the equation for y:

Subtract $3x$ from both sides.

On the right side of the equation, write the x-term before the constant.

Divide each term by 2.

Now the equation is written as $y = mx + b$.

$$\begin{array}{rcl} 3x+2y & = & 6 \\ -3x \quad\quad & & -3x \\ \hline 2y & = & -3x+6 \\ \frac{2y}{2} & = & \frac{-3x}{2}+\frac{6}{2} \\ y & = & -\frac{3}{2}x+3 \end{array}$$

m and b

Use the equation in $y = mx + b$ form to identify the slope (***m***) and y-intercept (***b***).

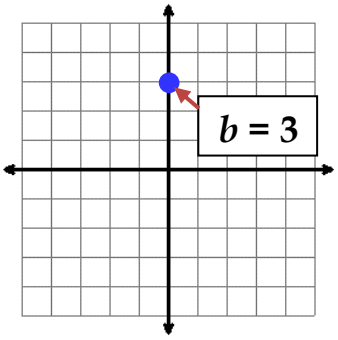
$$y = \boxed{-\frac{3}{2}}x\boxed{+3} \qquad \begin{array}{l} m = -\frac{3}{2} \\ b = 3 \end{array}$$

($-\frac{3}{2}$ → m; $+3$ → b)

y-intercept

$b = 3$

Plot the ***b*** value on the y-axis.



Slope

Rewrite m with the negative sign in the numerator. $m = -\frac{3}{2} = \frac{-3}{2}$

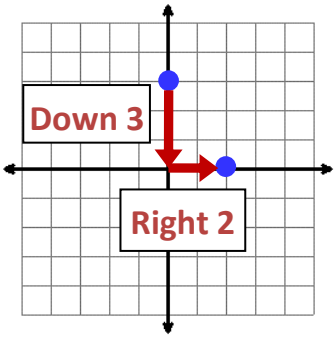
Write directions for the rise and run:

$$m = \frac{-3}{2} = \frac{\text{Down } 3}{\text{Right } 2}$$

To find a second point on the graph:

Start at the y-intercept.
Count 3 units down.
Count 2 units right.

Plot a point at this position.

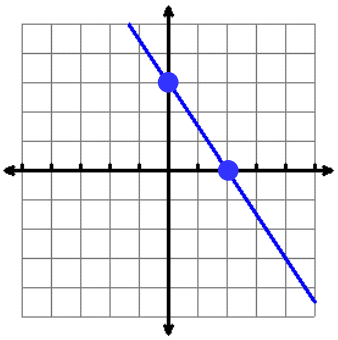


Graph of Line

Draw a line through the two points.

This is the graph of $3x+2y=6$.

NOTE: The slope of the line is negative and the line slants down.



Now we will rework the exact same problem. But this time we will complete the problem using the *x*- and *y*-intercept method.

EXAMPLE 1b: *x*- AND *y*-INTERCEPT METHOD Graph the line given by the equation $3x+2y=6$.

x-intercept

Set $\boxed{y=0}$.

Solve the equation for *x*.

The *x*-intercept is 2, so the line crosses the *x*-axis at the point (2, 0).

$$3x+2y=6$$
$$3x+2(0)=6$$
$$3x+0=6$$
$$\frac{3x}{3}=\frac{6}{3}$$
$$\boxed{x=2}$$

$$(x,\ y)$$
$$\downarrow\ \downarrow$$
$$(2,0)\ *$$

y-intercept

Set $\boxed{x=0}$.

Solve the equation for *y*.

The *y*-intercept is 3, so the line crosses the *y*-axis at the point (0, 3).

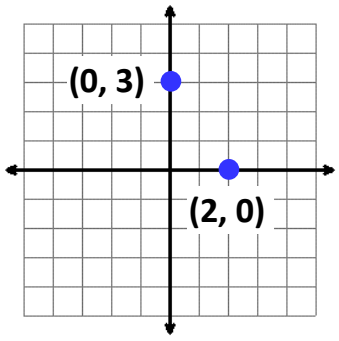
$$3x+2y=6$$
$$3(0)+2y=6$$
$$0+2y=6$$
$$\frac{2y}{2}=\frac{6}{2}$$
$$\boxed{y=3}$$

$$(x,\ y)$$
$$\downarrow\ \downarrow$$
$$(0,3)\ *$$

Points

x-intercept: Plot the point at (2, 0).

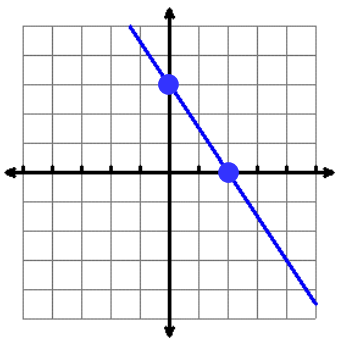
y-intercept: Plot the point at (0, 3).



Graph of Line

Draw a line through the two points.

This is the graph of $3x+2y=6$.



Notice that both methods produced a graph of the same line.

EXAMPLE 2a: *SLOPE – INTERCEPT METHOD* Graph the line given by the equation $x-2y=4$.

$y = mx + b$

Solve the equation for y:

$$x-2y = 4$$

Subtract x from both sides.

$$\underline{-x \qquad -x}$$

On the right side of the equation, write the x-term before the constant.

$$-2y = -x+4$$

Divide each term by – 2.

$$\frac{-2y}{-2} = \frac{-x}{-2}+\frac{4}{-2}$$

Now the equation is written as $y = mx+b$.

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

m and b

Use the equation in $y = mx+b$ form to identify the slope (***m***) and y-intercept (***b***).

$$y = \boxed{\tfrac{1}{2}}x\ \boxed{-2}$$

m b

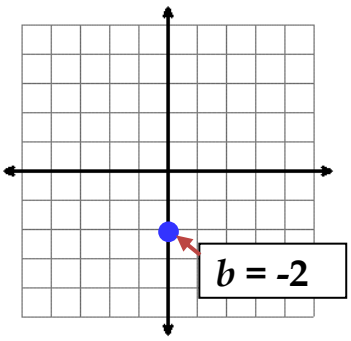
$$m = \frac{1}{2}$$

$$b = -2$$

y-intercept

$b = -2$

Plot the ***b*** value on the y-axis.



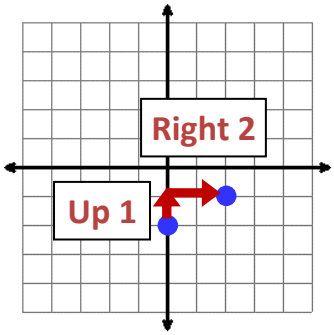
Slope

Write directions for the rise and run:

$$m = \frac{1}{2} = \frac{\text{Up 1}}{\text{Right 2}}$$

To find a second point on the graph:

Start at the y-intercept.
Count 1 unit up.
Count 2 units right.
Plot a point at this position.

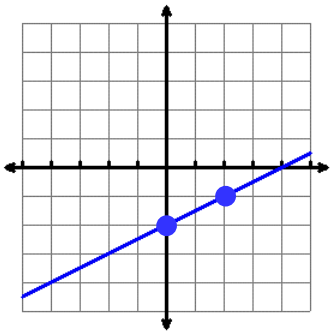


Graph of Line

Draw a line through the two points.

This is the graph of $x-2y=4$.

NOTE: The slope of the line is positive and the line slants up.



Now we will rework the exact same problem. But this time we will complete the problem using the x and y intercept method.

EXAMPLE 2b: *x- AND y-INTERCEPT METHOD* Graph the line given by the equation $x-2y=4$.

x-intercept

Set $\boxed{y=0}$.

Solve the equation for x.

The x-intercept is 4, so the line crosses the x-axis at the point (4, 0).

$$x-2y=4$$
$$x-2(0)=4$$
$$x-0=4$$
$$\boxed{x=4}$$

$$(x,\ y)$$
$$\downarrow\ \downarrow$$
$$(4,0)\ *$$

y-Intercept

Set $\boxed{x=0}$.

Solve the equation for y.

The y-intercept is –2, so the line crosses the y-axis at the point (0, –2).

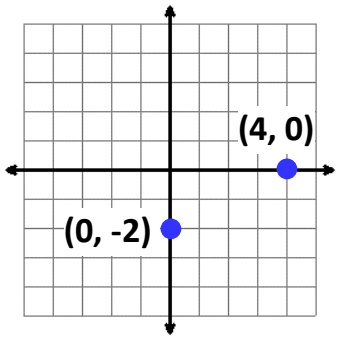
$$x-2y=4$$
$$0-2y=4$$
$$-2y=4$$
$$\frac{-2y}{-2}=\frac{4}{-2}$$
$$\boxed{y=-2}$$

$$(x,\ \ y)$$
$$\downarrow\ \ \downarrow$$
$$(0,-2)\ *$$

Points

x-intercept: Plot the point at (4, 0).

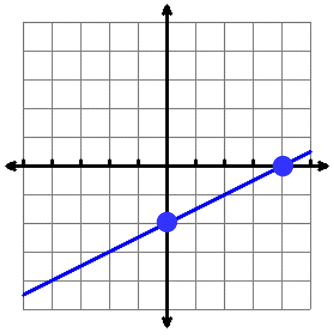
y-intercept: Plot the point at (0, –2).



Graph of Line

Draw a line through the two points.

This is the graph of $x-2y=4$.



Again, notice that both methods produced a graph of the same line.

EXAMPLE 3: Graph the line given by the equation $y = -4x - 1$.

Since the equation is already in $y = mx + b$ form, the ***slope-intercept method*** will be the easiest and quickest way to graph the line.

$y = mx + b$ The equation is already written in $y = mx + b$ form. $y = -4x - 1$

m and b Identify the slope (***m***) and y-intercept (***b***).

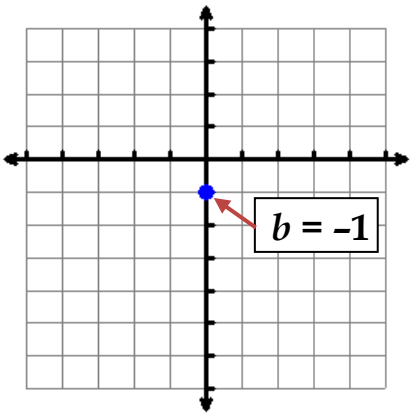
$y = \boxed{-4}x \boxed{-1}$ (-4 → m, -1 → b)

$m = -4$

$b = -1$

y-Intercept $b = -1$

Plot the ***b*** value on the y-axis.

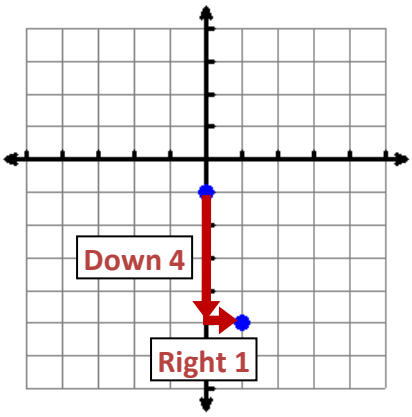


Slope Write directions for the rise and run:

$$m = -4 = \frac{-4}{1} = \frac{\text{Down } 4}{\text{Right } 1}$$

To find a second point on the graph:

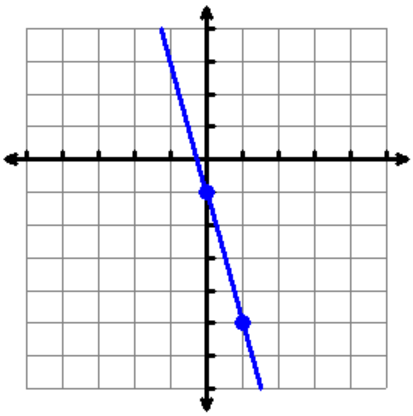
Start at the y-intercept.
Count 4 units down.
Count 1 unit right.
Plot a point at this position.



Graph of Line Draw a line through the two points.

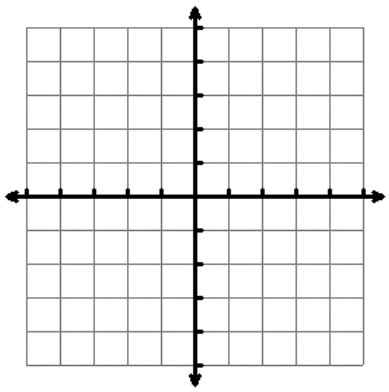
This is the graph of $y = -4x - 1$.

NOTE: The slope of the line is negative and the line slants down.

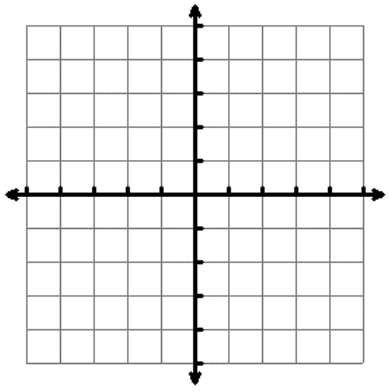


PRACTICE: Graph each line.

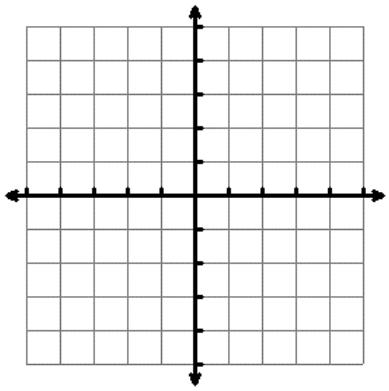
1. $4x - y = 4$



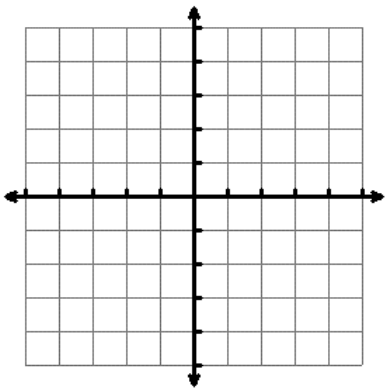
2. $2x - 4y = 8$



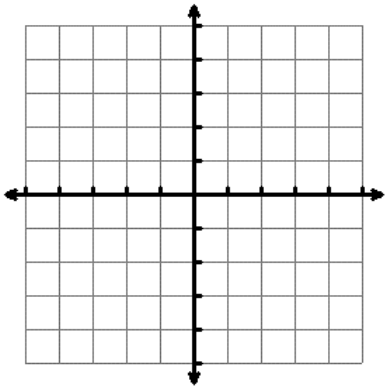
3. $4x + 3y = 12$



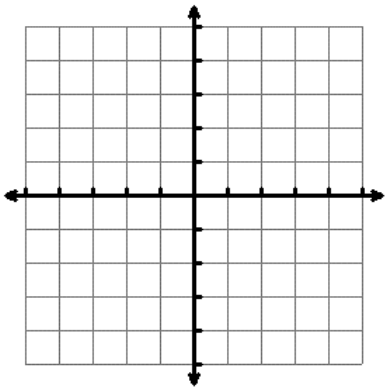
4. $3x - y = 6$



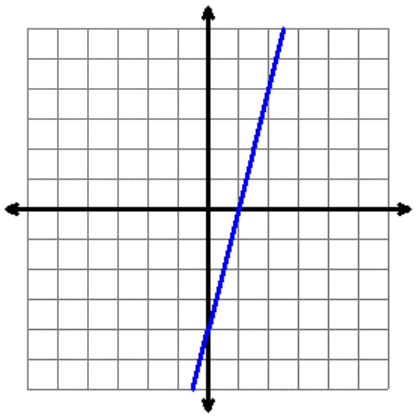
5. $x - 3y = -3$

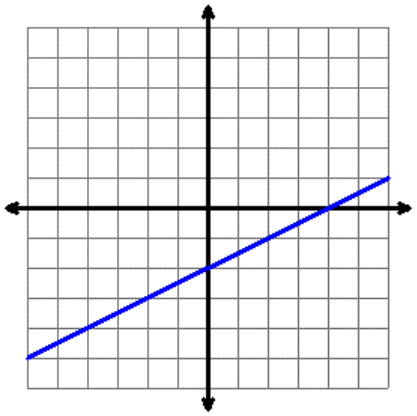


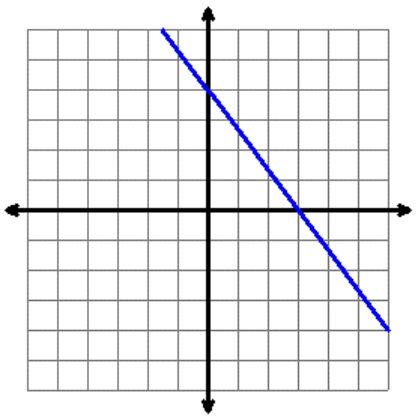
6. $2x + y = -4$

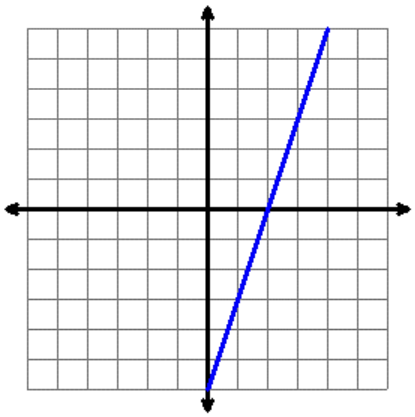


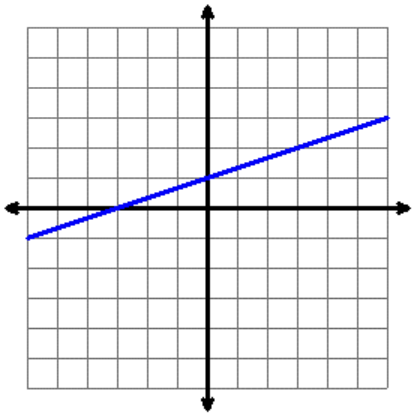
ANSWERS:

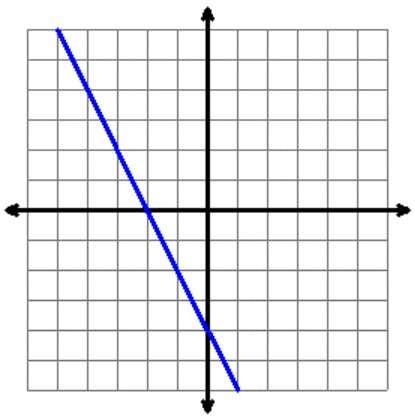
1. 

2. 

3. 

4. 

5. 

6. 

SYSTEMS OF LINEAR EQUATIONS

A ***system of equations*** is simply two or more equations that are solved together. We will be solving systems that consist of two linear equations in two variables. The equations will look similar to those in the previous problems, except there will be two equations for each problem.

A ***solution*** to a system of two linear equations in two variables is the ***ordered pair*** that satisfies both equations. To solve a system, we will graph the two lines on the same set of axes. Then we will determine the point where the two lines intersect. The ***ordered pair*** of the ***intersection point*** is the solution to the system of equations.

SOLVING A SYSTEM OF LINEAR EQUATIONS BY GRAPHING

1. Graph the line for each equation using either method:
   a. Slope-Intercept Method
      - Plot the *y*-intercept first.
      - Use the slope $\left(\frac{rise}{run}\right)$ to plot a second point.
      - Draw a line through the two points.
   b. *x*- and *y*-intercept Method
      - To get the *x*-intercept point, set $y = 0$, and solve for *x*.
      - To get the *y*-intercept point, set $x = 0$, and solve for *y*.
      - Draw a line through the two points.

   IMPORTANT: Graph both lines on the same set of axes.
2. Determine the intersection point for the two lines and write it as an ordered pair.
3. Check the solution in both equations.

Three examples will be presented. The first will be solved using the slope-intercept method, the second using the *x*- and *y*-intercept method, and the third using a mixture of the two methods. This will allow you to review both ways of graphing lines.

EXAMPLE 1: Solve the system of equations by graphing. $y = 2x - 1$ and $x + y = 5$

Slope - Intercept Method

Graph First Line

The first equation is in slope-intercept form.

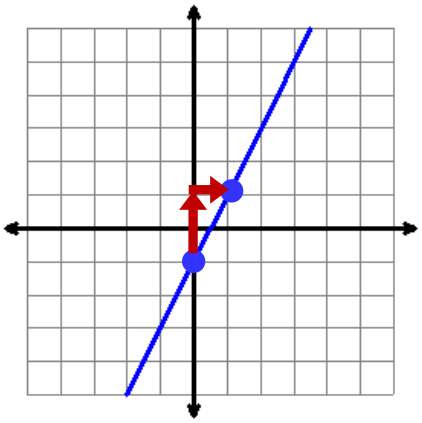
$$y = \underset{\downarrow}{\boxed{2}}x\underset{\downarrow}{\boxed{-1}}$$
$$m \quad b$$

Plot the y-intercept: $b = -1$

Use the slope to plot a second point:

$$m = \frac{2}{1} = \frac{\text{Up 2}}{\text{Right 1}}$$

Draw a line through the two points.



Graph Second Line

Put the second equation in slope-intercept form.

$$\begin{array}{r} x + y = 5 \\ -x \quad\quad -x \\ \hline y = \underset{\downarrow}{\boxed{-1}}x\underset{\downarrow}{\boxed{+5}} \\ m \quad b \end{array}$$

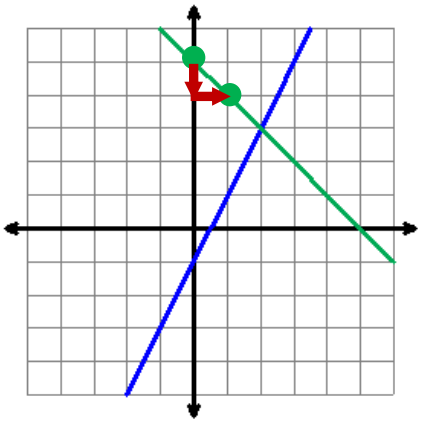
On the same set of axes as the first line,

Plot the y-intercept: $b = 5$

Use the slope to plot a second point:

$$m = \frac{-1}{1} = \frac{\text{Down 1}}{\text{Right 1}}$$

Draw a line through the two points.

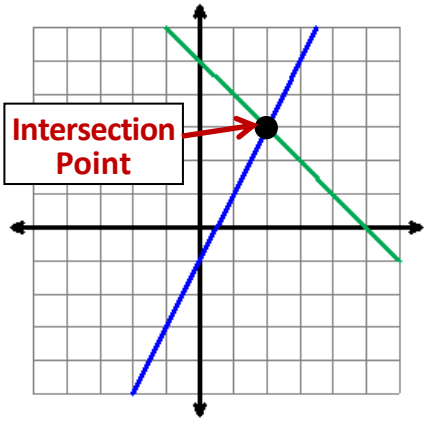


Intersection Point

Determine the point where the two lines intersect.

Write this point as an ordered pair: $(2,3)$

Answer: The solution to the system is $(2,3)$.



Check

$x = 2$ and $y = 3$

Place these values in both equations to verify the answer.

$y = 2x - 1$

$3 \stackrel{?}{=} 2(2) - 1$

$3 \stackrel{?}{=} 4 - 1$

$3 = 3$ ✓

$x + y = 5$

$2 + 3 \stackrel{?}{=} 5$

$5 = 5$ ✓

EXAMPLE 2: Solve the system of equations by graphing. $2x-3y=6$ and $4x+3y=12$

x- and y-intercept Method

Graph First Line

<u>x</u>-intercept: Set $y=0$

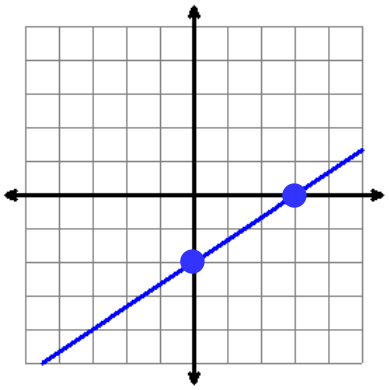
$$2x-3y=6$$
$$2x-3(0)=6$$
$$2x-0=6$$
$$\frac{2x}{2}=\frac{6}{2}$$
$$x=3$$

(x, y)
$(3, 0)$

<u>y</u>-intercept: Set $x=0$

$$2x-3y=6$$
$$2(0)-3y=6$$
$$0-3y=6$$
$$\frac{-3y}{-3}=\frac{6}{-3}$$
$$y=-2$$

(x, y)
$(0, -2)$



Draw a line through the 2 points.

Graph Second Line

<u>x</u>-intercept: Set $y=0$

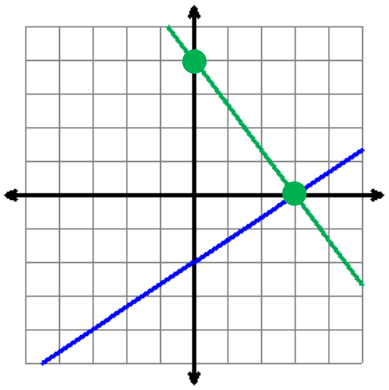
$$4x+3y=12$$
$$4x+3(0)=12$$
$$4x+0=12$$
$$\frac{4x}{4}=\frac{12}{4}$$
$$x=3$$

(x, y)
$(3, 0)$

<u>y</u>-intercept: Set $x=0$

$$4x+3y=12$$
$$4(0)+3y=12$$
$$0+3y=12$$
$$\frac{3y}{3}=\frac{12}{3}$$
$$y=4$$

(x, y)
$(0, 4)$



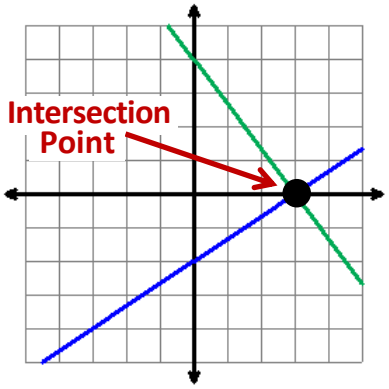
Draw a line through the 2 points.

Intersection Point

Determine the point where the two lines intersect.

Write this point as an ordered pair: $(3, 0)$

Answer: The solution to the system is $(3, 0)$.



Check

$x=3$ and $y=0$.

Place these values in both equations to verify the answer.

$$2x-3y=6$$
$$2(3)-3(0)\stackrel{?}{=}6$$
$$6-0\stackrel{?}{=}6$$
$$6=6 \checkmark$$

$$4x+3y=12$$
$$4(3)+3(0)\stackrel{?}{=}12$$
$$12+0\stackrel{?}{=}12$$
$$12=12 \checkmark$$

EXAMPLE 3: Solve the system of equations by graphing. $y = \frac{1}{4}x + 2$ and $2x - 8y = 8$

In this last example, we will use a mix of the two methods:

- Since the first equation is in $y = mx + b$ form, we will use the ***Slope-Intercept Method*** to graph it.
- Since the second equation is in A*x* + B*y* = C form, we will use the ***x- and y-intercept Method***.

Graph First Line

Slope Intercept Method

The first equation is in slope-intercept form.

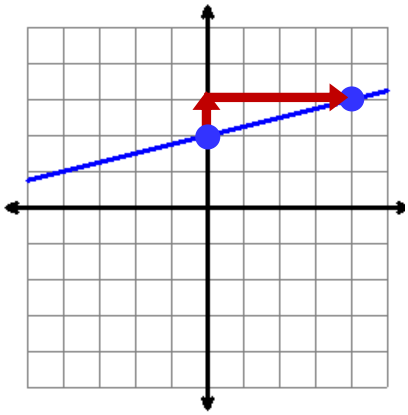
$$y = \underset{\downarrow}{\boxed{\frac{1}{4}}}x \underset{\downarrow}{\boxed{+2}}$$
$$m \quad b$$

Plot the *y*-intercept: $b = 2$

Use the slope to plot a second point:

$$m = \frac{1}{4} = \frac{\text{Up } 1}{\text{Right } 4}$$

Draw a line through the two points.



Graph Second Line

x and y Intercept Method

<u>*x*-Intercept</u>: Set $y = 0$

$$2x - 8y = 8$$
$$2x - 8(0) = 8$$
$$2x - 0 = 8$$
$$\frac{2x}{2} = \frac{8}{2}$$
$$x = 4$$

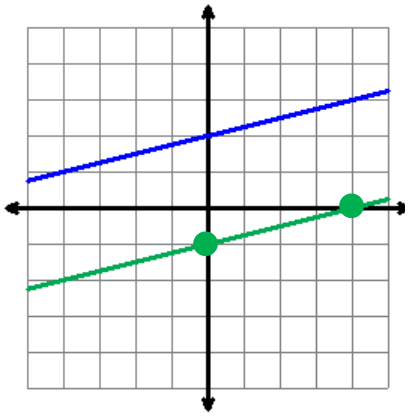
$$(x, y)$$
$$\downarrow\ \downarrow$$
$$(4, 0)$$

<u>*y*-Intercept</u>: Set $x = 0$

$$2x - 8y = 8$$
$$2(0) - 8y = 8$$
$$0 - 8y = 8$$
$$\frac{-8y}{-8} = \frac{8}{-8}$$
$$y = -1$$

$$(x, y)$$
$$\downarrow\ \downarrow$$
$$(0, -1)$$

Draw a line through the two points.

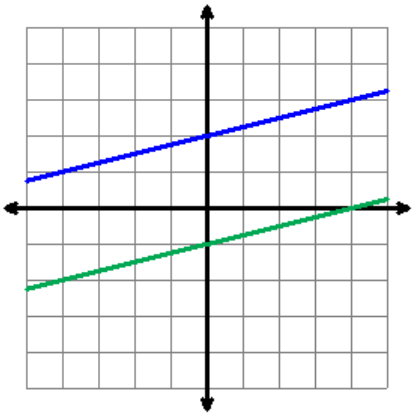


Intersection Point

This particular system illustrates a special case – the lines **<u>do not intersect</u>**. These kinds of lines, called **<u>parallel lines</u>**, have the same slope and will never meet.

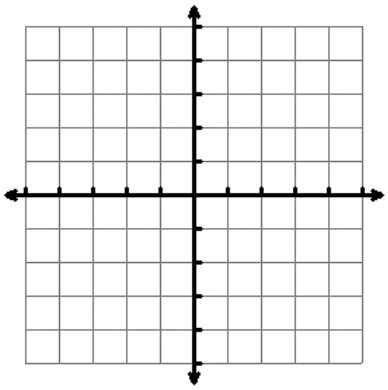
Because the lines have no intersection point, the system has no solution. The solution set can be written using the symbol $\varnothing$ which means "the empty set".

Answer: This system has **no solution**.

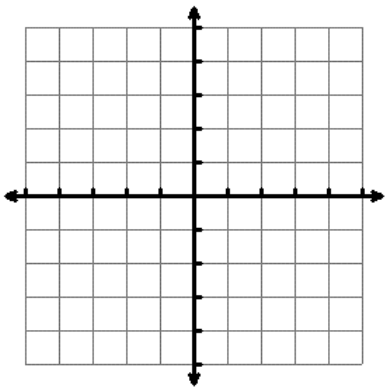


PRACTICE: Solve each system of equations by graphing.

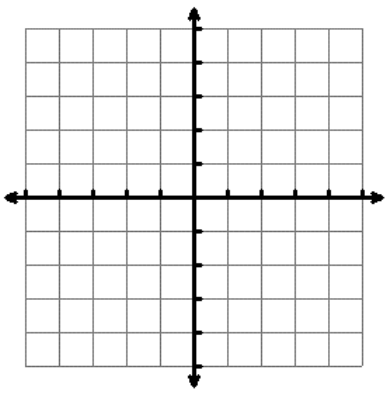
1. $y = -x - 2$
   $y = \frac{2}{3}x + 3$



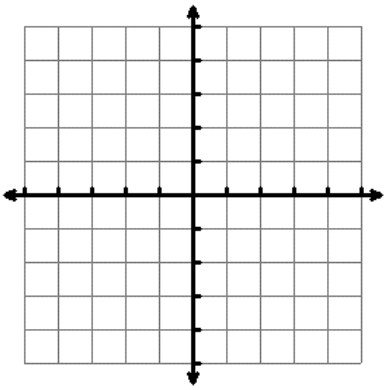
2. $4x + 2y = 8$
   $-2x + y = 0$



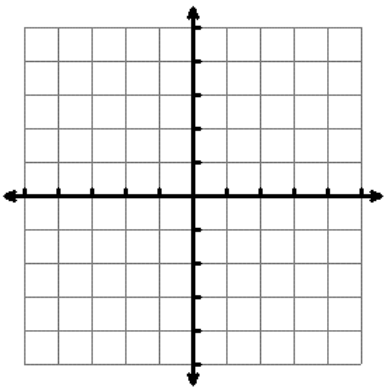
3. $3x - y = 6$
   $y = 3x + 1$



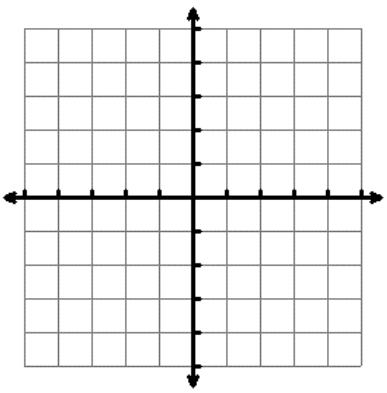
4. $y = \frac{1}{5}x + 1$
   $3x + 5y = -15$



5. $y = 2x + 2$
   $2x + y = 6$

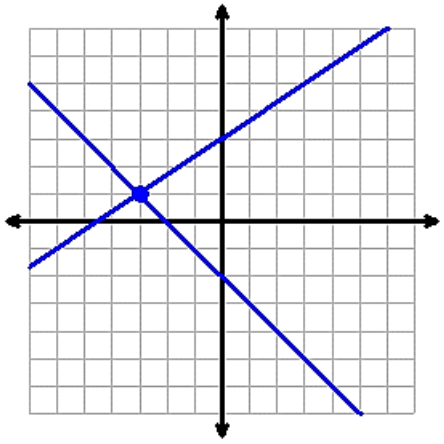


6. $y = \frac{1}{2}x + 3$
   $2x + 4y = -4$

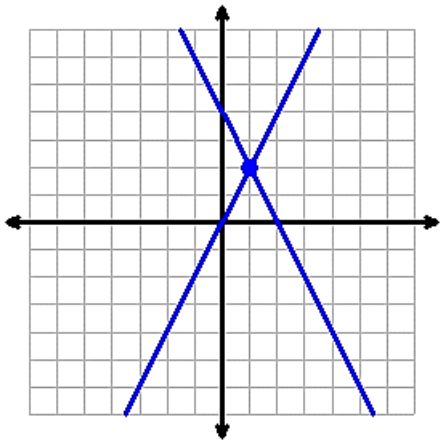


ANSWERS:

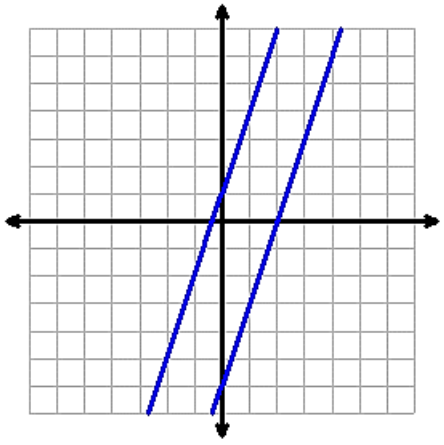
1. $(-3,1)$



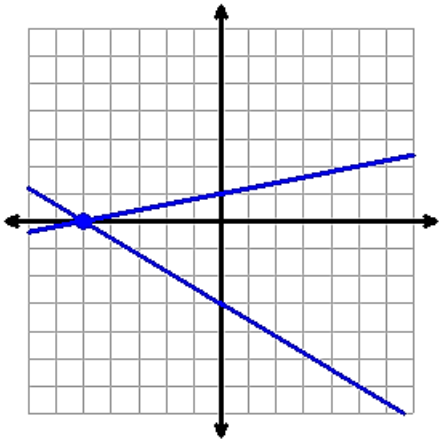
2. $(1,2)$



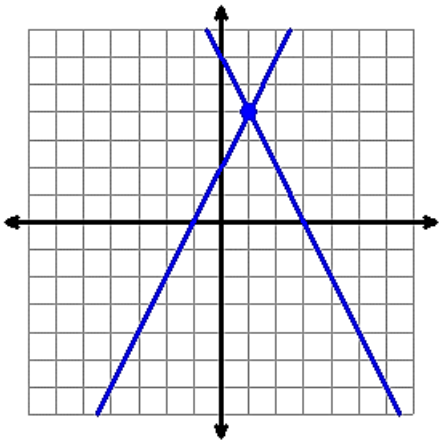
3. No Solution



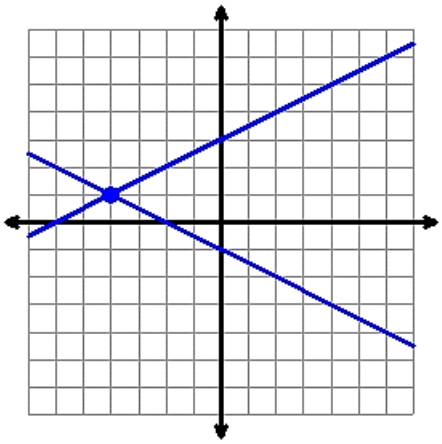
4. $(-5,0)$



5. $(1,4)$



6. $(-4,1)$



SECTION 4.4 SUMMARY
Graph of a Line

GRAPHING HORIZONTAL AND VERTICAL LINES

VERTICAL LINE

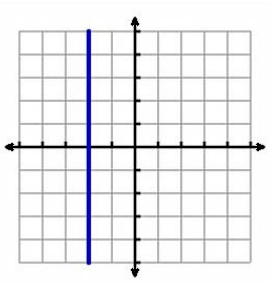
Equation of Line

$x = a$

Graph of Line

Vertical line that intersects the ***x***-axis at ***a***.

Example: Graph $x = -2$.



All points on the line have *x*-coordinate –2.

HORIZONTAL LINE

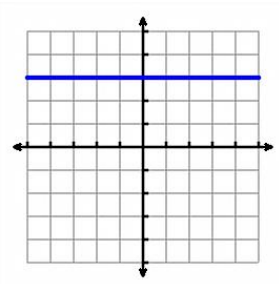
Equation of Line

$y = b$

Graph of Line

Horizontal line that intersects the ***y***-axis at ***b***.

Example: Graph $y = 3$.



All points on the line have *y*-coordinate 3.

GRAPHING LINES OF EQUATIONS IN SLOPE-INTERCEPT FORM

$y = mx + b$

1. ***y*-Intercept (*b*)**: Plot the ***b*** value on the *y*-axis.

   Note: If no *b* value is shown, then $b = 0$.

2. **Slope (*m*):** Start at the *y*-intercept and count $\frac{\text{rise}}{\text{run}}$ to plot another point.

   Notes:

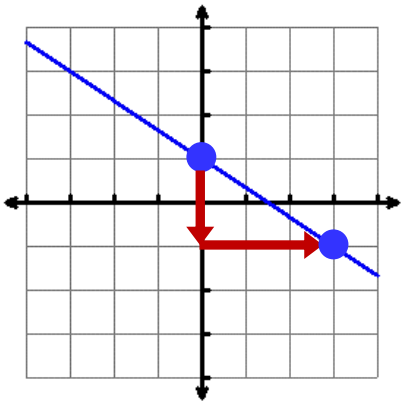
   - If no *m* value is shown, then $m = 1$.
   - If *m* is not a fraction, then write *m* as $\frac{m}{1}$.
   - If *m* is negative, rewrite *m* with the negative sign in the numerator. $\left(Ex: -\frac{1}{2} = \frac{-1}{2}\right)$
   - RISE: + Up – Down
   - RUN: + Right – Left

3. **Graph:** Draw a line through the two points.

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

$b = 1$

$m = \frac{-2}{3} = \frac{\text{Down 2}}{\text{Right 3}}$



GRAPHING LINES OF EQUATIONS IN STANDARD FORM

$Ax + By = C$

Use either method below to graph a line given in standard form.

Slope-Intercept Method

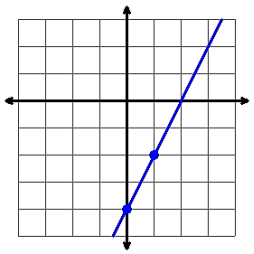
1. Solve the equation for ***y*** and rewrite the equation as ***y = mx + b.***
2. Plot the *b* value on the *y*-axis.
3. Use the slope and count $\frac{\text{rise}}{\text{run}}$ to plot another point.
4. Draw a line through the two points.

Example: Graph $-2x + y = -4$

$$\begin{array}{r} -2x + y = -4 \\ +2x \qquad +2x \\ \hline y = 2x - 4 \end{array}$$

$b = -4$

$m = \frac{2}{1} = \frac{\text{Up 2}}{\text{Right 1}}$



x- and y-Intercept Method

1. To get the *x*-intercept, set $y = 0$, and solve for *x*.
2. To get the *y*-intercept, set $x = 0$, and solve for *y*.
3. Plot the two points.
4. Draw a line through the two points.

Notice that both methods produced the same line.

Example: Graph $-2x + y = -4$

x-intercept: Set $y=0$

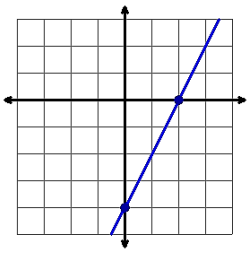
$-2x + y = -4$
$-2x + 0 = -4$
$-2x = -4$
$x = 2$

$(x, y) = (2, 0)$

y-intercept: Set $x=0$

$-2x + y = -4$
$-2(0) + y = -4$
$0 + y = -4$
$y = -4$

$(x, y) = (0, -4)$



SOLVING A SYSTEM OF LINEAR EQUATIONS BY GRAPHING

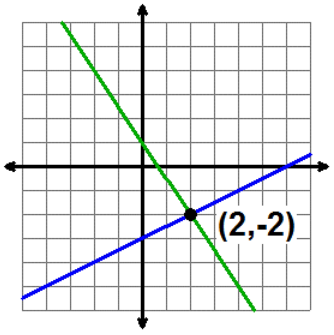
1. Graph each line using either the **Slope-Intercept Method** or the ***x*- and *y*-Intercept Method**. Important: Graph both lines on the same set of axes.
2. Determine the intersection point for the two lines and write it as an ordered pair.
3. Check the solution by substituting the coordinates of the intersection point in the original equations.

NOTE: If the two lines are parallel (do not intersect), then the system of equations has **No Solution**.

Example: $x - 2y = 6$

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

Use the steps above to graph each line.

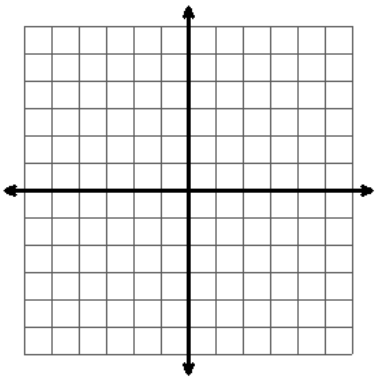


SECTION 4.4 EXERCISES

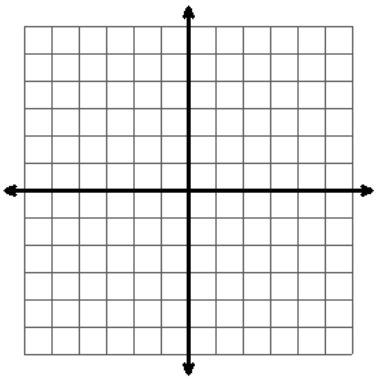
Graph of a Line

Graph each line.

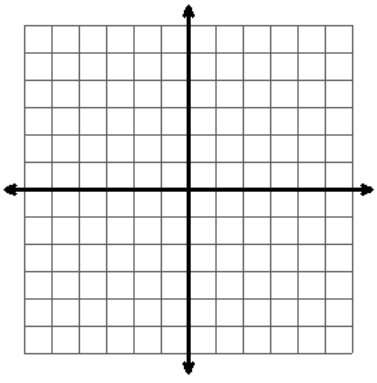
1. $y = -5$



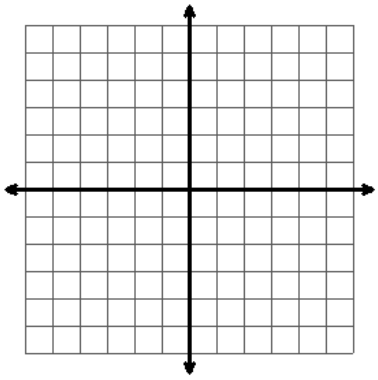
2. $x = 4$



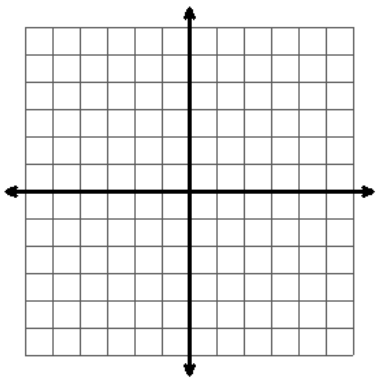
3. $y = -5x + 2$



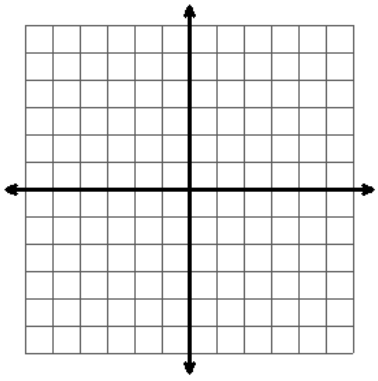
4. $y = -\frac{1}{3}x - 4$



5. $y = 3x - 1$

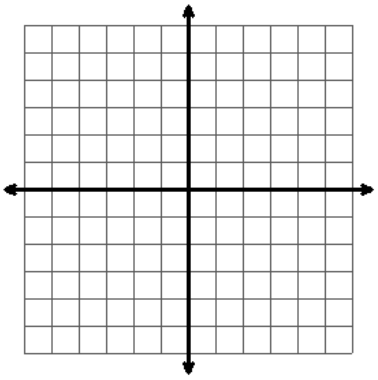


6. $y = \frac{2}{5}x + 3$

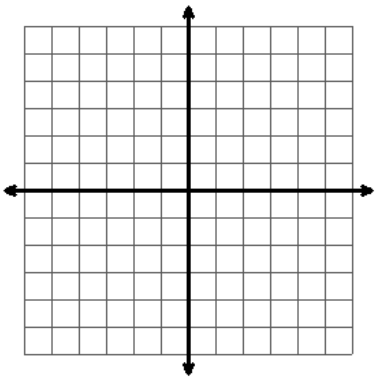


Graph each line.

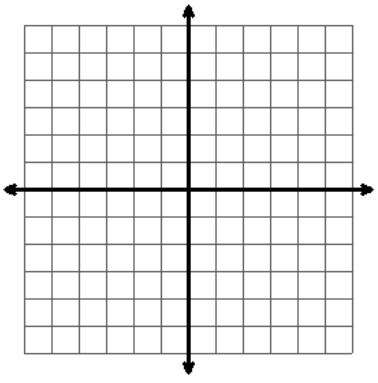
7. $y = 2x$



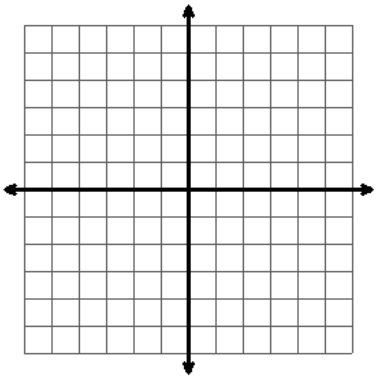
8. $y = -\frac{3}{4}x$



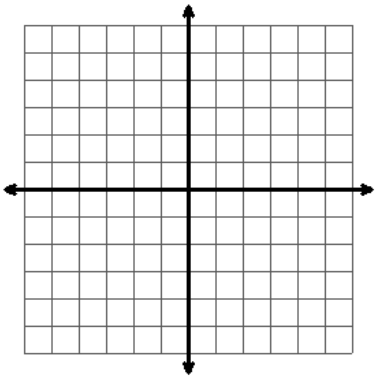
9. $x + 2y = 6$



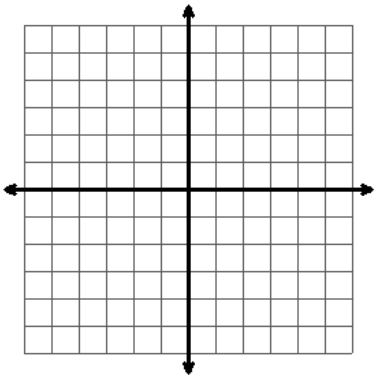
10. $2x - 5y = -10$



11. $4x + 2y = -8$

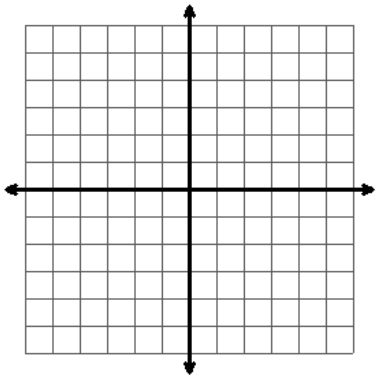


12. $-2x + 3y = 12$

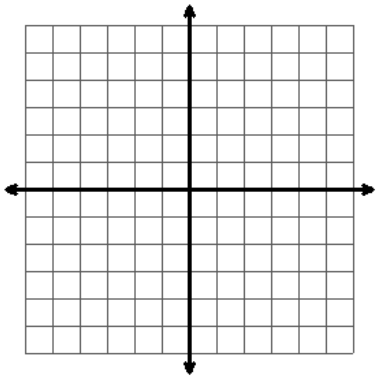


Solve each system of equations by graphing.

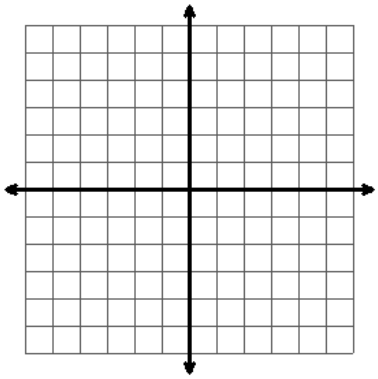
13. $y = 4x - 4$
$y = \frac{1}{2}x + 3$



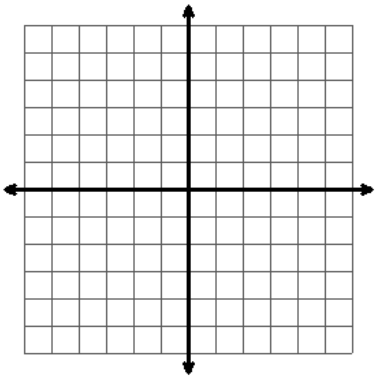
14. $x + y = 3$
$4x - 6y = 12$



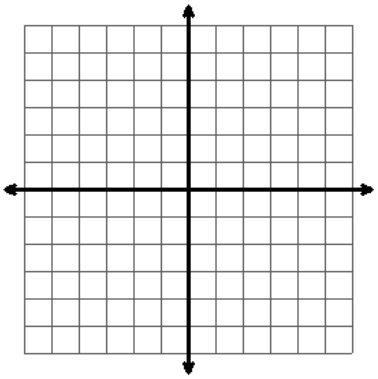
15. $y = -\frac{2}{3}x + 6$
$2x + 3y = 6$



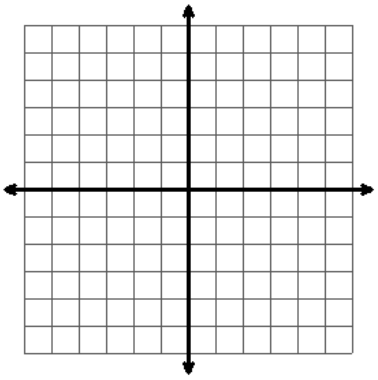
16. $y = x - 2$
$y = -\frac{1}{4}x + 3$



17. $4x - y = 4$
$12x - 3y = -6$

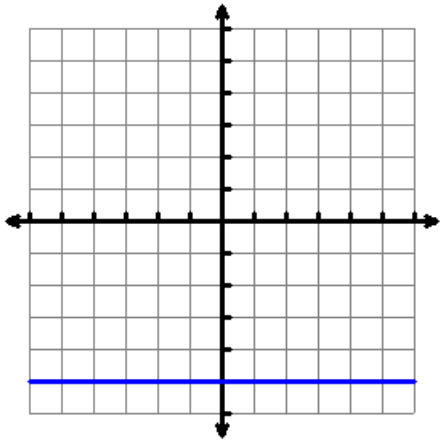


18. $y = 2x - 2$
$2x - 3y = 6$



Answers to Section 4.4 Exercises

1.



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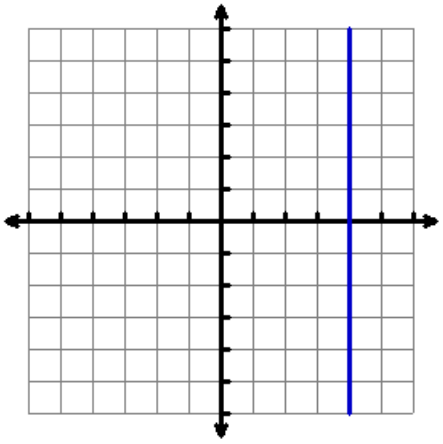

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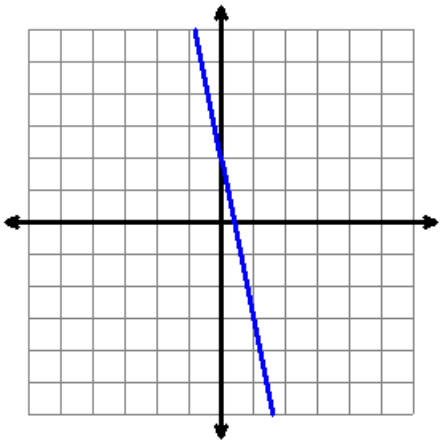

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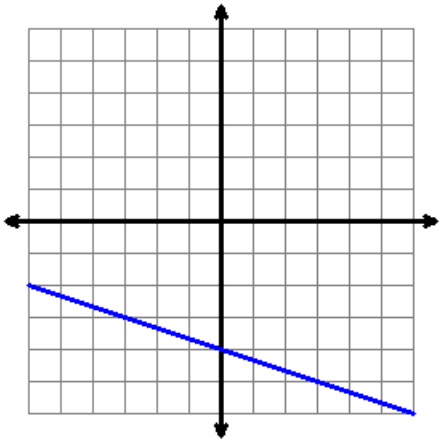

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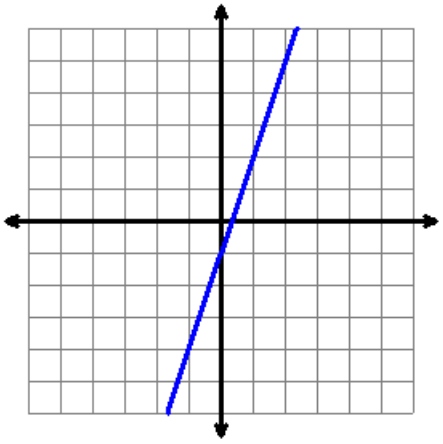

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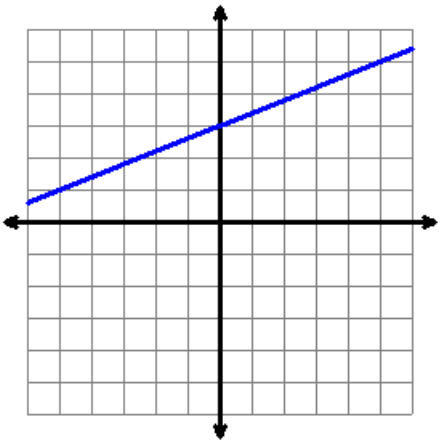
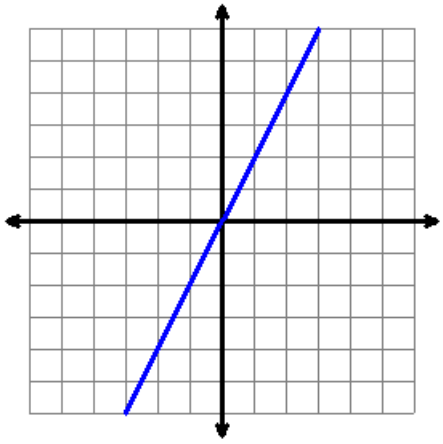
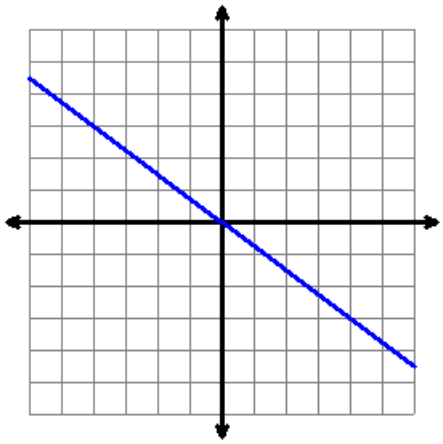
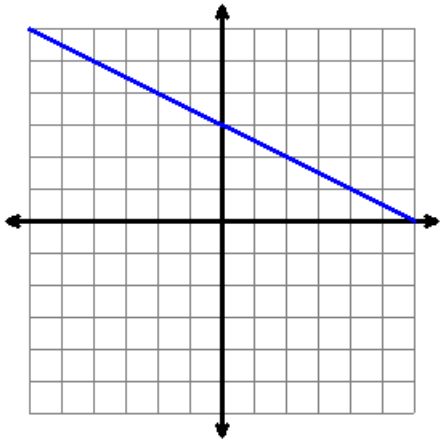
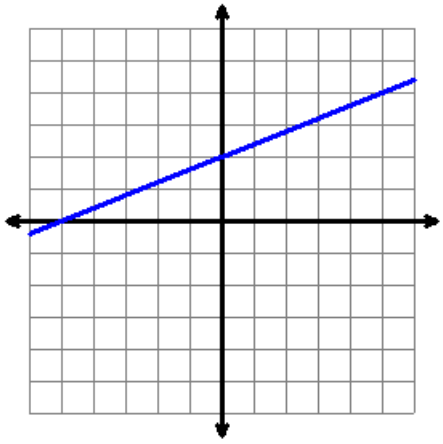
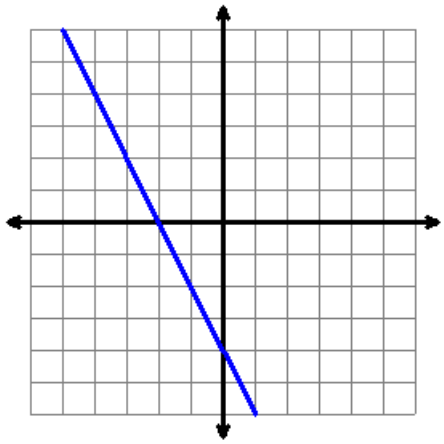


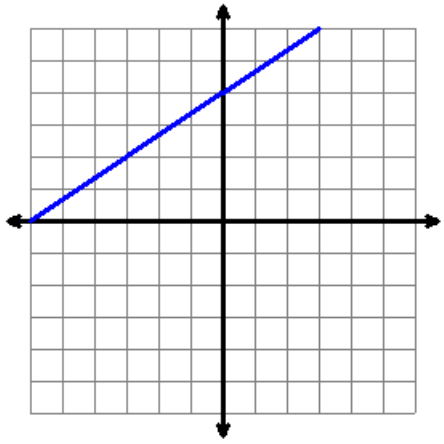
7. 

8. 

9. 

10. 

11. 

12. 

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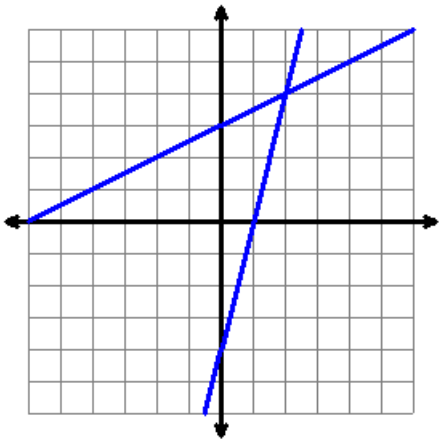
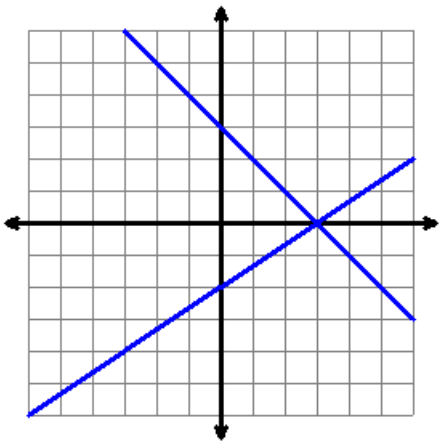


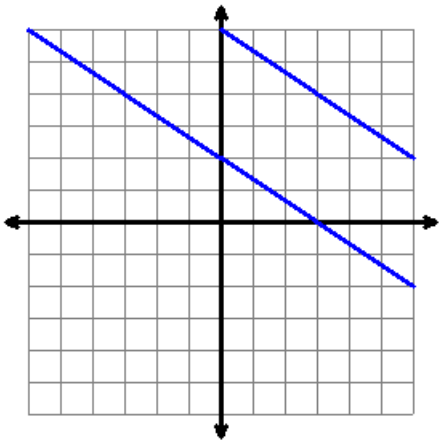
Solution: $(2,4)$

14.



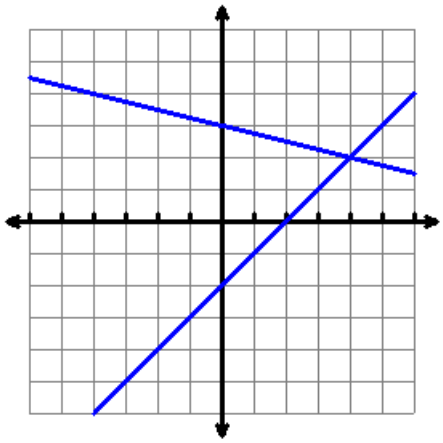
Solution: $(3,0)$

15.



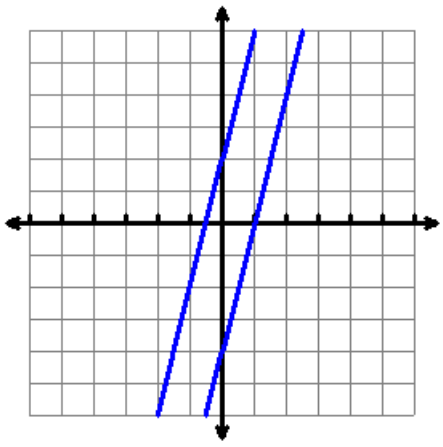
No Solution OR $\varnothing$

16.



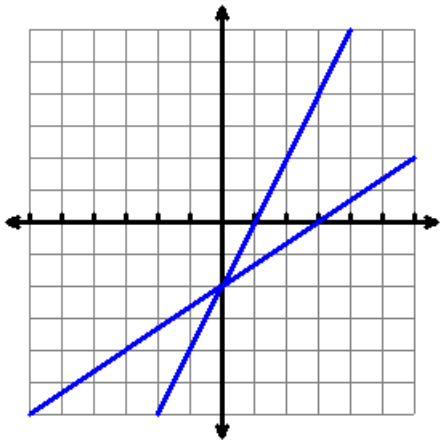
Solution: $(4,2)$

17.



No Solution OR $\varnothing$

18.

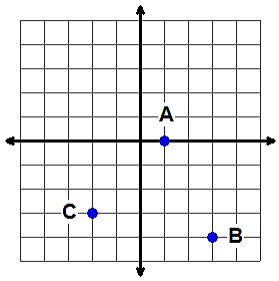


Solution: $(0,-2)$

Mixed Review

Sections 1.1 – 4.4

1. Write the ordered pair for each of the points shown on the graph to the right.



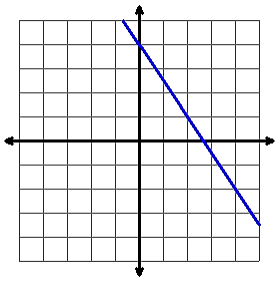
2. Solve $-4a+7b=36$ for a.

3. Solve $-3(6x+8)+4<12-10x$, graph the solution, and write it in interval notation.

4. Jamal currently rents his apartment for $825 per month. He was notified that, in 6 months, there would be a 4% increase in his rent. What will be the amount of his rent after the increase?

5. Determine if $(-5,9)$ is a solution of the equation $8x-2y=-58$.

6. Write the equation of the line graphed to the right.



7. What percent of 980 is 343?

8. Find the x and y intercepts of the line $-6x+7y=84$.

9. Molly is a black Labrador retriever who weighs 72 pounds. Feeding guidelines say that a 40 pound dog should be fed 2 ½ cups of food. Based on this, how many cups of food should Molly get?

10. Write the equation of the line that passes through the points $(4,2)$ and $(-4,4)$.

Answers to Mixed Review

1. A $(1,0)$ B $(3,-4)$ C $(-2,-3)$

2. $a=\frac{7}{4}b-9$

3. $x>-4$
   $(-4,\infty)$

4. \$858

5. Yes

6. $y=-\frac{3}{2}x+4$

7. 35%

8. $x=-14$ and $y=12$

9. 4 ½ cups

10. $y=-\frac{1}{4}x+3$