Key to

Algebra

8
Student Workbook

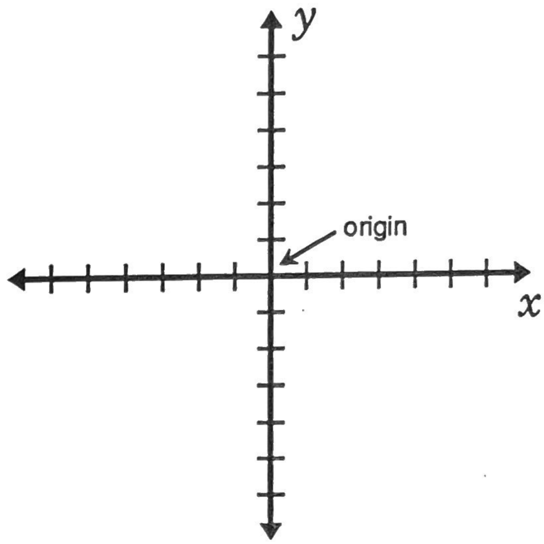
Graphs

By Julie King and Peter Rasmussen

Using Ordered Pairs to Name Points

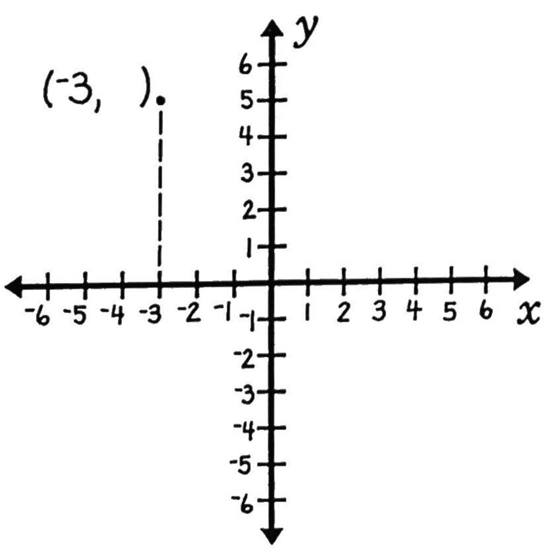
In Book 5 we graphed sets of numbers on a number line. Some of these were solution sets of inequalities which had one variable. In this book we will explore graphs of equations and inequalities which have two variables. To make and read graphs we use a **coordinate system.** In a coordinate system pairs of letters or numbers are used to locate points. The order in which we write the letters or numbers makes a difference so we call them **ordered pairs.**

Maybe you have seen maps on which places could be located by using letter coordinates. In algebra we use number coordinates to name points on a plane. To set up a coordinate system, we draw two **axes.** The **horizontal axis** (or **x-axis**) runs left and right, like the horizon. The **vertical axis** (or **y-axis**) runs up and down. Each axis is a number line. The axes usually cross at their zero points. The point of intersection is called the **origin.**

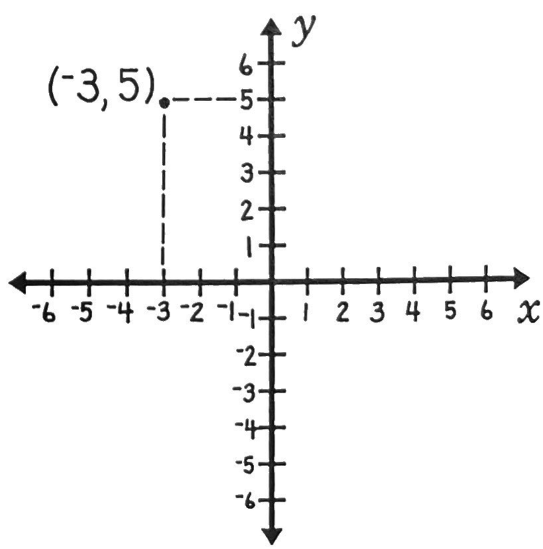


We can name any point on a plane by writing an ordered pair of numbers: the **x-coordinate** and the **y-coordinate.**

We find the x-coordinate of a point by following a line up or down to the x-axis.



We find the y-coordinate by following a line across to the y-axis.

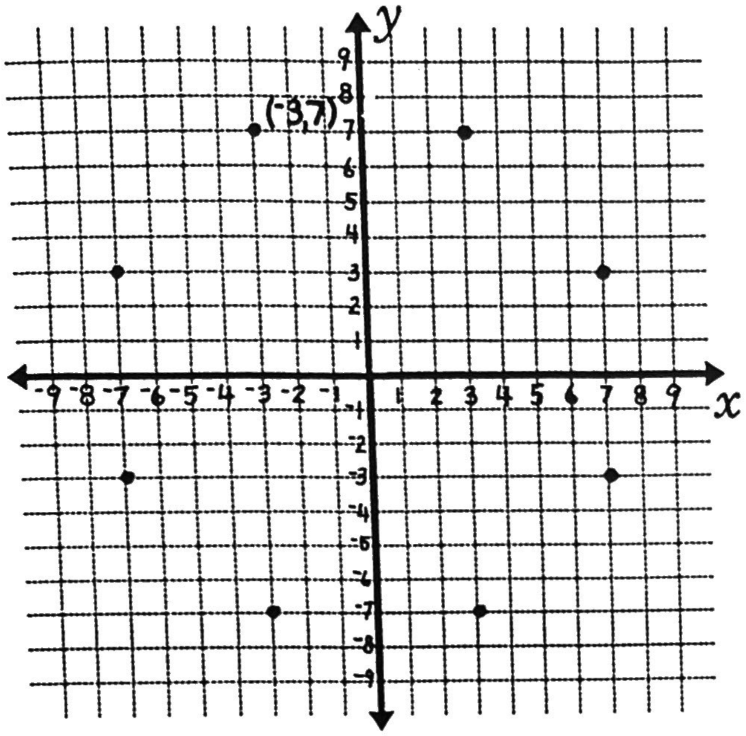


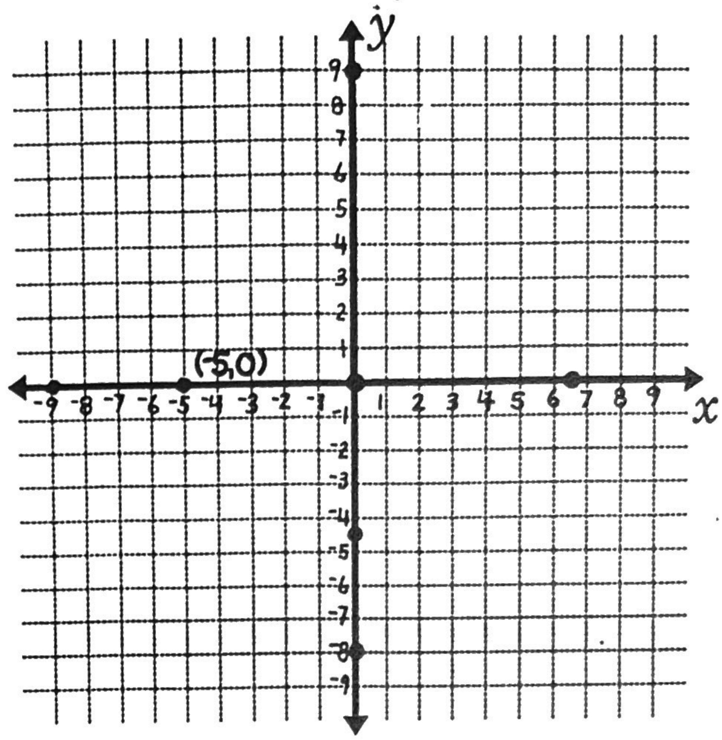
The numbers are written in parentheses with a comma between them. The x-coordinate is the first number in the ordered pair and the y-coordinate is the second number.

The x-coordinate of the point graphed above is _____. The y-coordinate is _____.

The ordered pair that names the point is ________.

ing a grid makes it easier to find the coordinates of points. Write the ordered pair that
mes each point.



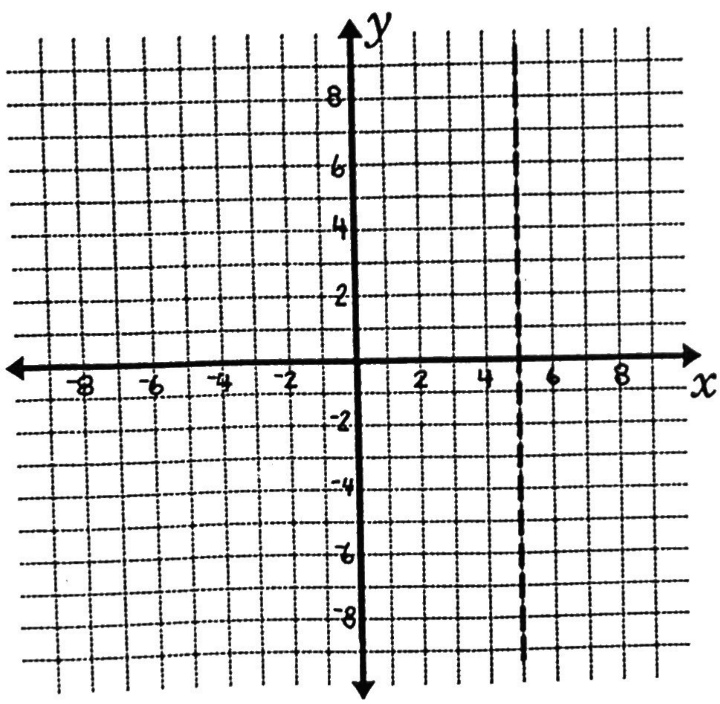


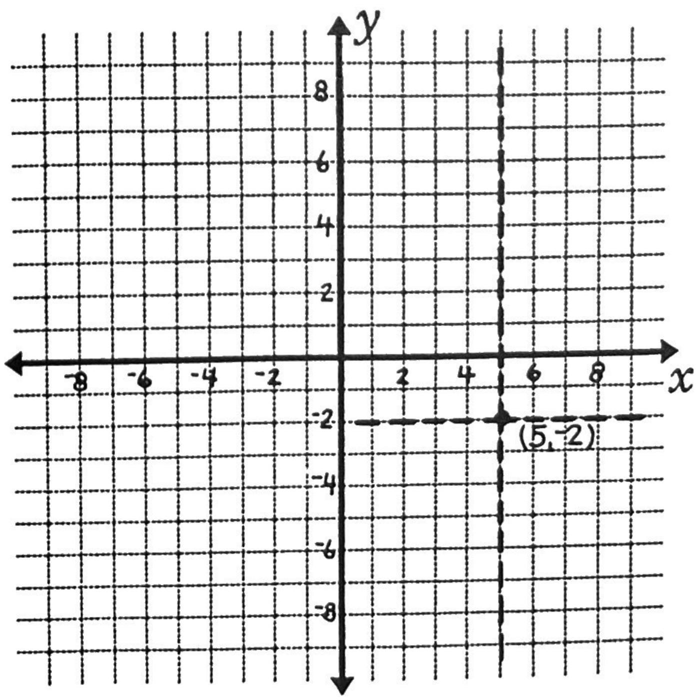
Plotting Points

For any ordered pair of numbers we can find a point on the plane. This is the reverse of naming a point. We call it **plotting** the point. Here's how to plot the point (5, ⁻2):

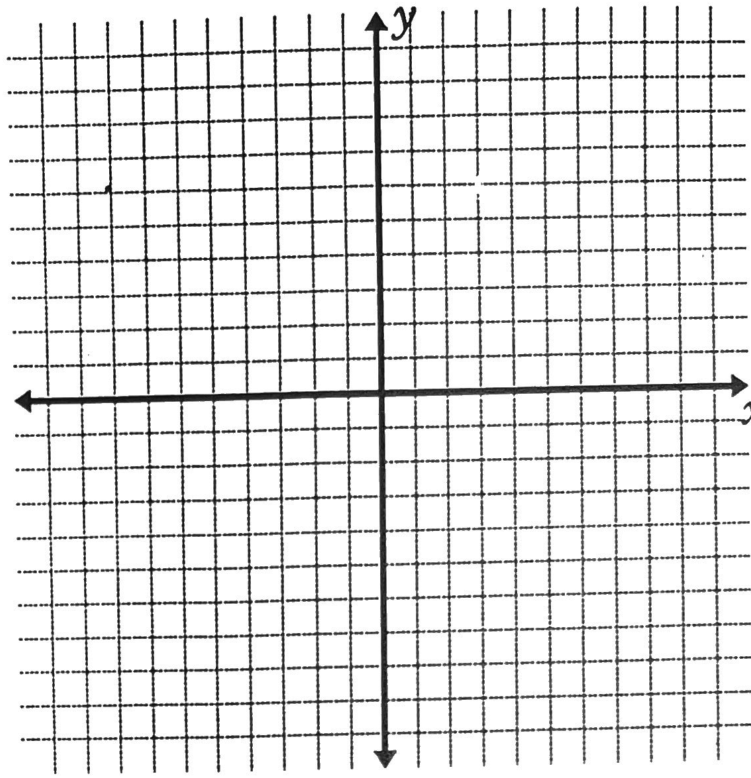
First find 5 on the x-axis.
Draw a vertical line through 5.

Then find ⁻2 on the y-axis.
Draw a horizontal line through ⁻2.
Mark the point where the lines cross.





Number the axes on the grid.
Then plot each point and label it by writing its ordered pair.



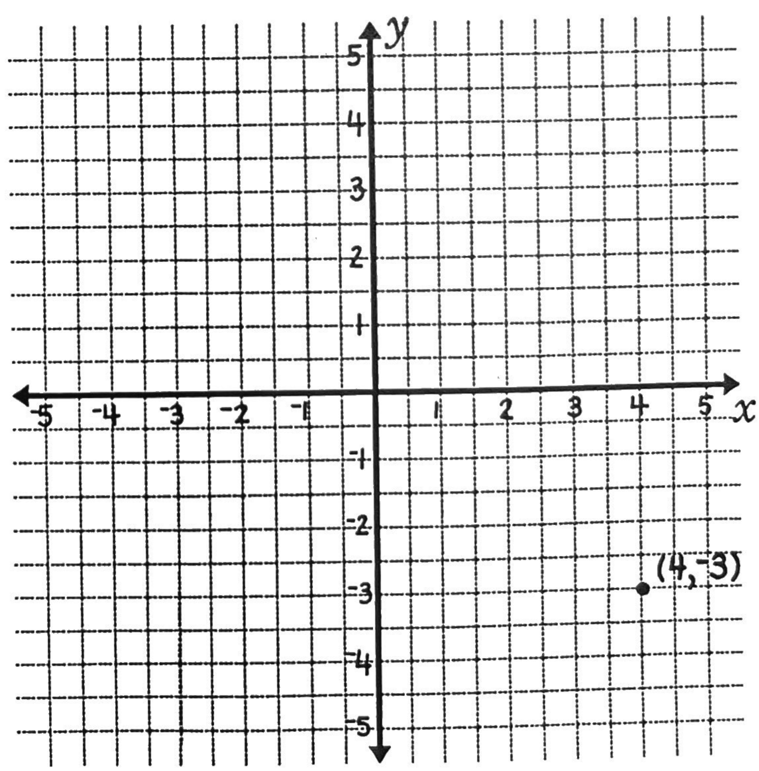
(4,1) (0,6) (⁻2,⁻5)

(7,⁻3) (⁻3,0) (⁻8,8)

(8,8) (8,⁻8) (⁻8,⁻8)

To plot points quickly we can think of the coordinates as directions from the origin (0, 0) to the point. Starting at the origin, count right (+) or left (–) the number of units given by the x-coordinate. From there count up (+) or down (–) the number of units given by the y-coordinate. To find (4, ⁻3) we start at (0, 0) and go right 4, then down 3.

Plot each point by counting. Then label each with its coordinates.



(4,⁻3) (⁻3,4)

(⁻5,⁻2) (2.5,4)

(2,⁻3.5) (0,1.5)

(4.4,4.4) (⁻4.4,⁻4.4)

(⁻1,0) (⁻3.6,0)

Plotting Graphs from Tables

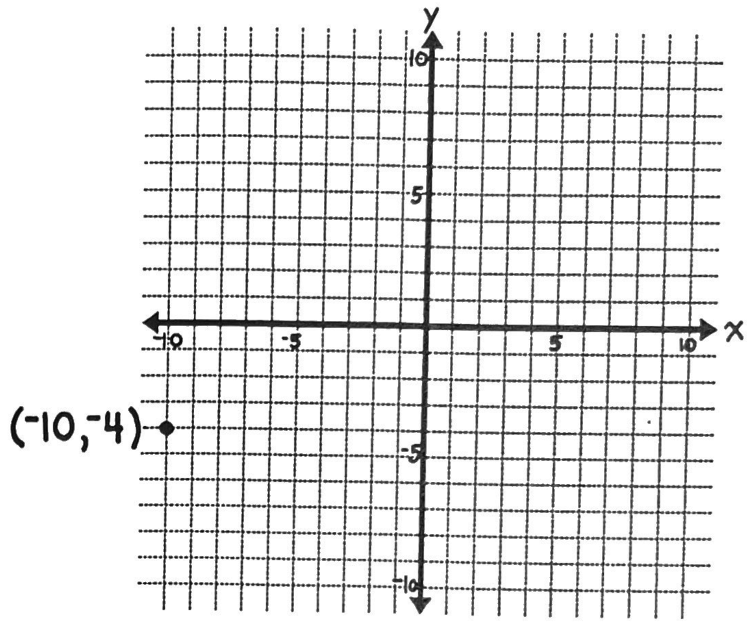
When we have to plot many points we can save work by showing the ordered pairs in a **table.**

Finish plotting the points in the table below. (You don't have to label the points.)

x	y
-10	-4
-8	0
-6	2
-4	3
-2	2
0	0
2	-4
4	-6
6	-7
8	-6
10	-4

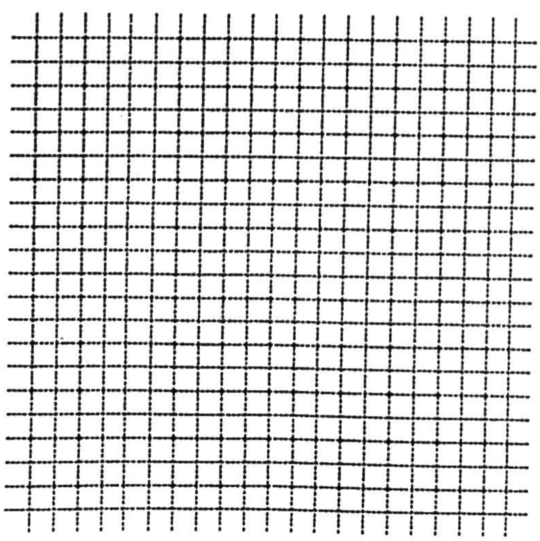
I should plot (-10,-4).

If you plotted all the points correctly, you should see a wave.



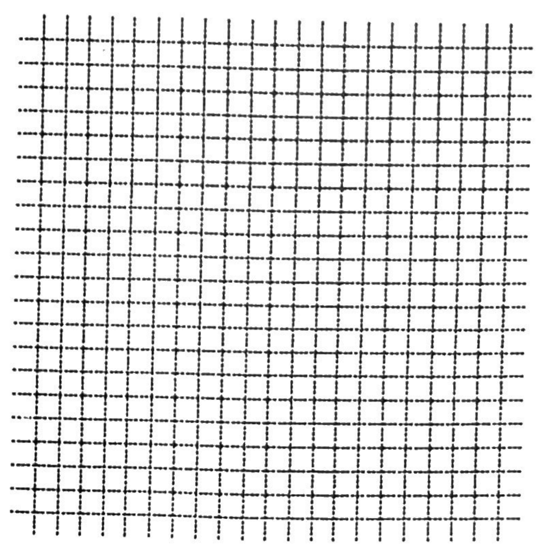
Make a graph for each table. Think about how to place your axes and how to label units so that all the points in the table can be plotted.

x	y
-8	9
-6	7
-4	5
-2	3
0	1
2	-1
4	-3
6	-5
8	-7



The x-axis has to go from 0 to 16.

x	y
0	-2
2	0
4	2
6	0
8	-2
10	0
12	2
14	0
16	-2



Here is a graphical puzzle for you to solve. To see the solution, graph the points in the first table, and connect the points in order. Do the same for each of the other tables. Do not connect points from one table to points from another table.

x	y
-13	2
-13	-2

x	y
-10	-2
-9	-1
-9	1
-10	2
-11	2
-12	1
-12	-1
-11	-2
-10	-2

x	y
-5	-2
-8	-2
-5	1
-6	2
-7	2
-8	1

x	y
-4	0
-2	0

x	y
-3	1
-3	-1

x	y
0	2
0	-2

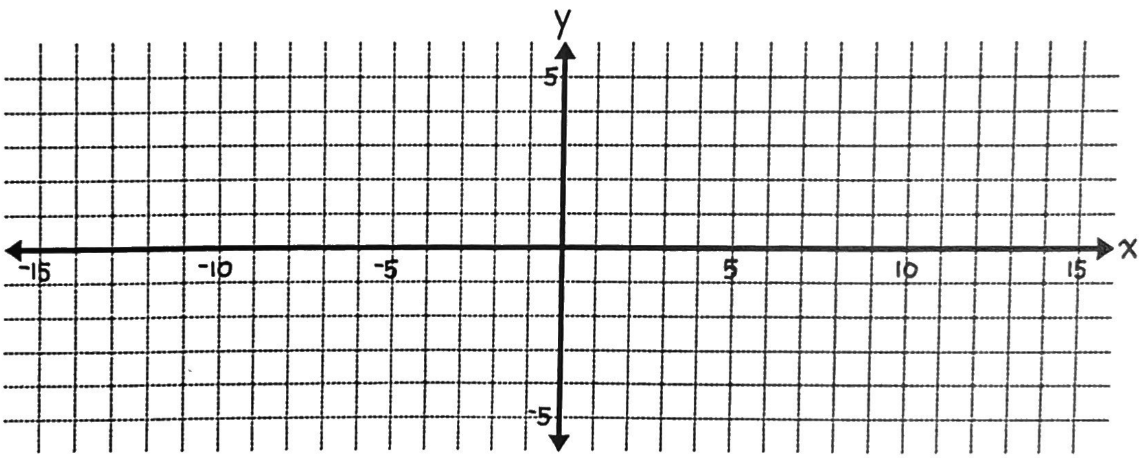
x	y
2	.5
4	.5

x	y
2	-.5
4	-.5

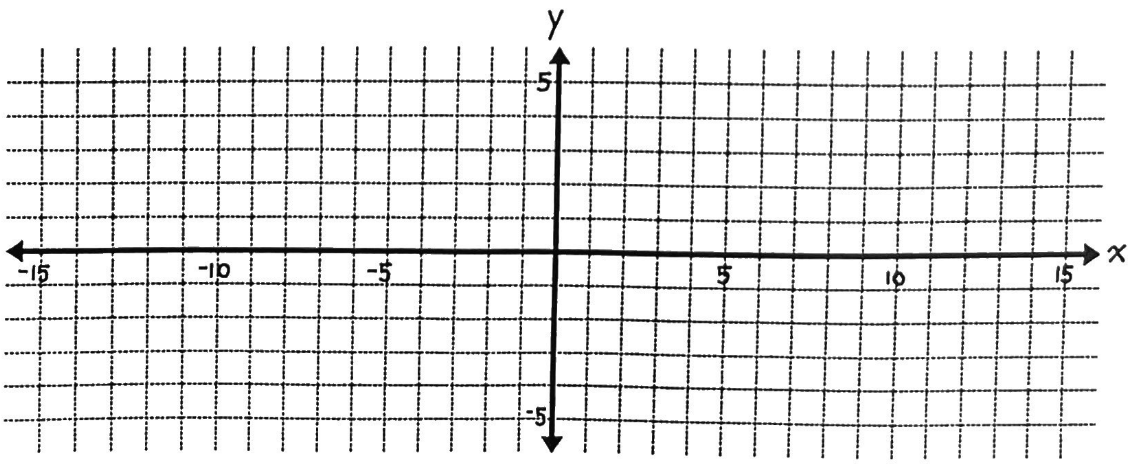
x	y
6	2
6	-2

x	y
7	-1
7	1
8	2
9	2
10	1
10	-1
9	-2
8	-2
7	-1

x	y
11	-2
11	2

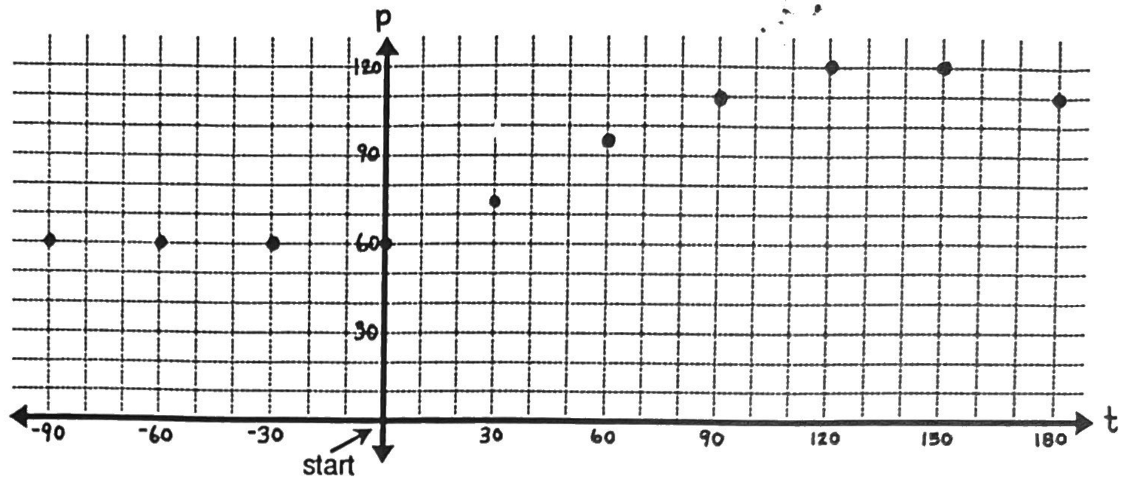


Something's wrong with what you graphed! You can correct it by adding the same number to all of the *y*-coordinates in one of the tables. Show the corrected graph below.

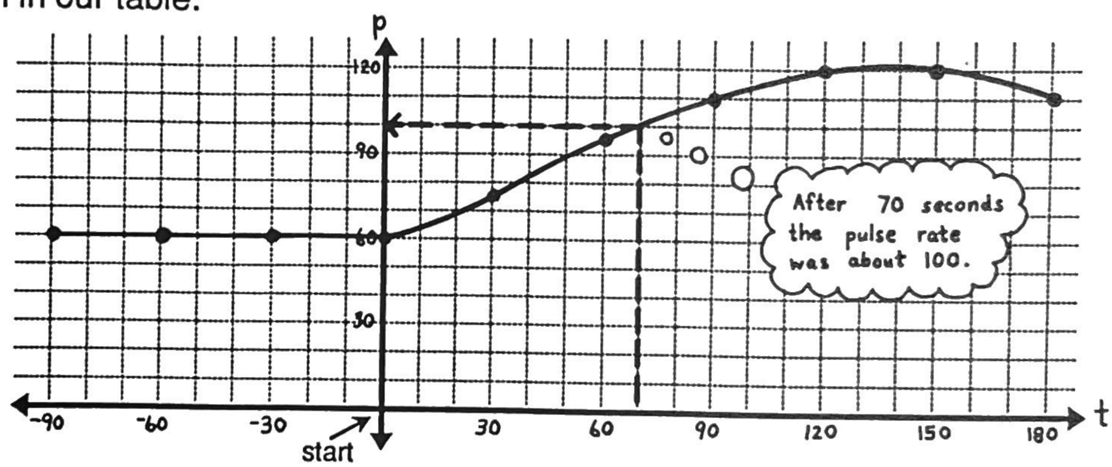


To make a graph showing a person's pulse rate before and after beginning to exercise we could use t to stand for time (in seconds) and p to stand for pulse rate.

t	p
-90	60
-60	60
-30	60
0	60
30	75
60	95
90	110
120	120
150	120
180	110

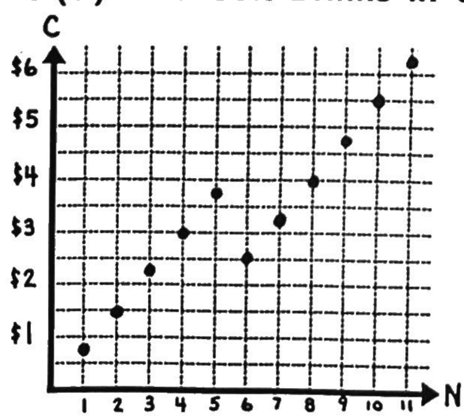


We could also connect the points to show what the pulse rate might have been at times in between those shown in our table.



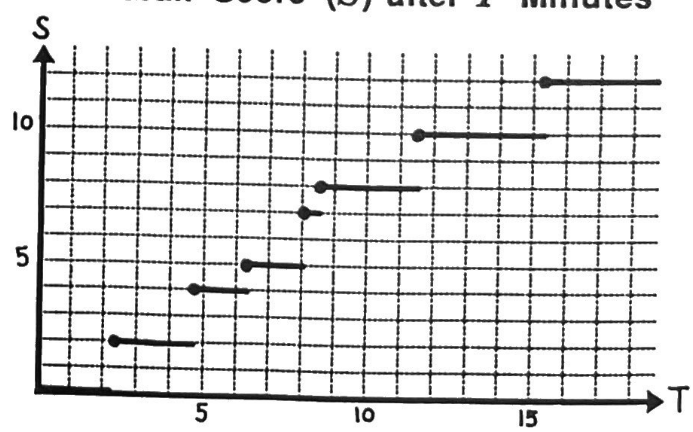
Sometime it makes sense to connect the points in a graph and sometimes it doesn't. Look at these examples.

Cost (*C*) of *N* Soft Drinks in Cans



Points in this graph are not connected because we can't buy a fraction of a soft drink can.

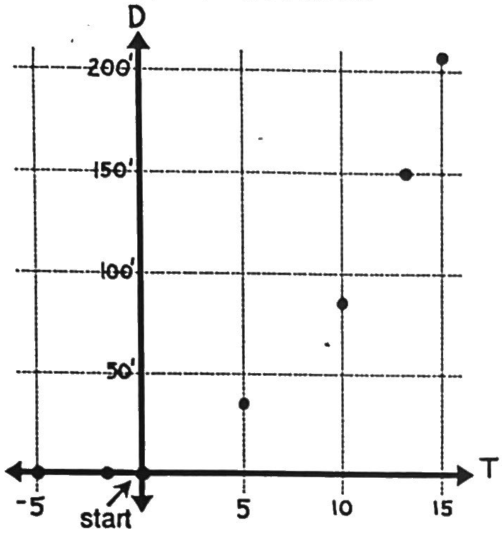
Basketball Score (*S*) after *T* Minutes



This graph shows that the team's score stays the same until another basket is scored, then jumps up one or two points.

Connect the points in each graph if you think it makes sense. If it doesn't, explain why.

Car's Distance (D) after T Seconds

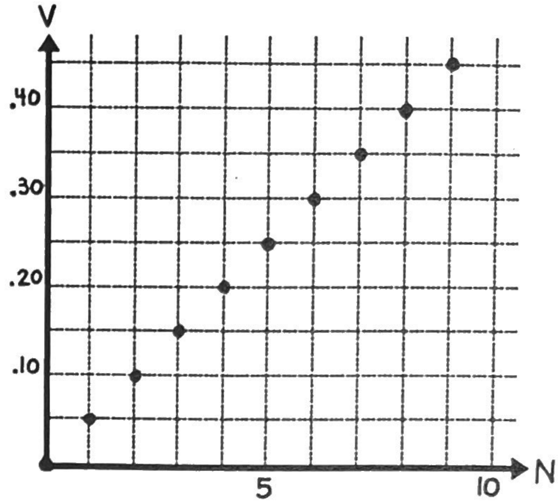


☐ It does make sense to connect the points.
☐ It doesn't make sense. Here's why:

____

____

Value (V) of N Nickels

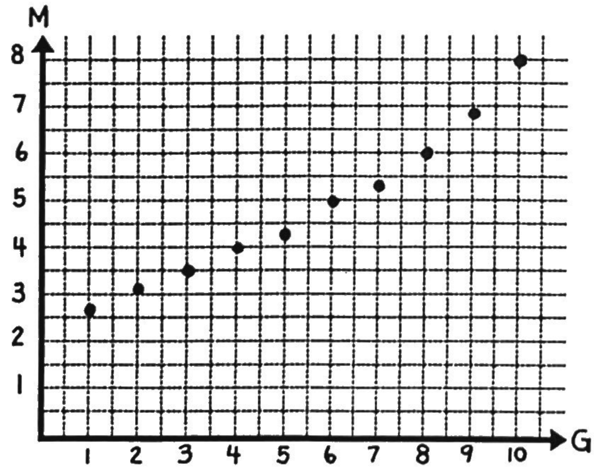


☐ It does make sense to connect the points.
☐ It doesn't make sense. Here's why:

____

____

Meters Traveled in One Pedal Revolution in Gears 1-10 of a Bicycle

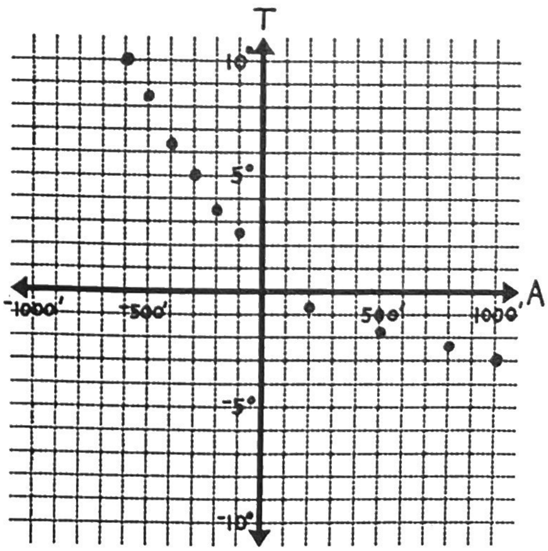


☐ It does make sense to connect the points.
☐ It doesn't make sense. Here's why:

____

____

Temperature at Various Altitudes



☐ It does make sense to connect the points.
☐ It doesn't make sense. Here's why:

____

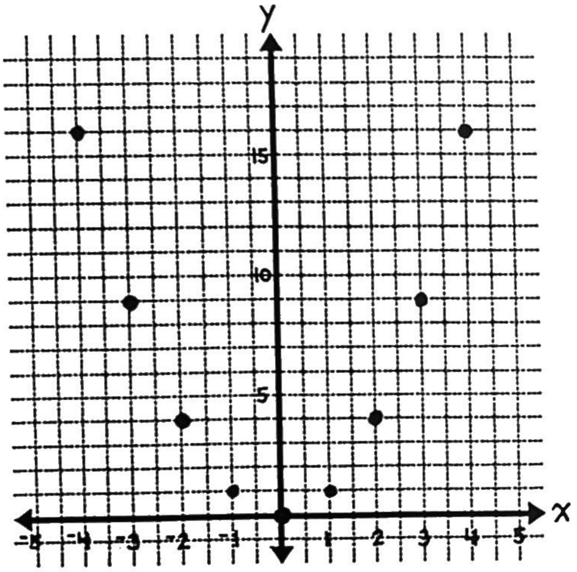
____

When should we connect points in a graph? The following examples show how to decide.

In the first example we are graphing only the squares of *integers*. The x-values in the table include all integers from ⁻4 to 4. No points are missing, so we do not connect the points.

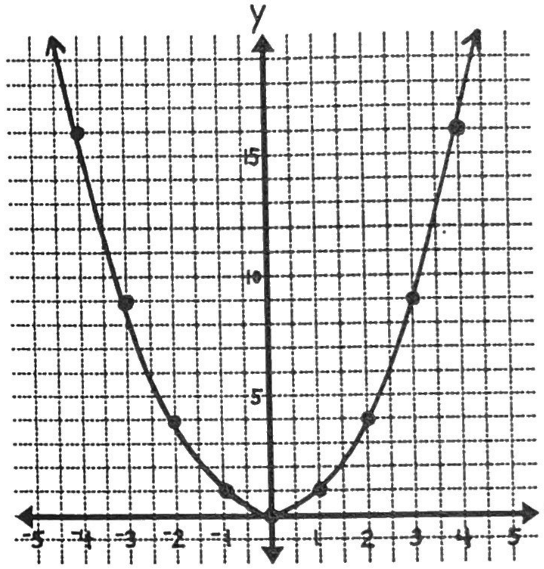
In the second example we are graphing the squares of *rational numbers*. The x-values in the table are all rational, but there are many other rational numbers between those in the table (such as ⁻3.5, .75 and 2.1). To include the squares of these numbers we connect the points we've plotted. If the points form a curve, we try to follow the curve. Arrows on the ends of our curve show that it could continue.

Squares of Integers



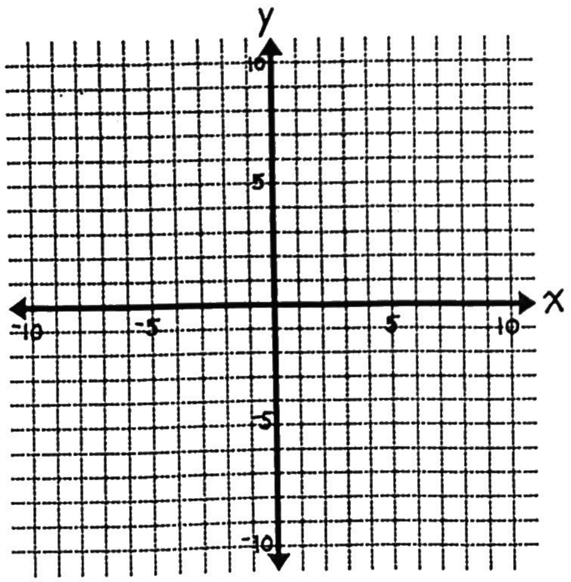
x	y
⁻4	16
⁻3	9
⁻2	4
⁻1	1
0	0
1	1
2	4
3	9
4	16

Squares of Rational Numbers



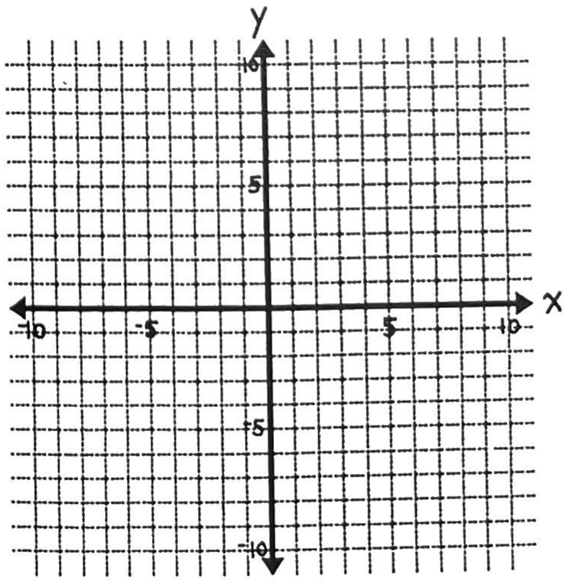
Here are two for you to graph.

Halves of Even Integers



x	y
⁻10	⁻5
⁻8	
⁻6	
⁻4	
⁻2	
0	
2	
4	
6	
8	
10	

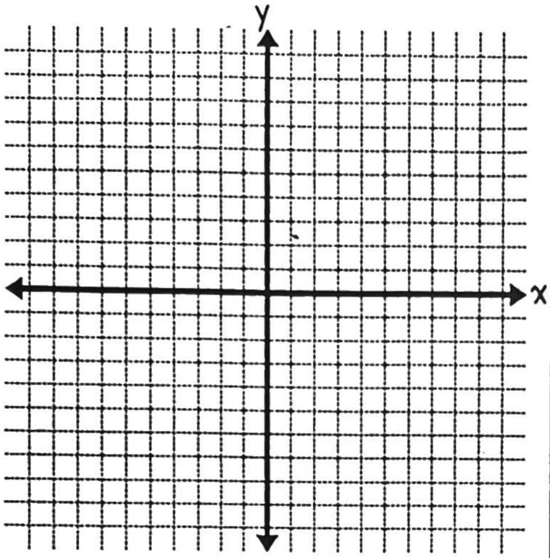
Halves of Rational Numbers



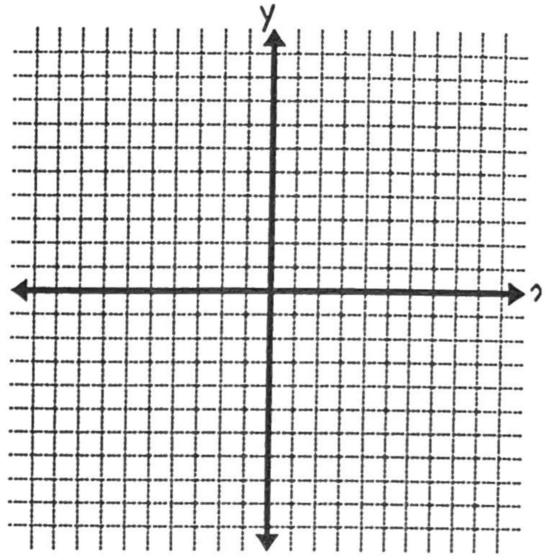
From now on in this book we will assume that x can be any rational number, so we'll connect the points on our graphs.

Plot the points in each table. Then connect the points with a line or smooth curve. Don't forget to label the axes.

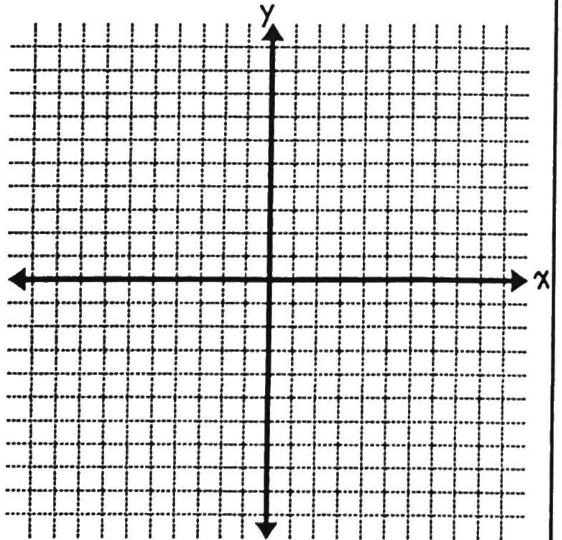
x	y
-10	-6
-7	-5.5
-5	-5
-2	-3
0	0
2	3
5	5
7	5.5
10	6



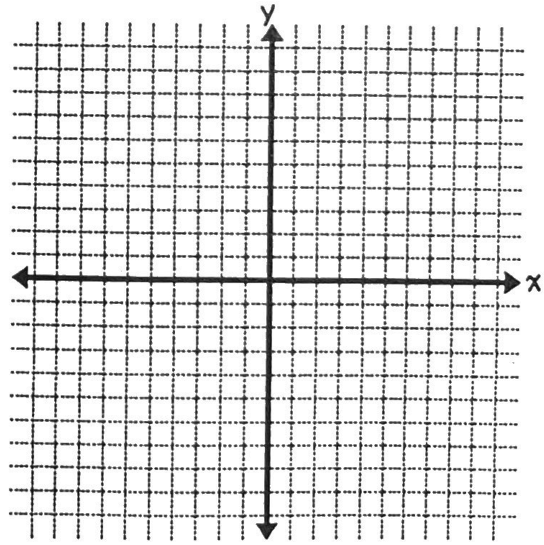
x	y
-10	0
-8	-3
-6	-6
-3	-4
0	-2
3	0
6	2
9	4



x	y
-10	0
-8	6
-6	8
-3	9.5
0	10
3	9.5
6	8
8	6
10	0



x	y
-10	0
-9	-3
-7	-8
-5	-10
-3	-8
-1	-3
0	0
1	3
3	8
5	10
7	8
9	3
10	0



Graphing Equations

To graph an equation we first make a **table of solutions** for the equation. Each solution is an ordered pair of numbers which makes the equation true.

Look at the equation $2x + y = 6$.

y has to be 4.

When $x = 1$, the equation becomes $2 \cdot 1 + y = 6$

(1, 4) is one solution because $2 \cdot 1 + 4 = 6$

We can find more solutions by picking different numbers for x.

Find some other solutions of $2x + y = 6$. Enter each solution in the table.

$2 \cdot$ 8 + -10 = 6, so (8, -10) is a solution.

$2 \cdot$ 5 + ____ = 6, so (,) is a solution.

$2 \cdot$ -1 + ____ = 6, so (,) is a solution.

$2 \cdot$ 2 + ____ = 6, so (,) is a solution.

$2 \cdot$ 6 + ____ = 6, so (,) is a solution.

$2 \cdot$ 0 + ____ = 6, so (,) is a solution.

$2 \cdot$ 3 + ____ = 6, so (,) is a solution.

$2 \cdot$ .5 + ____ = 6, so (,) is a solution.

$2 \cdot$ 2.5 + ____ = 6, so (,) is a solution.

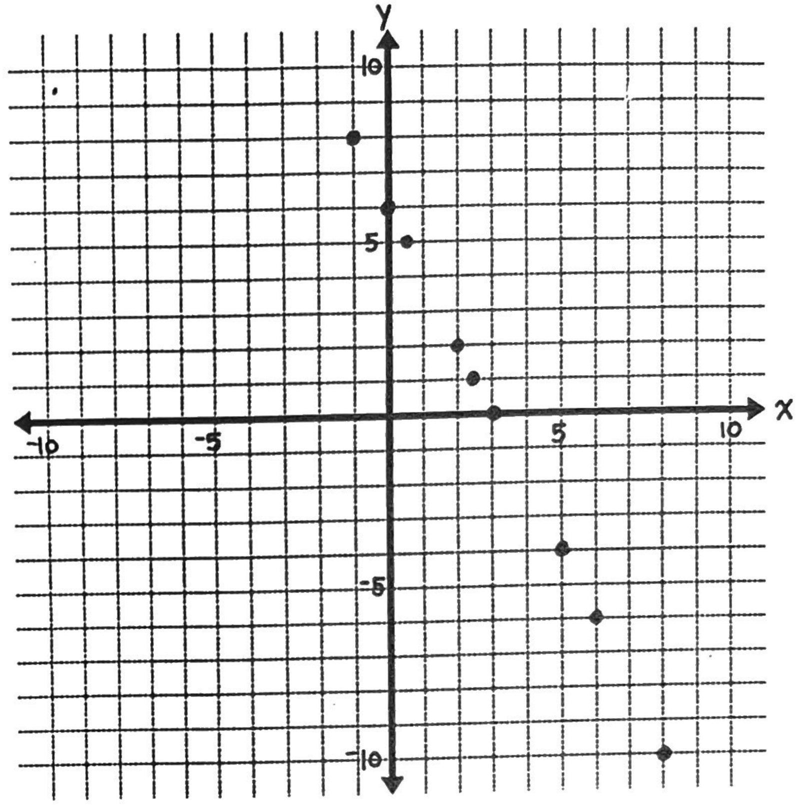
$2 \cdot$ ____ + ____ = 6, so (,) is a solution.

$2 \cdot$ ____ + ____ = 6, so (,) is a solution.

x	y
8	-10

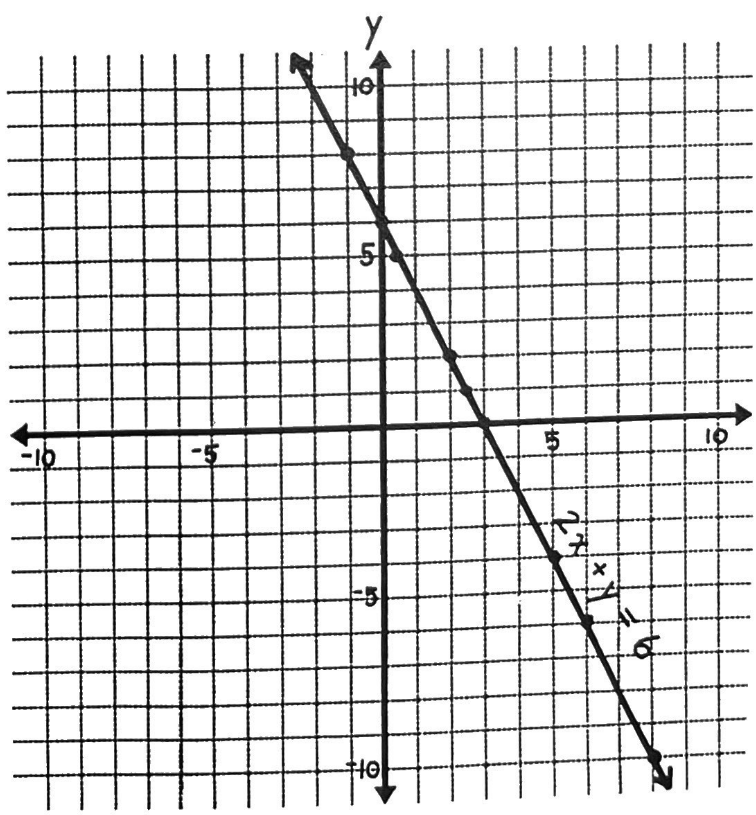
Next we graph the solutions of $2x + y = 6$ that we found on the previous page. Here are the first nine points. Add any other points you found which will fit on this grid.

x	y
8	-10
5	-4
-1	8
2	2
6	-6
0	6
3	0
.5	5
2.5	1



Remember that these are only some of the solutions of $2x + y = 6$.

We could have chosen any rational number for x and found a number for y to satisfy the equation. To show all the solutions of $2x + y = 6$ we need to connect the points we have plotted. In this case the graph is a straight line.



Every point on the line has coordinates which are a solution of the equation. Choose two points on the line which were not in your table. Show that the coordinates of those two points are solutions.

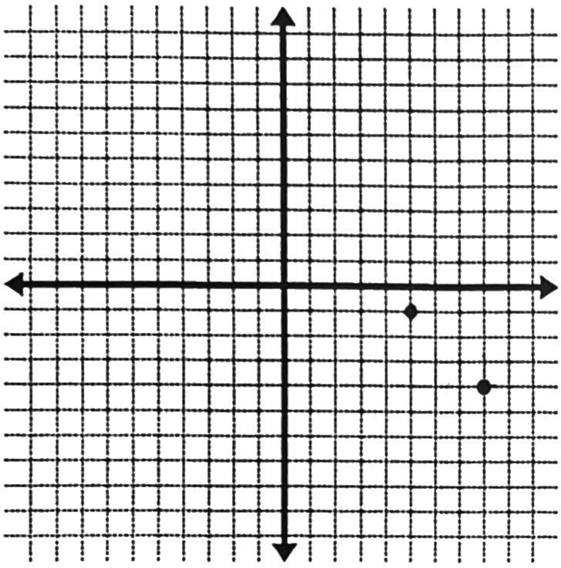
(____, ____) $2 \cdot$ ____ + ____ = 6

(____, ____) $2 \cdot$ ____ + ____ = 6

Finish making the table of solutions for each equation. Then graph the equation.

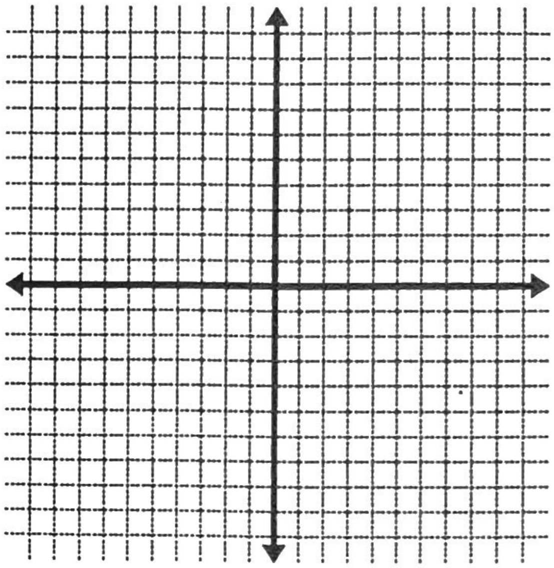
$x + y = 4$

x	y
8	-4
5	-1
1	
0	
-2	
-4	



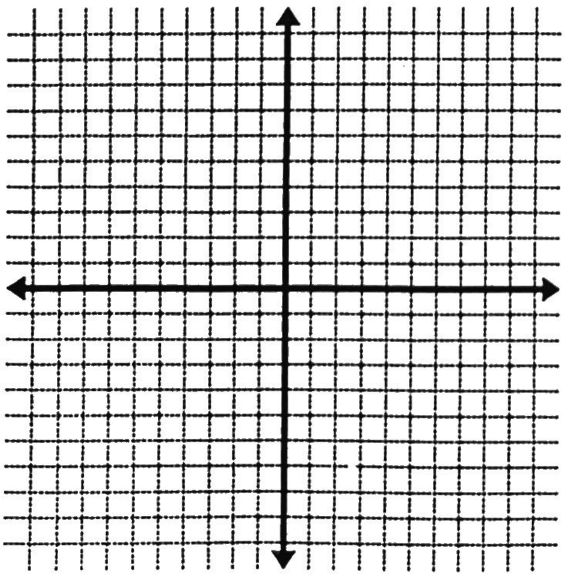
$3x + y = 6$

x	y
-1	
0	
1	
2	
4	
5	



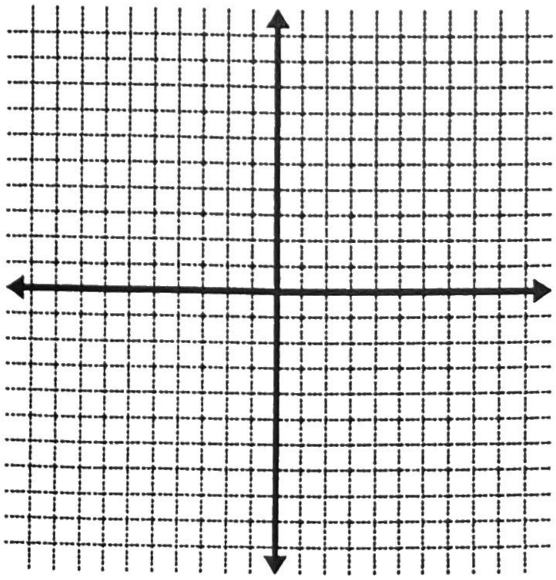
$y = -x$

x	y
10	
7	
3	
0	
-5	
-10	



$x + 2y = 10$

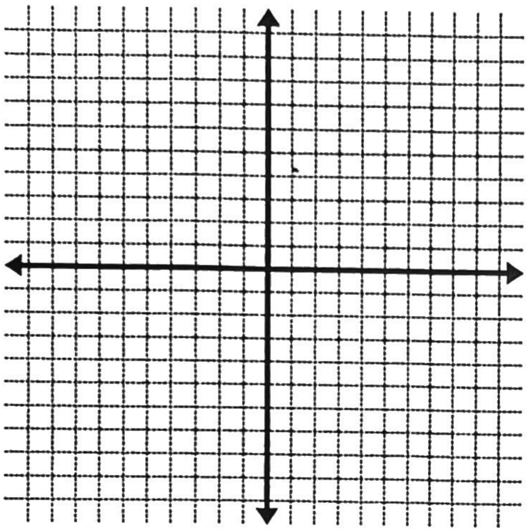
x	y
	10
	7
	5
	3
	1
	0



Make a table of solutions for each equation. Choose six numbers for x and find the values of y that satisfy the equation. One of the numbers you choose for x should be zero. Also choose some positive numbers and some negative numbers. Then graph the equation.

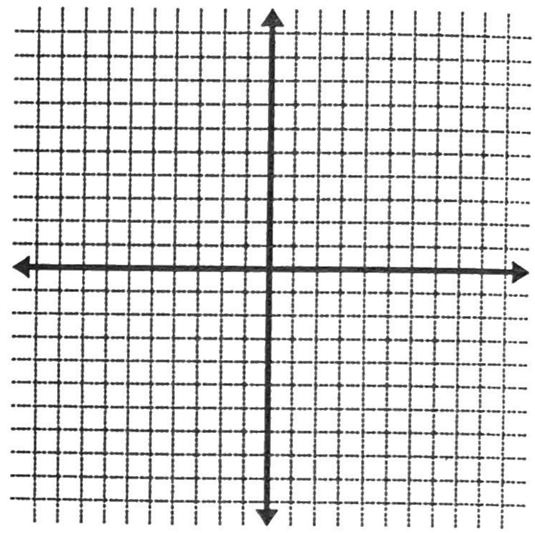
$y + 2x = 5$

x	y

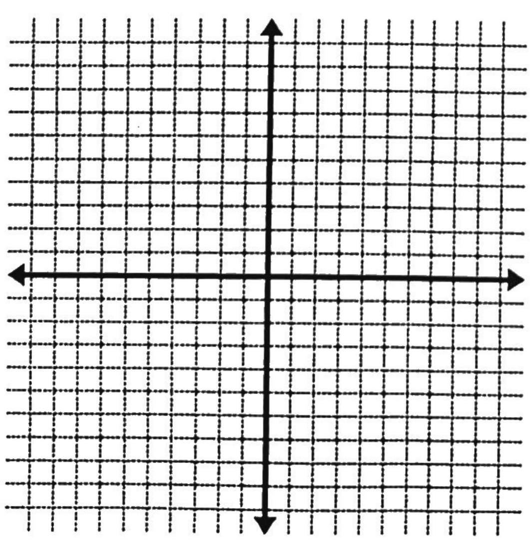


$y = 3x - 5$

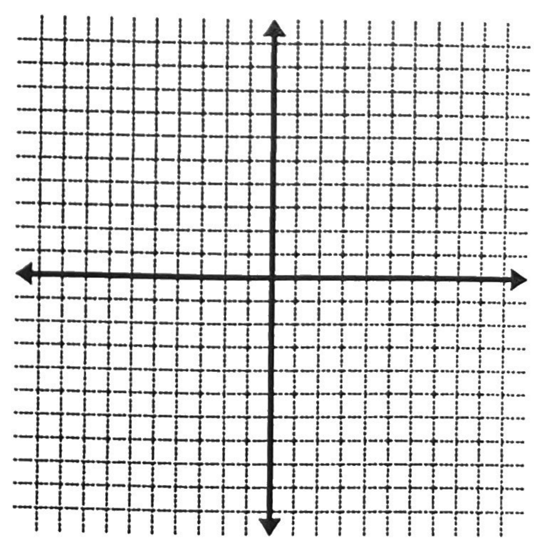
x	y



$x = 2y$

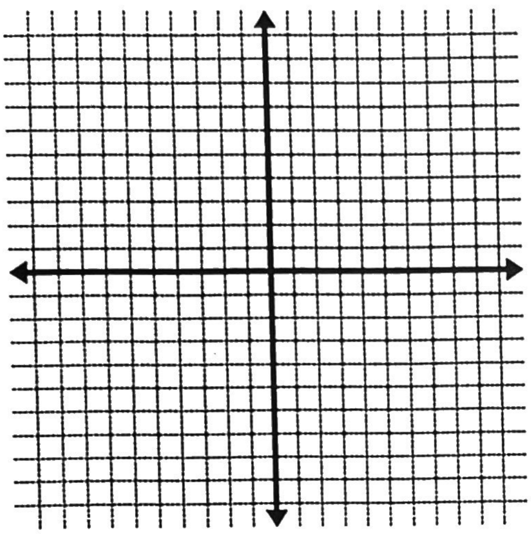


$4x - y = 6$

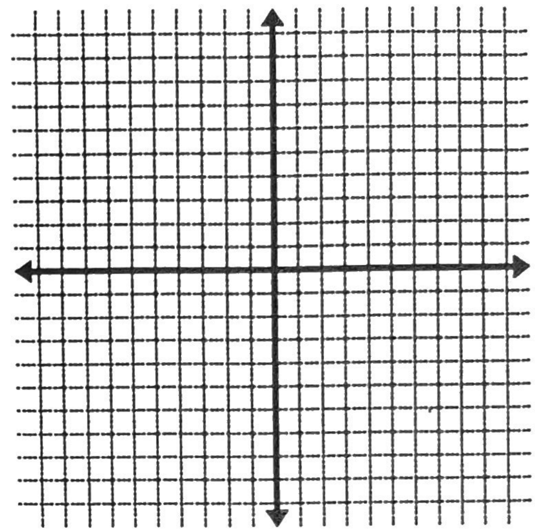


Graph each equation.

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



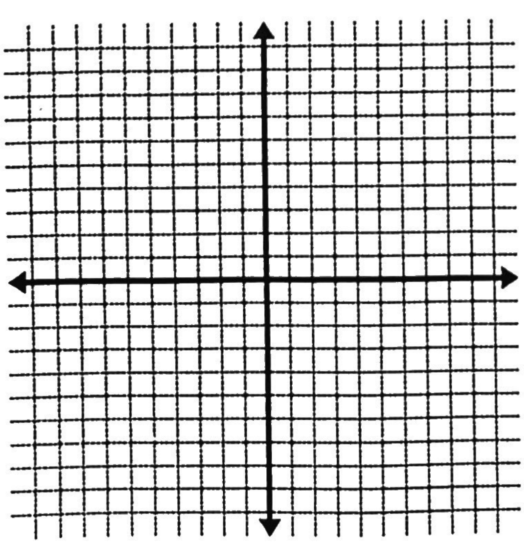
$y = \frac{2x+1}{3}$



Graph each equation. List some positive and some negative numbers for x in your table.

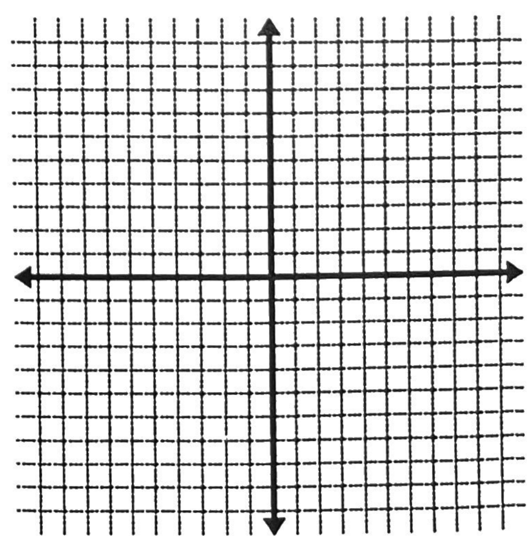
$y = |x| - 4$

x	y
0	



$y = |x + 1|$

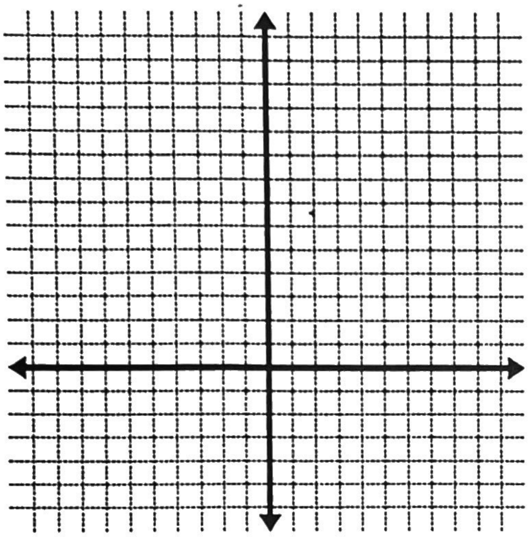
x	y
0	



The graphs of the last two equations were not single straight lines. The graphs of the next two do not even have any straight portions.

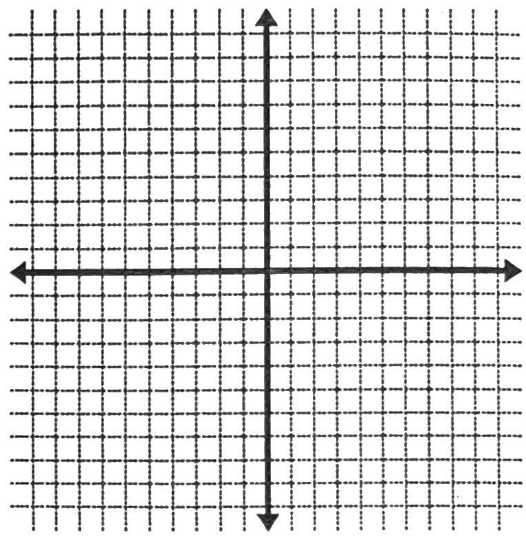
$y = x^2 + 4x$

x	y
2	
1	
0	
-1	
-2	
-3	
-4	
-5	
-6	



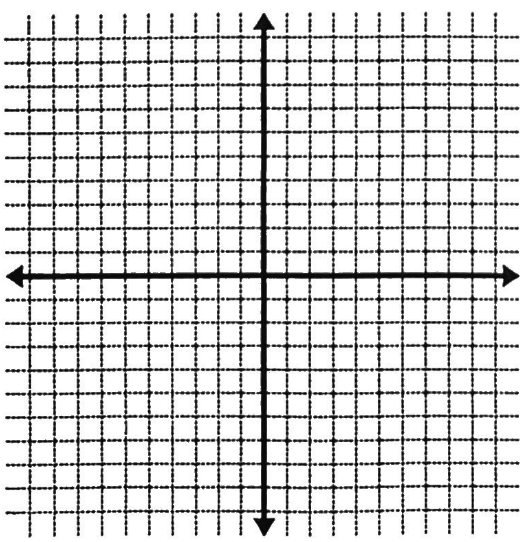
$y = x^2 - 10$

x	y
4	
3	
2	
1	
0	
-1	
-2	
-3	
-4	

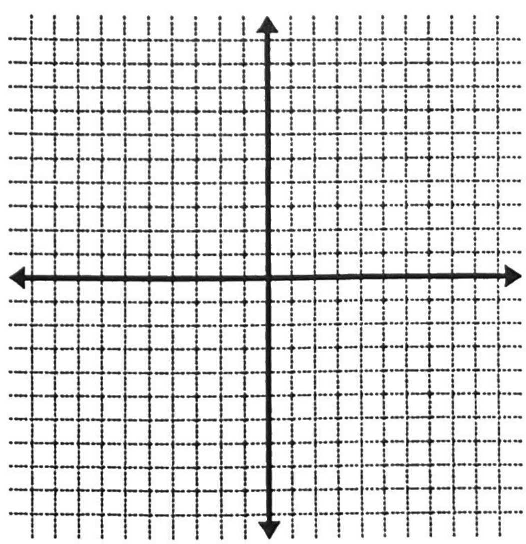


Each of these graphs has two separate parts. To make sure that you graph both parts choose both positive and negative numbers for x.

$xy = 10$



$y = \frac{|x|}{x}$

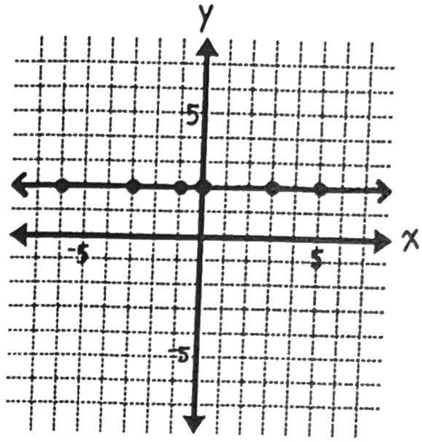


Graphing Equations with Only One Variable

Let's graph the equation $y = 2$. An equivalent equation with two variables is $y = 0x + 2$. When we make our table of solutions for this equation we find that y always is 2 regardless of what number we choose for x.

$y = 2$
$y = 0x + 2$

x	y
5	2
3	2
0	2
$^-1$	2
$^-3$	2
$^-6$	2

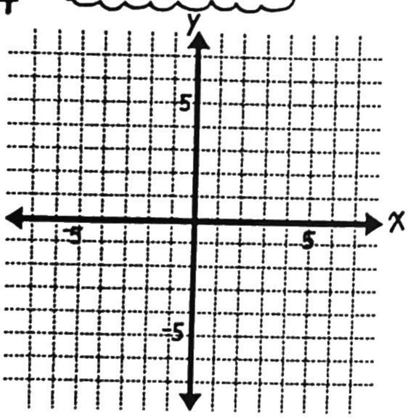


Graph each equation by writing an equivalent equation with two variables and then making a table of solutions.

$y = 4$
$y = 0x + 4$

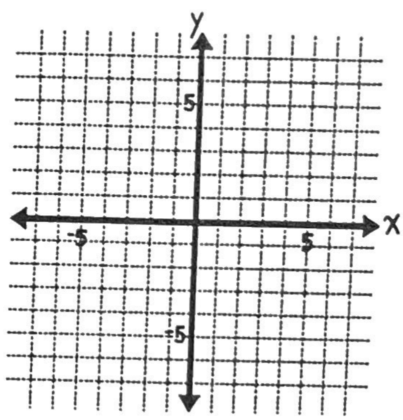
(This term will be 0 no matter what x is.)

x	y



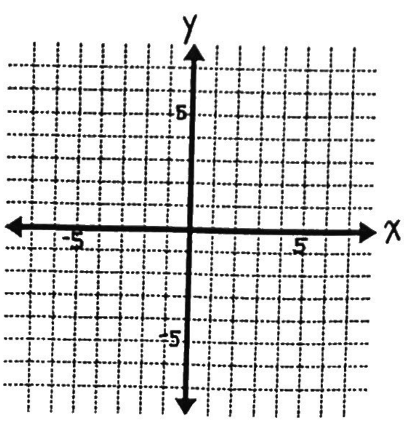
$y = {}^-3$
$y =$

x	y



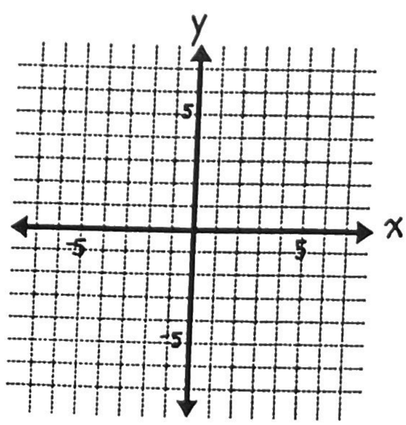
$y = 5$
$y =$

x	y



$y = 0$
$y =$

x	y



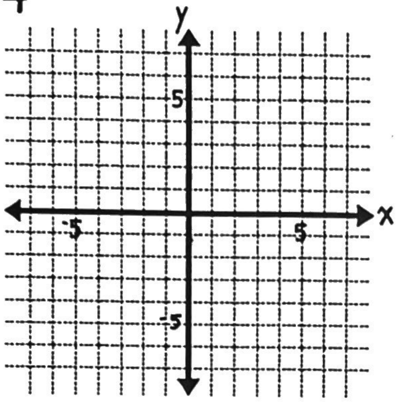
Can you guess how to graph an equation which contains only the variable x?

For each equation below find an equivalent equation with two variables. Then graph the equation.

$x = 4$

$x = 0y + 4$

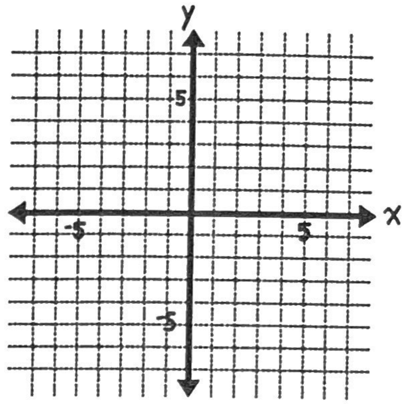
x	y



$x = {}^-2$

$x =$

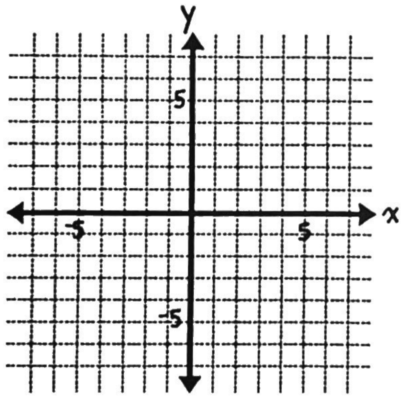
x	y



$x = 1$

$x =$

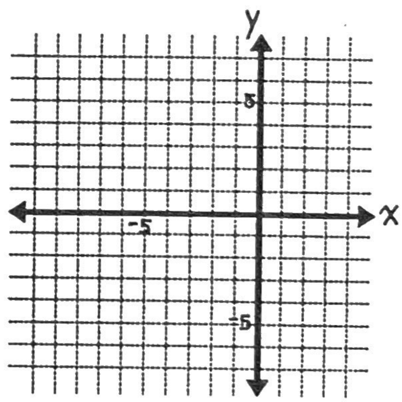
x	y



$x = {}^-8$

$x =$

x	y



In what way are the graphs on page 16 alike? ____________________

In what way are the graphs on this page alike? ____________________

Use a ruler to draw a pair of axes. Then graph each equation below. See if you can do this without making tables.

$y = 5$

$x = {}^-3$

$x = 3$

$y = {}^-1$

Linear Equations

Some equations are called **linear** because their graphs are single straight lines. (From now on we will use "line" to mean "straight line.")

Look back at the graphs on pages 12 to 15. List at least five equations which are linear and five equations which are not linear.

linear	*not linear*
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

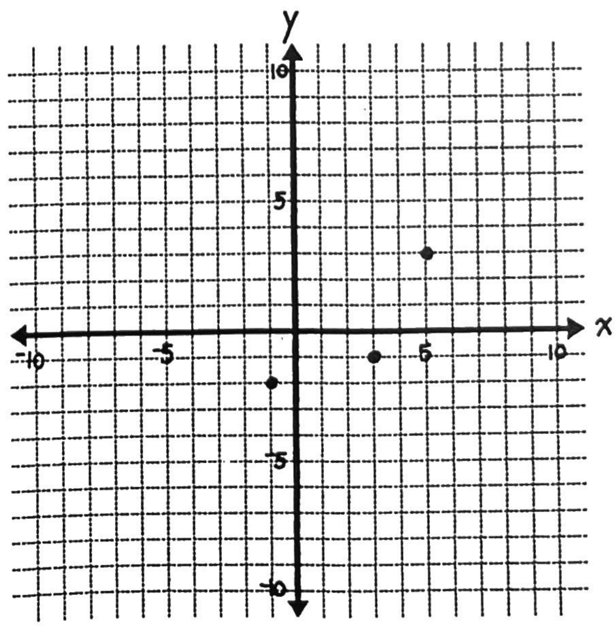
Did you notice that in the linear equations the terms with variables are all first degree terms? The equations which are not linear contain terms of higher degree or absolute values of variables.

Linear equations are easy to graph because we need to plot only two points to draw a line. But it is better to plot three points just to be safe. If the three points are not in line, then we know we made an error.

Find the error in the table below. Cross out the point that doesn't belong and draw the graph.

$x - 4y = 7$

x	y
-1	-2
5	3
3	-1



Graph each linear equation by making a table and plotting three points.

$y = x + 6$

$y = 3x - 4$

$y = 10 - x$

$4x + y = 6$

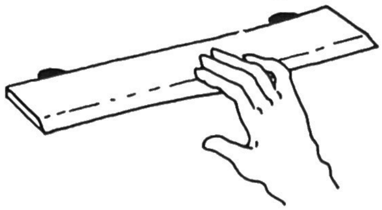
$y = {}^{-}3x$

$y - 2x = 2$

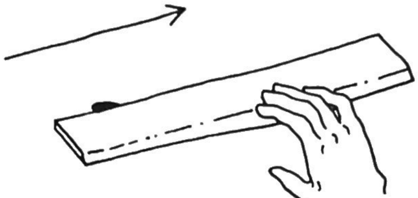
The Slope of a Line

If we want to give someone directions for drawing a line, we can do it two ways:

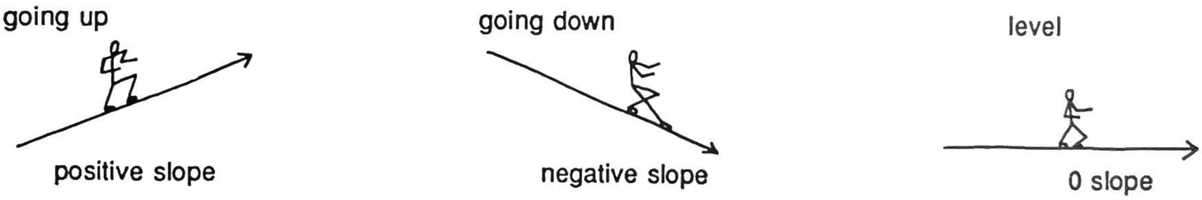
(1) We can give two points the line should go through.



(2) We can give the slant of the line and one point it should pass through.



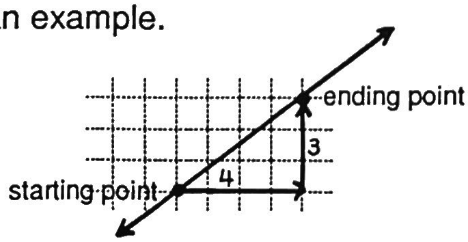
We use a positive or negative number or 0 to describe a line's slant. This number is called its **slope.** To get a picture of positive, negative and 0 slopes, you can think of someone walking from left to right:



We find the slope by figuring out how far to the right (+) or left (–) and how far up (+) or down (–) we have to go to get from one point on the line to another. Then we make a fraction from the two distances as follows.

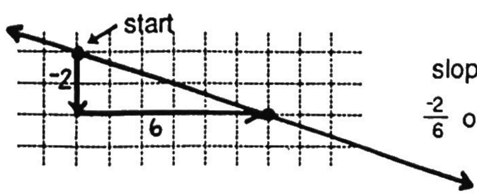
$$\text{slope} = \frac{\text{distance up or down}}{\text{distance right or left}} = \frac{\textbf{rise}}{\textbf{run}}$$

Here is an example.

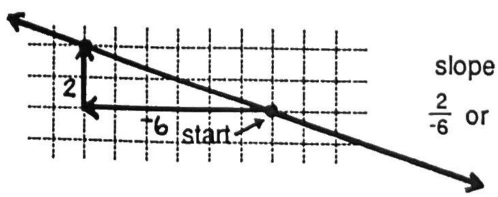


$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{3}{4}$$

It doesn't matter which point we start with. The number will be the same either way.

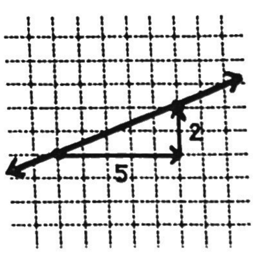


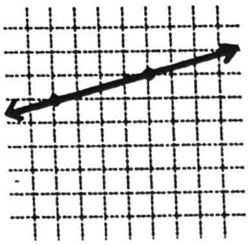
slope is $\frac{-2}{6}$ or $\frac{-1}{3}$

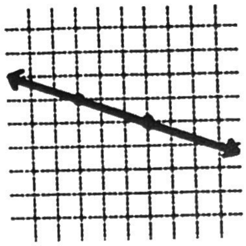


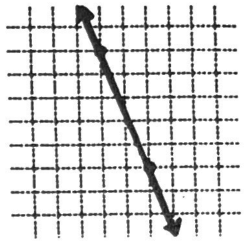
slope is $\frac{2}{-6}$ or $\frac{-1}{3}$

Find the slope of each line. Simplify the slope or write it as an integer if you can.

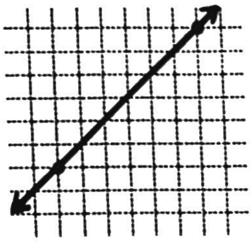


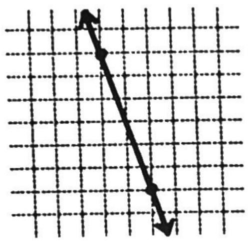


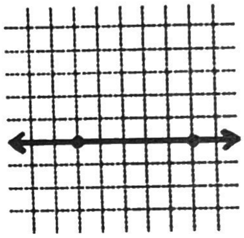


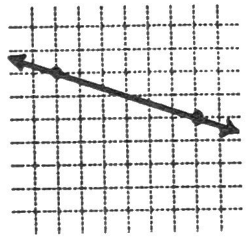


______ ______ ______ ______



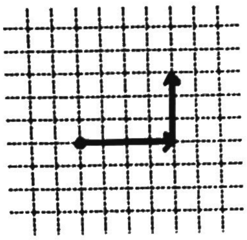




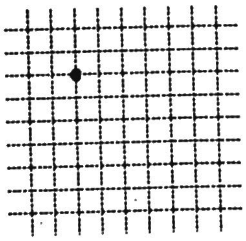


______ ______ ______ ______

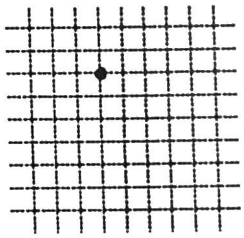
Through each point draw a line that has the slope shown below the grid. Use a ruler.



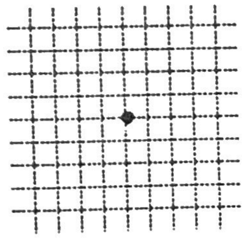
$\frac{3}{4}$



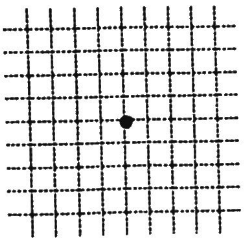
$\frac{-3}{4}$



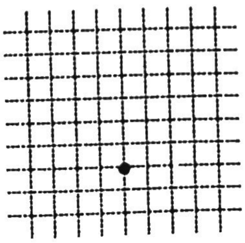
$\frac{-3}{2}$



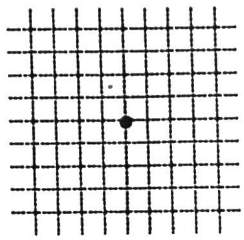
$\frac{3}{2}$



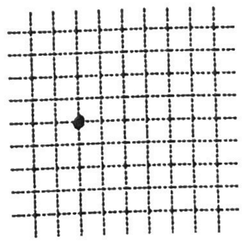
4 (4 equals $\frac{4}{1}$.)



$\frac{1}{3}$

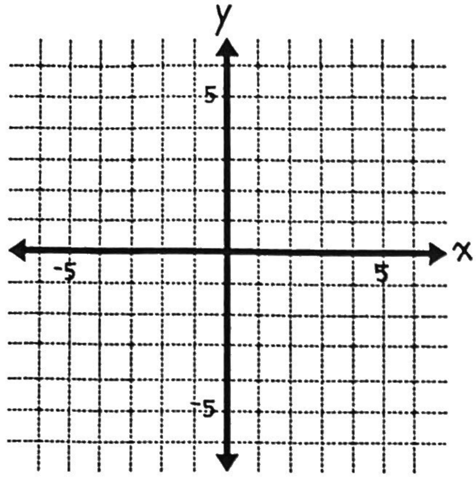


-2

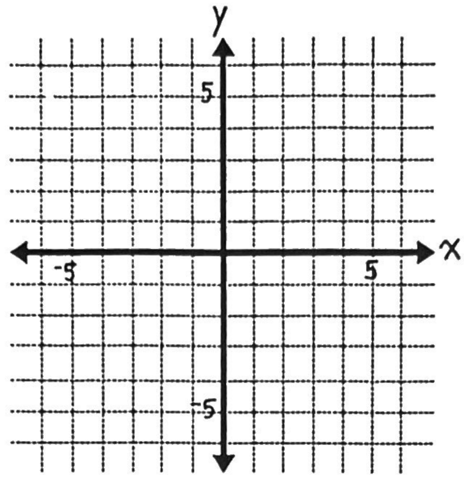


$\frac{1}{2}$

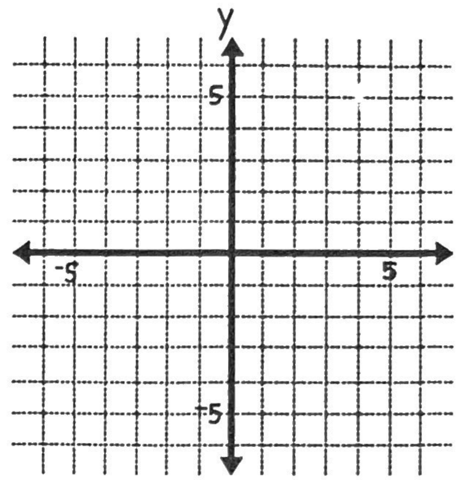
In each problem first plot the given point. Then use a ruler to draw a line through the point with the given slope.



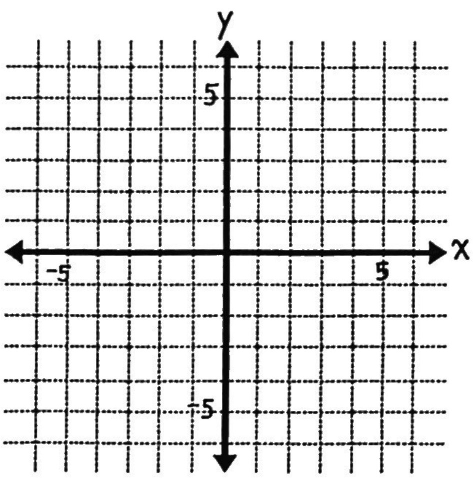
(-2, -4) slope: $\frac{5}{3}$



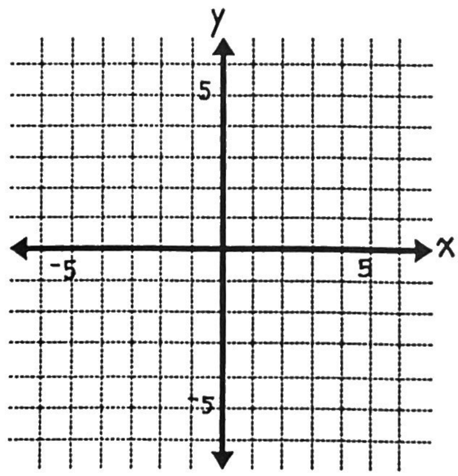
(1, 1) slope: $\frac{2}{3}$



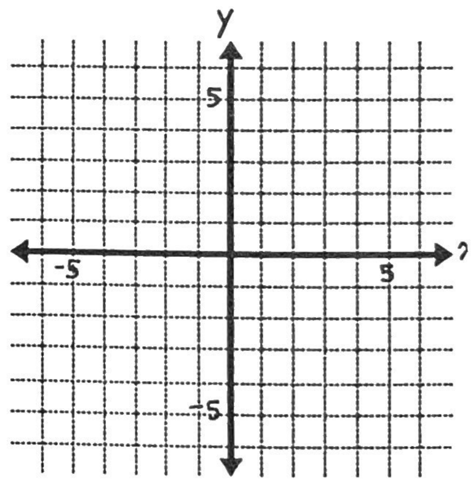
(-3, 1) slope: 2



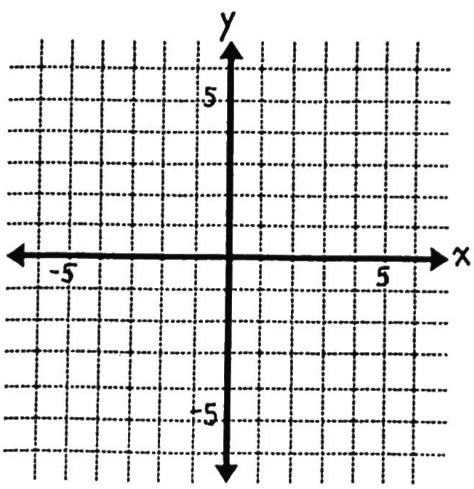
(0, 0) slope: $\frac{1}{5}$



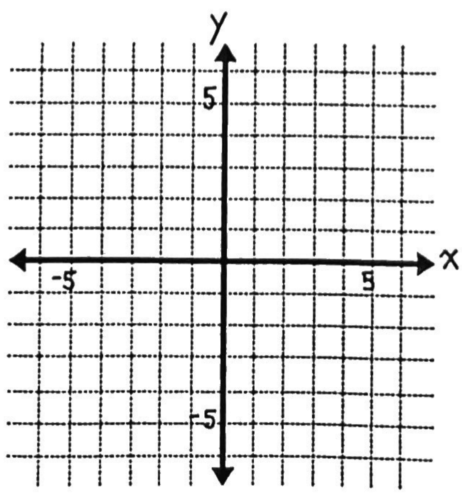
(-4, 1) slope: $\frac{-1}{4}$



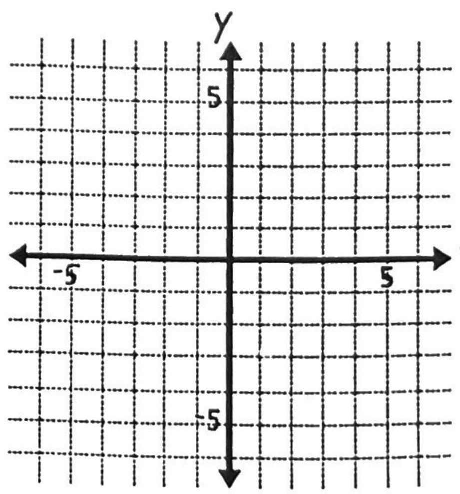
(-3, -5) slope: 3



(0, 5) slope: $\frac{-3}{4}$



(0, -3) slope: 1

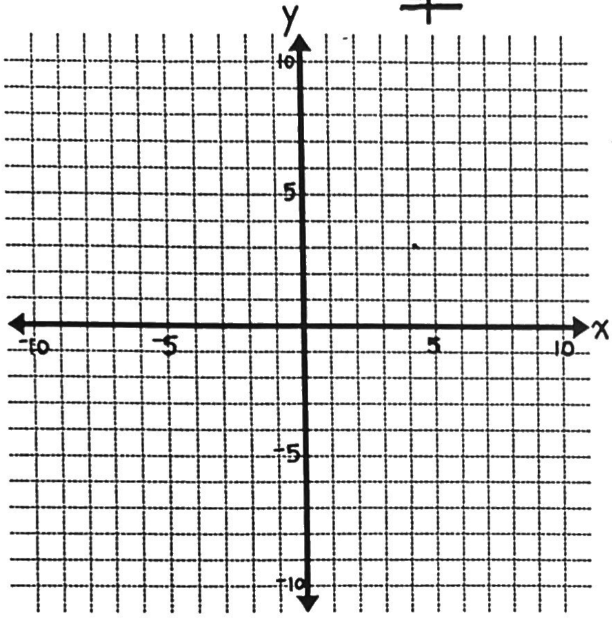


(0, 1) slope: -1

Graph each linear equation by making a table and plotting three points. Then find the slope of the graph.

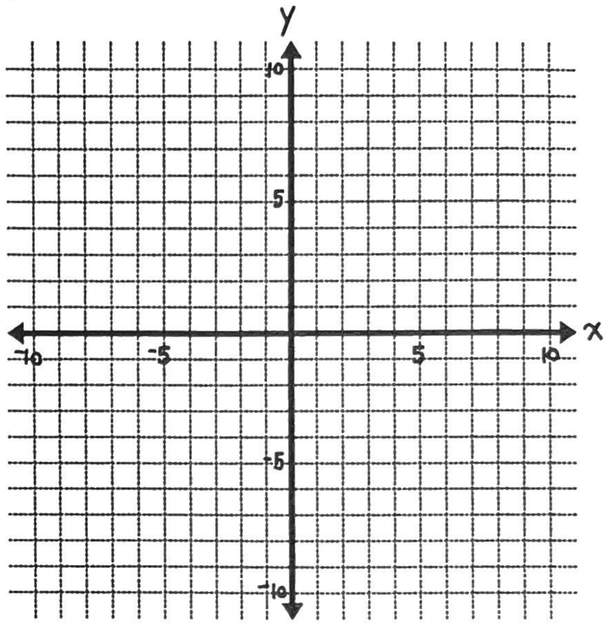
$y = 2x - 3$

x	y
0	
5	
-2	



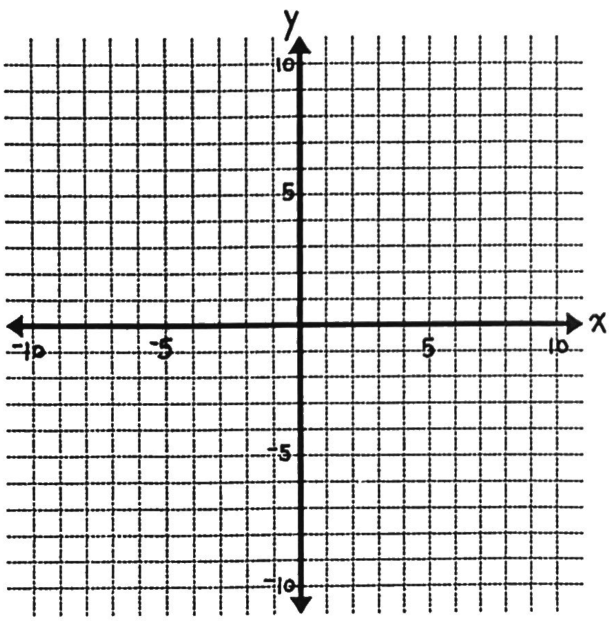
slope: ________

$y = \frac{1}{4}x + 2$



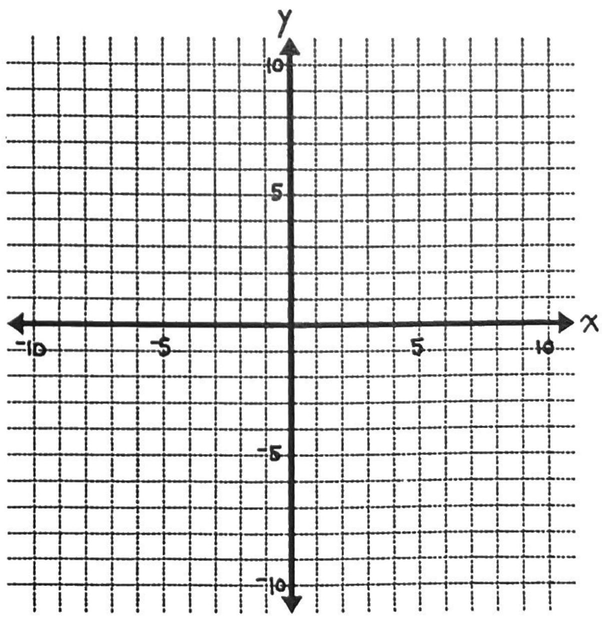
slope: ________

$y = -3x + 4$



slope: ________

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



slope: ________

.ook at the equations on page 23. Did you notice that the slope of each graph appears ight in the equation?

$$y = \textcircled{2}x - 3 \qquad y = \textcircled{\tfrac{1}{4}}x + 2$$

$$y = \textcircled{{}^-3}x + 4 \qquad y = \textcircled{\tfrac{-1}{2}}x + 6$$

This always happens in linear equations which have only y on one side. This means we can graph the equation by plotting only *one* point and then using the slope to draw the line.

The easiest point to plot is the point whose x-coordinate is 0. You can see why by looking at the equation $y = 2x + 5$. When $x = 0$, then $y = 5$. So the point is (0, 5).

This is the point where the graph crosses the y-axis. It is called the ***y*-intercept**. By just looking at the equation we can see both the slope and the y-intercept.

slope ↙ y-intercept ↙

$$y = \textcircled{2}x + \textcircled{5}$$

Write the slope and the y-intercept of the graph for each equation.

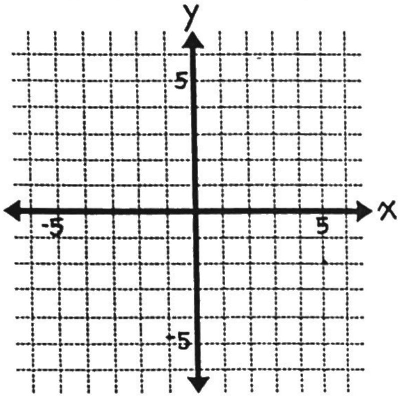
	slope	*y-intercept*
$y = 5x + 2$	______	______
$y = \frac{1}{3}x + 6$	______	______
$y = \frac{3}{2}x + 9$	______	______
$y = \frac{-1}{4}x + 4$	______	______
$y = {}^-9x + 1$	______	______
$y = x + 1$ ($y = 1x + 1$)	______	______
$y = x + 6$	______	______
$y = 2x$ ($y = 2x + 0$)	______	______
$y = {}^-3x$	______	______

	slope	*y-intercept*
$y = 2x - 7$ ($y = 2x + {}^-7$)	______	______
$y = 3x - 1$	______	______
$y = \frac{1}{5}x - 4$	______	______
$y = {}^-2x + 6$	______	______
$y = \frac{3}{4}x - 5$	______	______
$y = -x + 2$ ($y = {}^-1x + 2$)	______	______
$y = -x - 10$	______	______
$y = \frac{1}{3}x$	______	______
$y = \frac{-5}{3}x$	______	______

Write the slope and y-intercept. Then plot the y-intercept and finish the graph by drawing a line through that point with the proper slope.

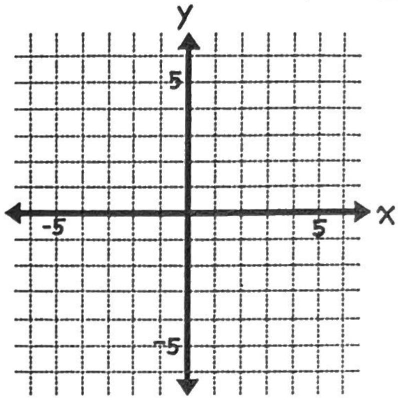
$y = 2x - 5$

slope: ______ y-intercept: ______



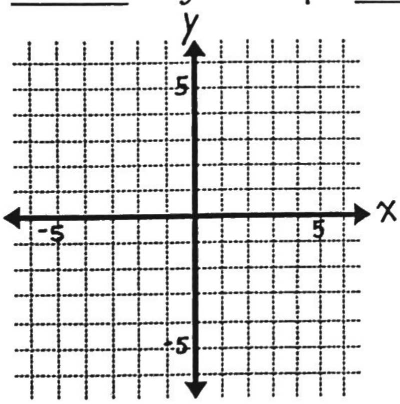
$y = \frac{1}{3}x + 2$

slope: ______ y-intercept: ______



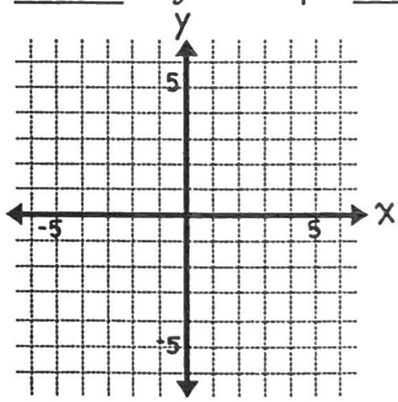
$y = \frac{-2}{5}x + 1$

slope: ______ y-intercept: ______



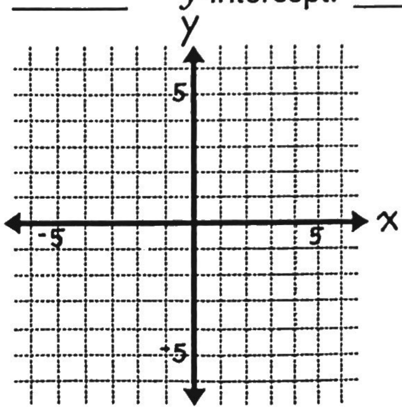
$y = \frac{3}{4}x$

slope: ______ y-intercept: ______



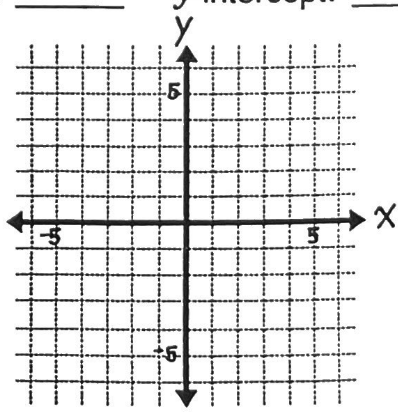
$y = x - 3$

slope: ______ y-intercept: ______



$y = -x + 4$

slope: ______ y-intercept: ______



Writing Linear Equations in the Form $y = mx + b$

If we want to use the slope and y-intercept to graph an equation like $4x + 3y = 6$, we first have to **solve the equation for y**. That means to find an equivalent equation in the form $y = mx + b$, where m is the slope and b is the y-intercept. To do that we use the Addition and Division Principles to get the y-term by itself on one side of the equation.

$$4x \overset{-4x}{} + 3y = \overset{-4x}{} 6$$

$$3y = {}^{-}4x + 6$$

$$\frac{\not{3}y}{\not{3}} = \frac{{}^{-}4x + 6}{3}$$

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

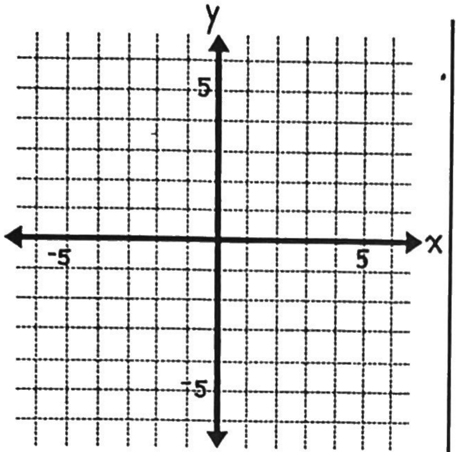
Now we can see that the slope is $\frac{-4}{3}$ and the y-intercept is 2.

Solve each equation for y. Write the slope (m) and y-intercept (b) of the graph.

$5x + 2y = 12$ $m =$ ______ $b =$ ______	$6x + 2y = 10$ $m =$ ______ $b =$ ______	$4y - 3x = 20$ $m =$ ______ $b =$ ______
$x + y = 8$ $m =$ ______ $b =$ ______	$x - 2y = 6$ $m =$ ______ $b =$ ______	$x + 3y = 15$ $m =$ ______ $b =$ ______

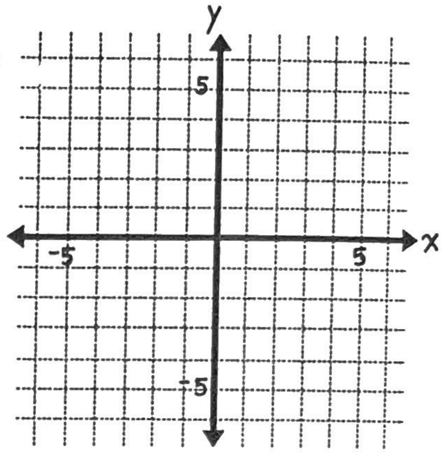
Solve each equation for y. Write the slope and y-intercept. Then use these to graph the equation.

$2x + 3y = 12$



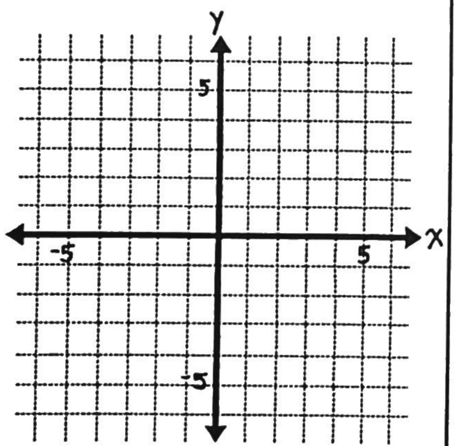
$m =$ ______ $b =$ ______

$5x - 2y = 8$



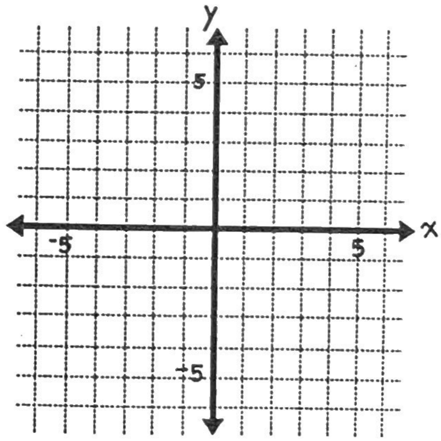
$m =$ ______ $b =$ ______

$x + y = 3$



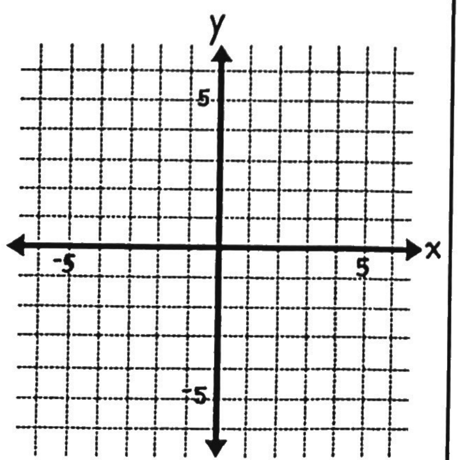
$m =$ ______ $b =$ ______

$3x - y = 2$



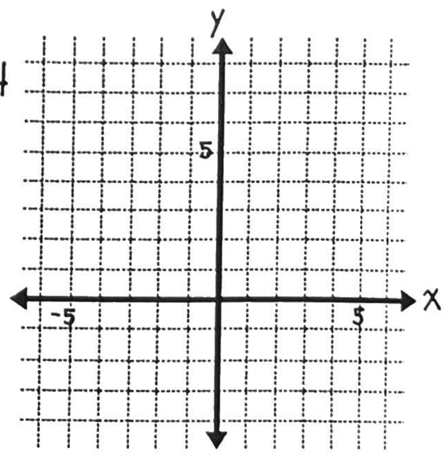
$m =$ ______ $b =$ ______

$5x - 10y = 0$



$m =$ ______ $b =$ ______

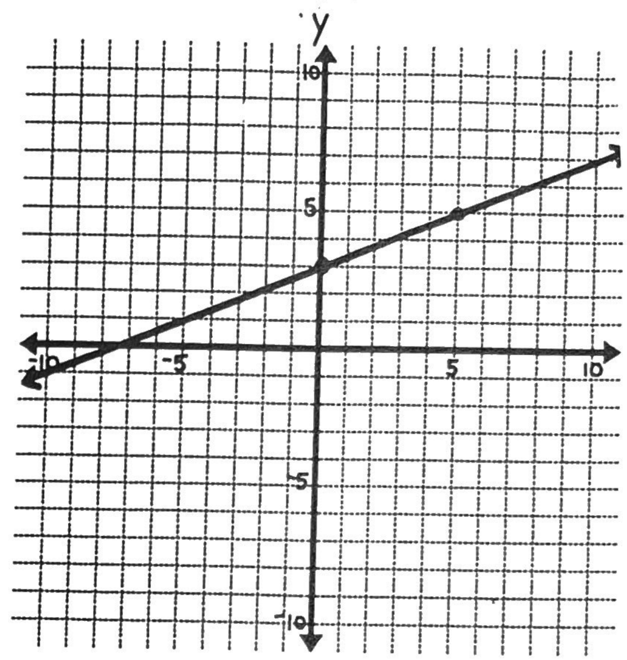
$x - 4y = {}^{-}24$



$m =$ ______ $b =$ ______

Finding the Equation of a Line

Every line is the graph of some linear equation. Can you guess the equation of the graph to the right?



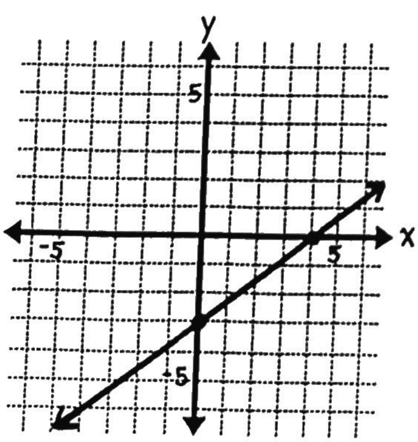
Its slope is ______.

Its y-intercept is ______.

So its equation is $y =$ ______ $x +$ ______.

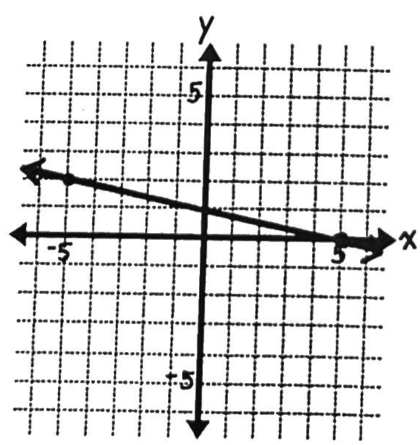
To write the equation for a line, we find its slope (m) and y-intercept (b). The equation is $y = mx + b$. In the graph above the slope is $\frac{2}{5}$ and the y-intercept is 3, so the equation is $y = \frac{2}{5}x + 3$.

For each line below find the slope and y-intercept. Then write the equation.



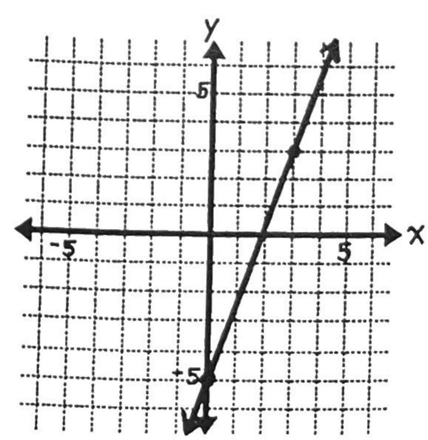
$m =$ ______ $b =$ ______

$y =$ __________



$m =$ ______ $b =$ ______

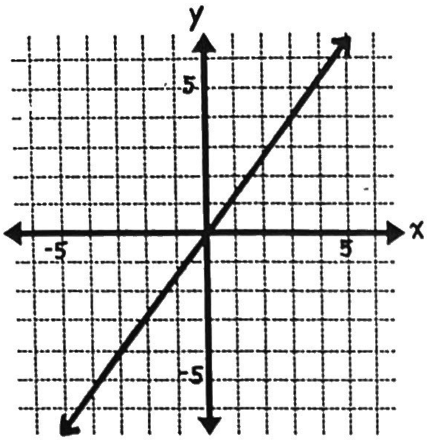
$y =$ __________



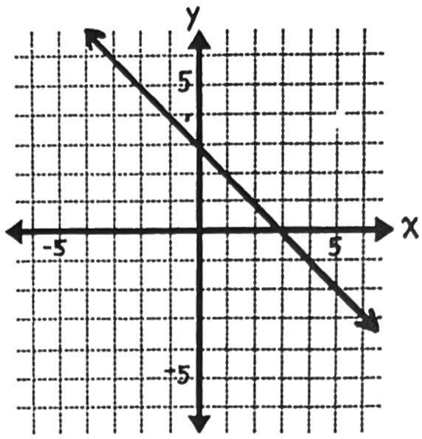
$m =$ ______ $b =$ ______

$y =$ __________

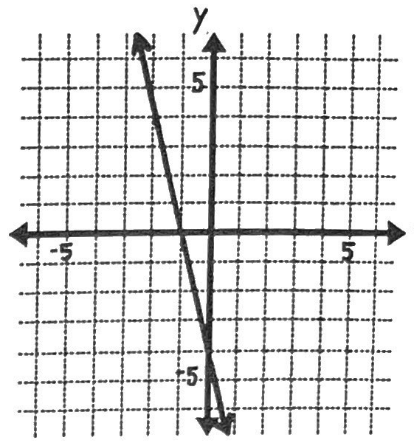
Write the equation of each line.



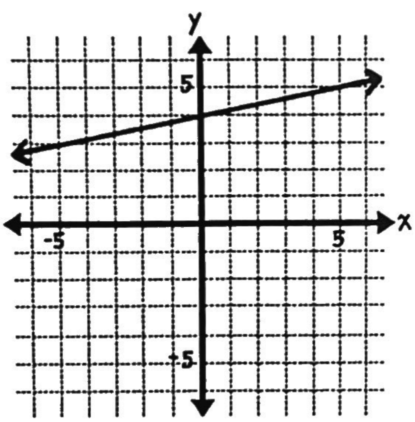
$y =$ ____________



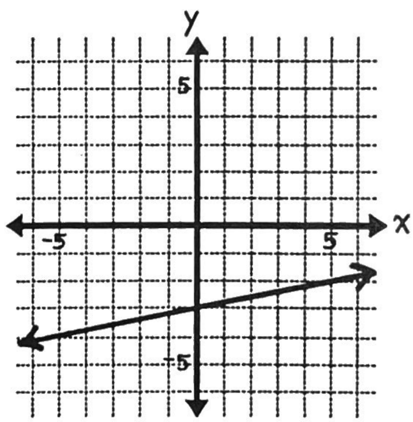
$y =$ ____________



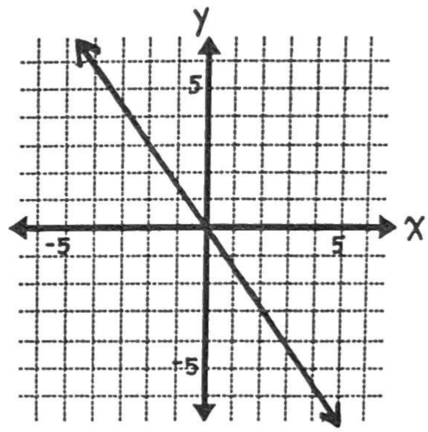
$y =$ ____________



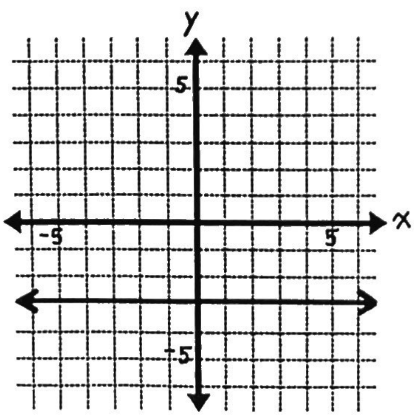
$y =$ ____________



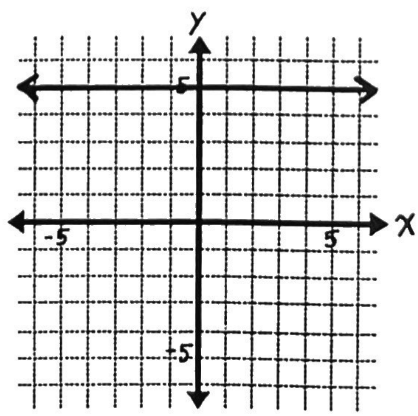
$y =$ ____________



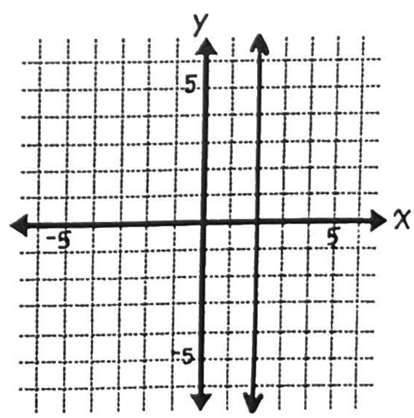
$y =$ ____________



$y =$ ____________



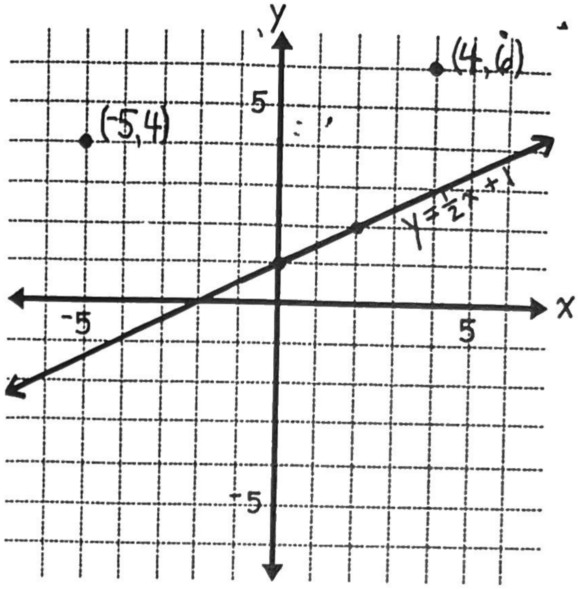
$y =$ ____________



$x =$ ____________

Graphing Linear Inequalities

At the right is the graph of $y = \frac{1}{2}x + 1$. We already know that every point on the graph satisfies the equation $y = \frac{1}{2}x + 1$.

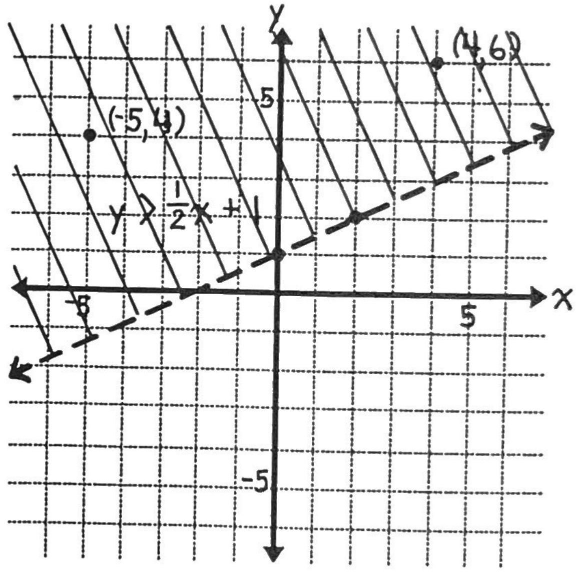


What about the points that are *not* on the graph? First let's pick some points *above* the graph and see what we get when we substitute the coordinates of these points in $y = \frac{1}{2}x + 1$.

(You pick a point above the graph.)

	y	$\frac{1}{2}x + 1$
Try (4, 6):	6	$\frac{1}{2}(4) + 1 = 3$
Try (-5, 4):	4	$\frac{1}{2}(-5) + 1 = -1\frac{1}{2}$
Try (,):		

You might guess from this that no matter what point we pick *above* the graph of $y = \frac{1}{2}x + 1$, y is always *greater* than $\frac{1}{2}x + 1$. In fact, every point above $y = \frac{1}{2}x + 1$ satisfies the inequality $y > \frac{1}{2}x + 1$. To graph $y > \frac{1}{2}x + 1$, we shade in all the points above the line $y = \frac{1}{2}x + 1$. We use a dashed line to show that the points on $y = \frac{1}{2}x + 1$ are not included.

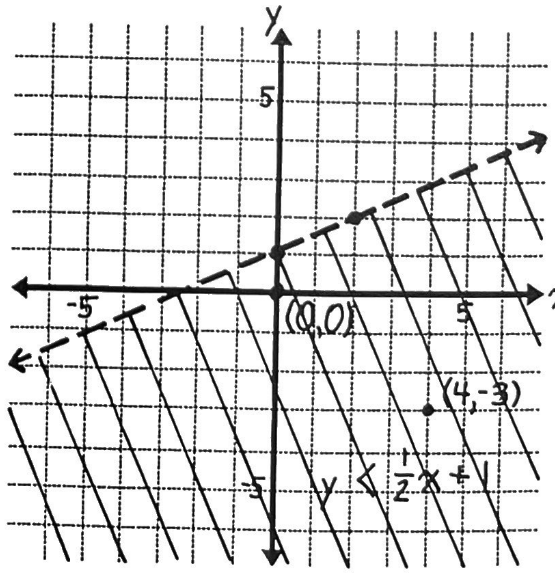


Now let's pick some points *below* $y = \frac{1}{2}x + 1$.

(You pick a point below the graph.)

	y	$\frac{1}{2}x + 1$
Try (4, -3):	-3	$\frac{1}{2}(4) + 1 = 3$
Try (0, 0):		
Try (,):		

From this you might guess that no matter what point we pick *below* the graph of $y = \frac{1}{2}x + 1$, y is always *less* than $\frac{1}{2}x + 1$. In fact, every point below $y = \frac{1}{2}x + 1$ satisfies the inequality $y < \frac{1}{2}x + 1$. To graph $y < \frac{1}{2}x + 1$, we shade all the points below $y = \frac{1}{2}x + 1$ and use a dashed line to show that the points on $y = \frac{1}{2}x + 1$ are not included.

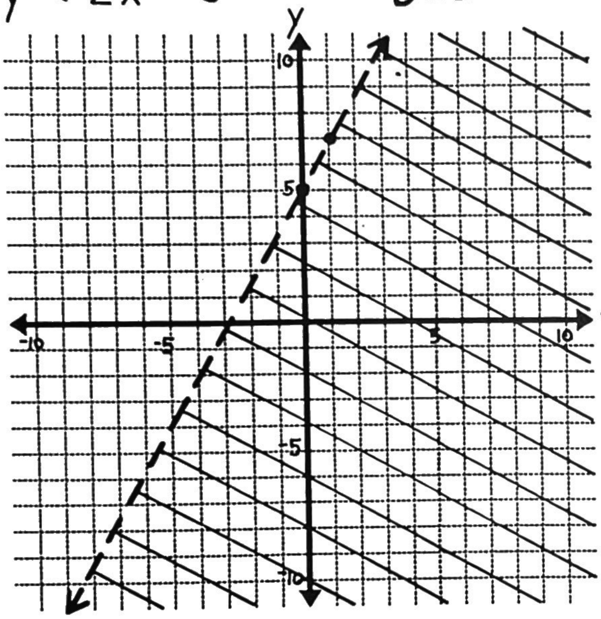


The example on page 30 suggests a way to graph any inequality which is written as $y > mx + b$ or $y < mx + b$. We just have to follow these steps:

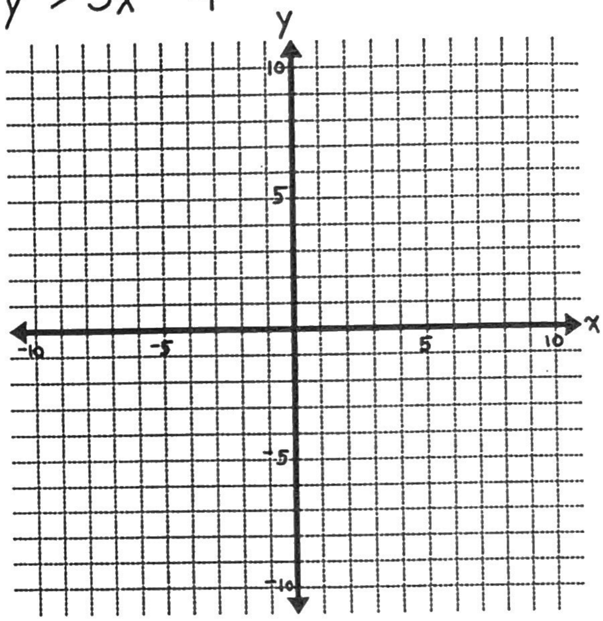
1. Graph the *equation* $y = mx + b$. This line will be the boundary of the graph for the inequality. Use a dashed line to show that points on this line are not included.
2. Shade the region *above* the line to graph $y > mx + b$. Or, shade the region *below* the line to graph $y < mx + b$.

Graph each inequality.

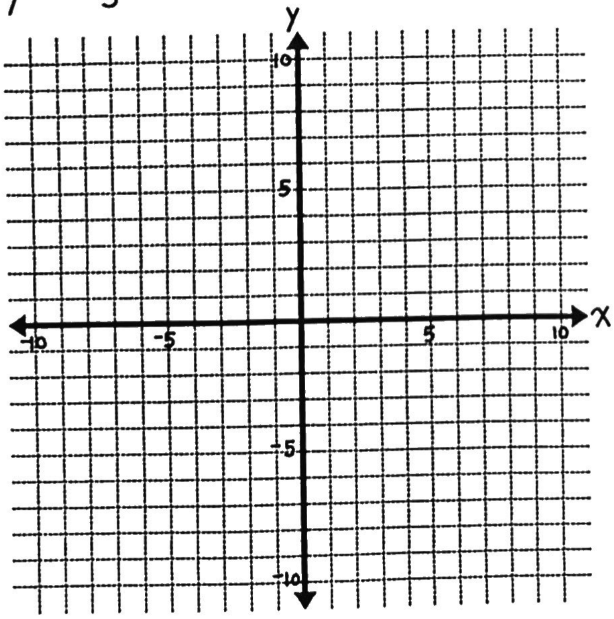
$y < 2x + 5$ $m = 2$ $b = 5$



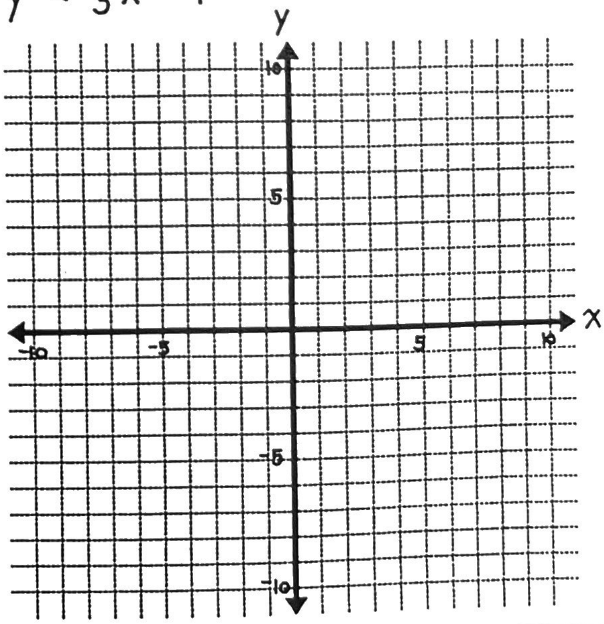
$y > 3x - 4$



$y > \frac{-1}{5}x + 4$

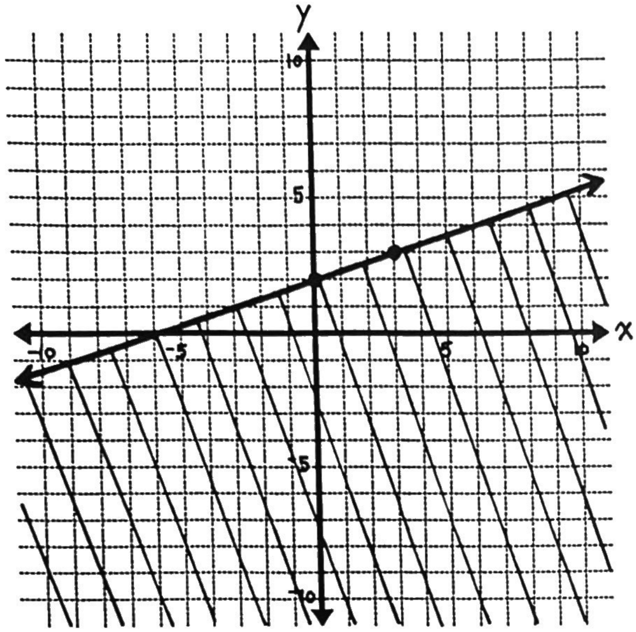


$y < \frac{2}{3}x - 1$

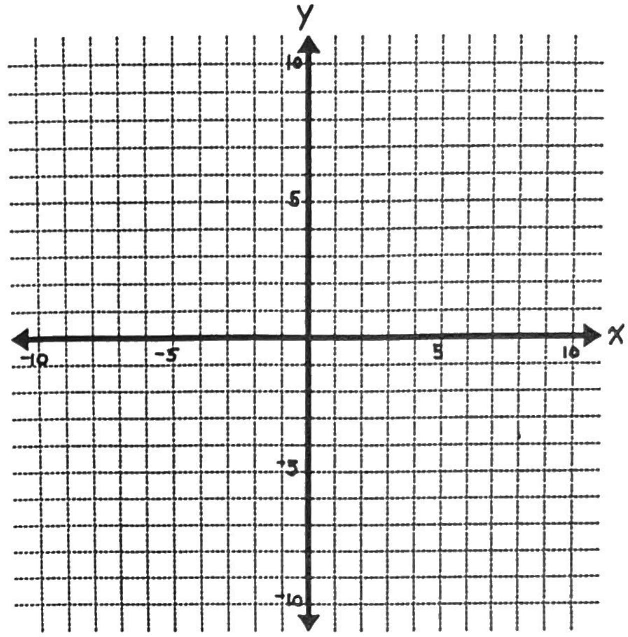


The inequalities on this page contain ≥ and ≤ instead of > and <. That means their solution sets include the points where $y = mx + b$. These points are on the line so we draw a solid line instead of a dashed line for the boundary.

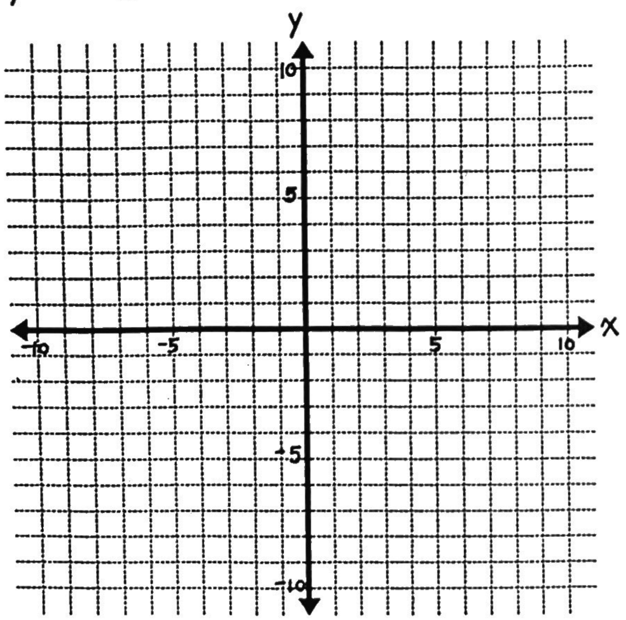
$y \leq \frac{1}{3}x + 2$ $m = \frac{1}{3}$ $b = 2$



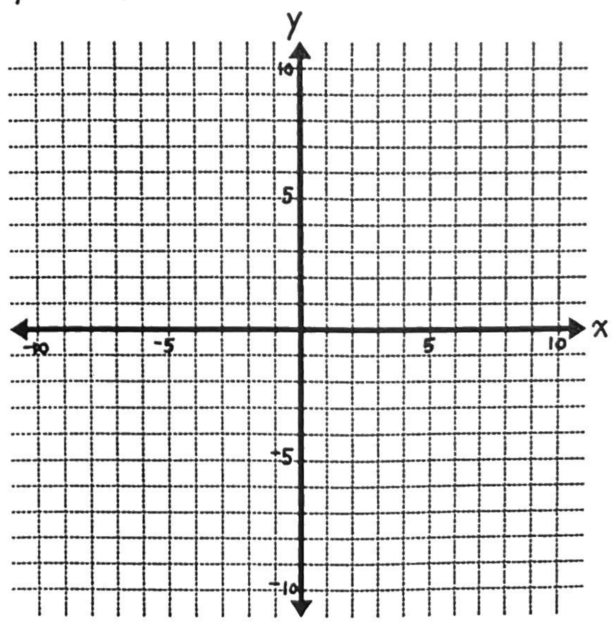
$y \geq x - 4$



$y \geq \frac{-2}{3}x - 1$

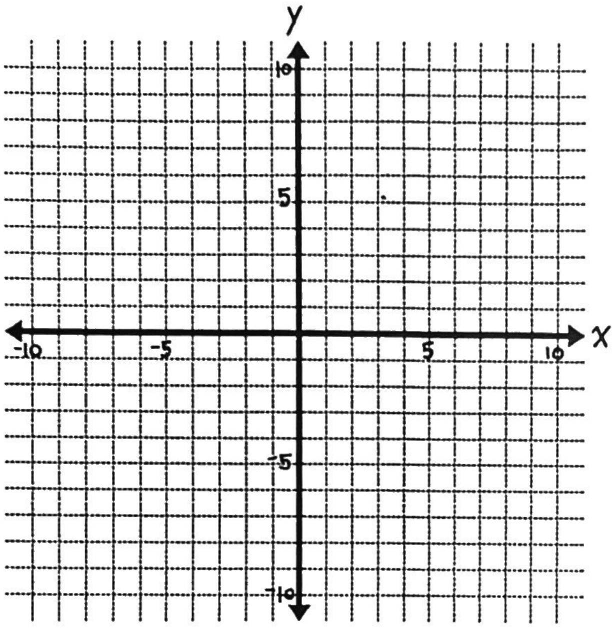


$y \leq \frac{5}{3}x + 4$

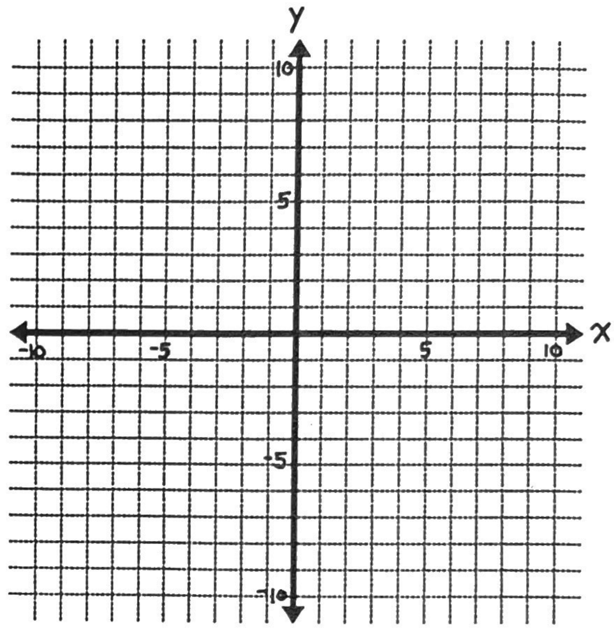


You will have to solve each of these inequalities for y before graphing it.

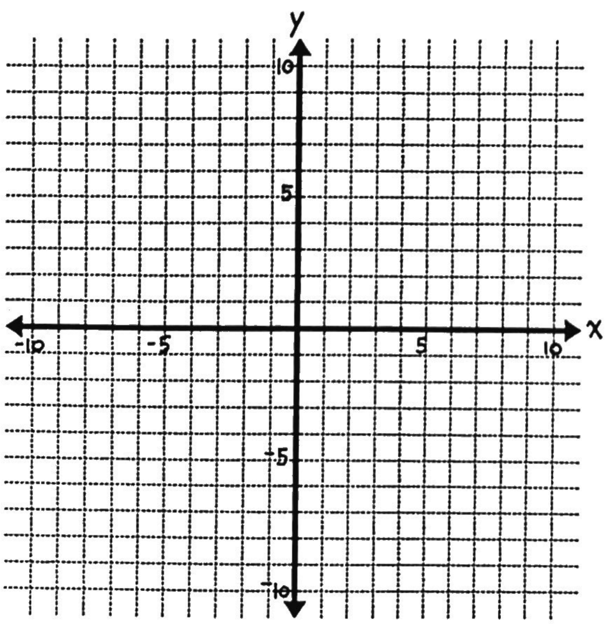
$y - 2x > 3$



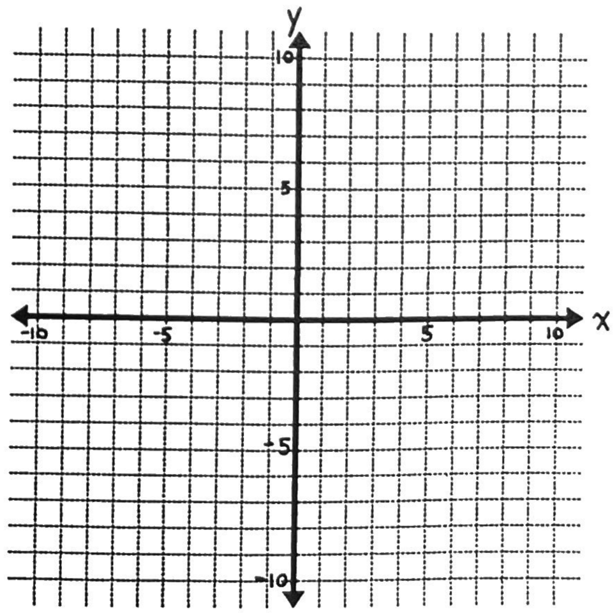
$2x + y \leq 5$



$3y - 2x \geq 9$

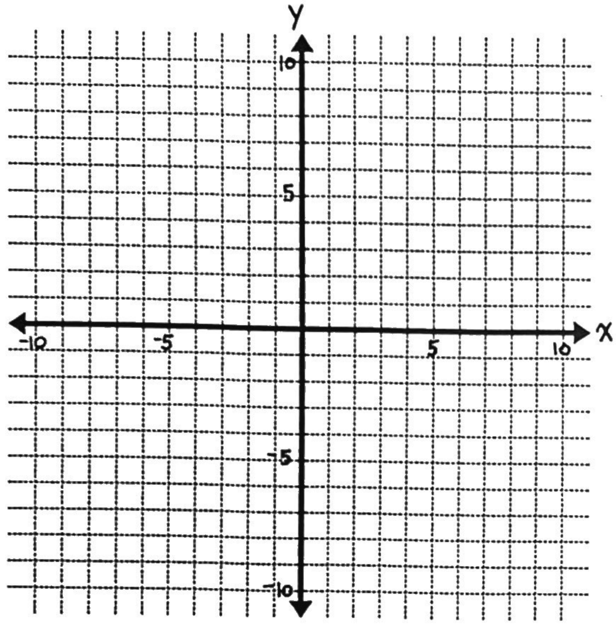


$4y - x < 0$

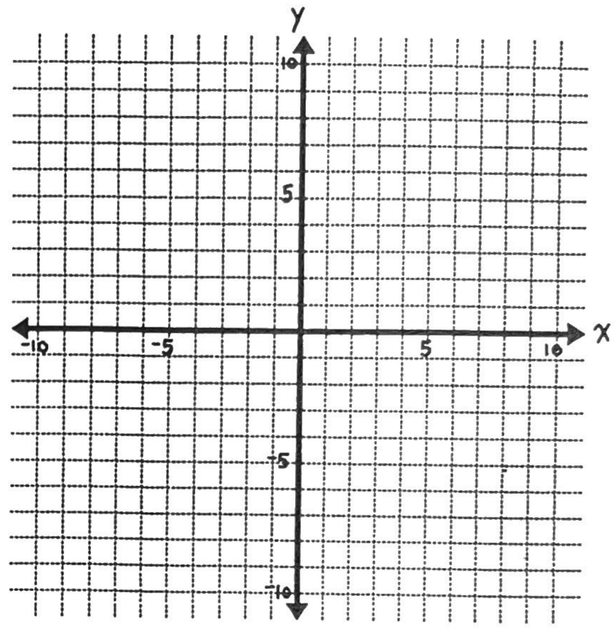


Graph each inequality. If you're not sure which side to shade, choose a point on each side and see which pair of coordinates is a solution.

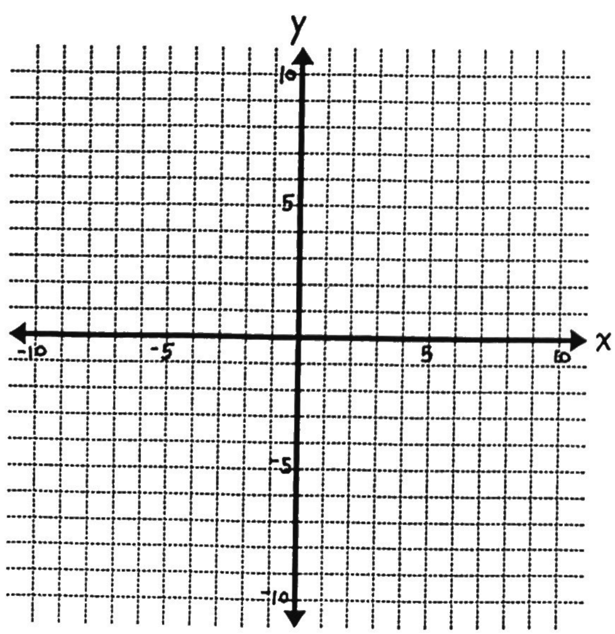
$y > -4$



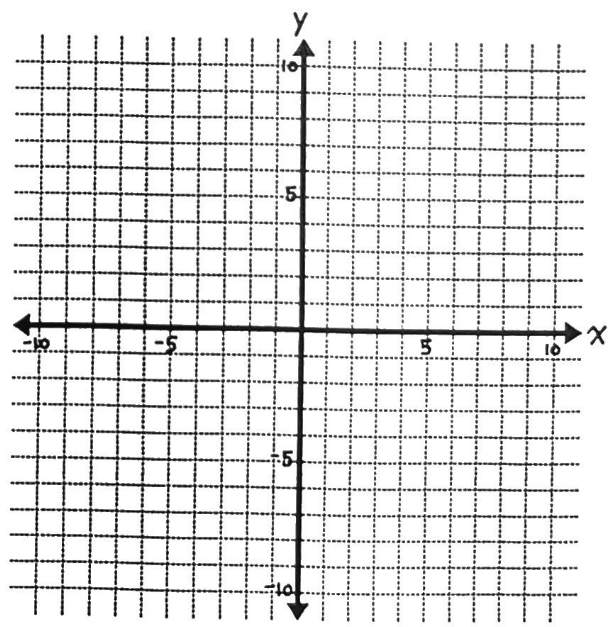
$x \geq -3$



$x < 0$



$y \geq x^2 - 5$



Written Work

Do these problems on some clean paper. Label each page of your work with your name, your class, the date, and the book number. Also number each problem. Keep this written work inside your book, and turn it in with your book when you are finished. Please do a neat job.

1. Draw and label a pair of axes. Then graph each of these points.

   (0, 5) (3, ⁻4) (4, 3) (5, 0) (3, 4) (0, ⁻5) (4, ⁻3)

   These points lie on a circle. Draw the circle and label four more points.

2. Graph the information in this table, which shows the speed (*s*) of a runner *t* seconds before (–) and after (+) the start of a race. Join the points smoothly.

t (seconds from start)	⁻5	⁻3	⁻1	0	1	2	3	4	5	6	7	8
s (speed in meters per sec.)	0	0	0	0	.5	2	5	7	8	8	8	8

3. Graph each linear equation by plotting three points. Make your table on a piece of plain paper. Draw all the graphs on the same pair of axes. Write the equation of each graph along the line.

   $3x + y = 19$ $\qquad$ $x - 4y = 0$ $\qquad$ $2x + 3y = 6$

   $5x - y = 2$ $\qquad$ $^-2x + y = 5$ $\qquad$ $x + 5y = 14$

4. Graph each inequality. Then write an inequality for the *unshaded* part (the points which are not included in your graph).

   $y \geq \frac{1}{2}x + 3$ $\qquad$ $y < {}^-3x + 1$

5. Graph the equations in each set below, using one pair of axes for each set. What do you notice about the graphs? What do the equations in each set have in common?

   a) $y = \frac{^-2}{5}x + 4$ $\qquad$ b) $y = 3x + 2$ $\qquad$ c) $y = x^2 - 8$

   $y = {}^-\frac{2}{5}x - 6$ $\qquad$ $y = {}^-4x + 2$ $\qquad$ $y = x^2 + 1$

   $y = \frac{^-2}{5}x$ $\qquad$ $y = \frac{1}{2}x + 2$ $\qquad$ $y = x^2 + 4$

6. Draw a pair of axes on a piece of graph paper. Then draw a vertical line.
   a) Write the equation of your line.
   b) Pick two points on the line and try to use them to find its slope.
   c) Explain why it is not possible to find a slope for a vertical line.

7. Plot the points (⁻3, 4) and (6, 1). Draw a line through the points and write its equation.

8. On a piece of plain paper, solve each equation for *y*. Then graph each equation using the slope and *y*-intercept.

   $4x + 2y = 12$ $\qquad$ $x - 3y = {}^-15$ $\qquad$ $2x + 5y = 0$

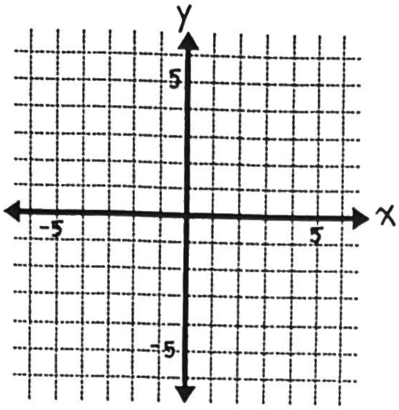
Practice Test

Graph and label each point.

(2, ⁻6) (⁻4, ⁻5)

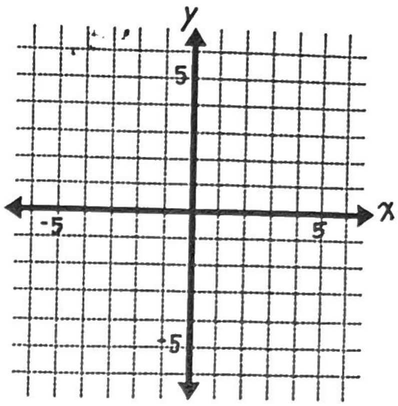
(4, 0) (⁻6, 3)

(0, 0) (2, 5)



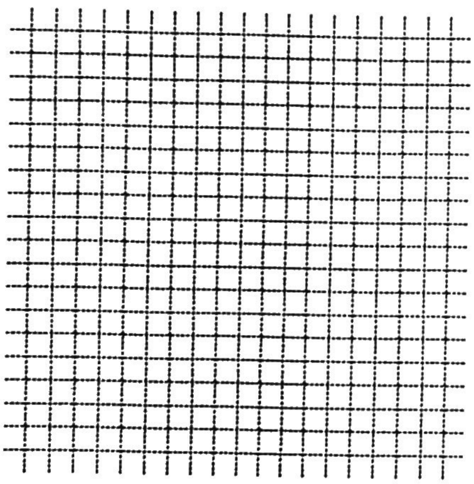
Graph the information in this table.

x	y
⁻6	⁻3
⁻4	⁻3
⁻2	⁻2
0	0
2	2
4	3
6	3

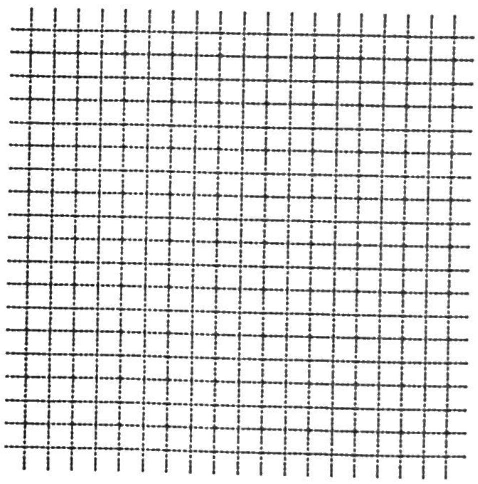


Make a table and graph for each equation.

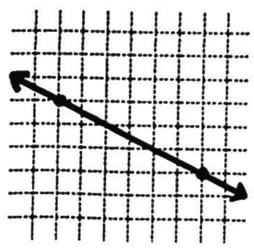
$x^2 + y = 4$



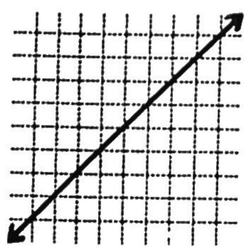
$y = |x| - 6$



Find the slope of each line.

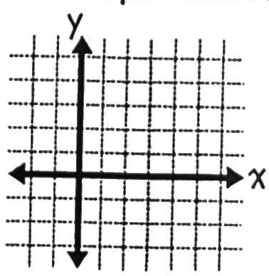


$m =$ ______



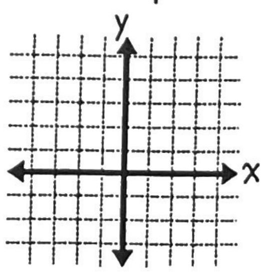
$m =$ ______

Draw a line with the given slope and *y*-intercept. Then write the line's equation.



$m = \frac{3}{5}$ $b = {}^-2$

$y =$ ______

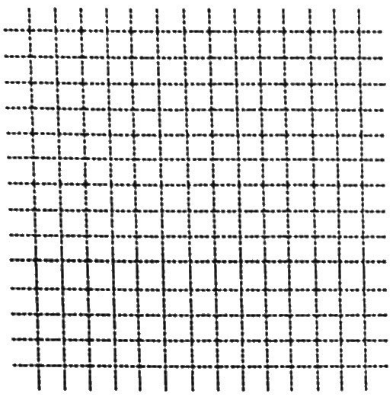


$m = {}^-2$ $b = 4$

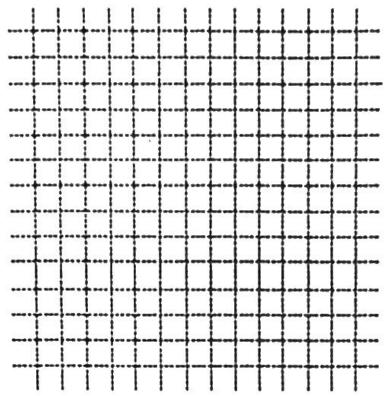
$y =$ ______

Solve each equation for *y*. Then graph the equation.

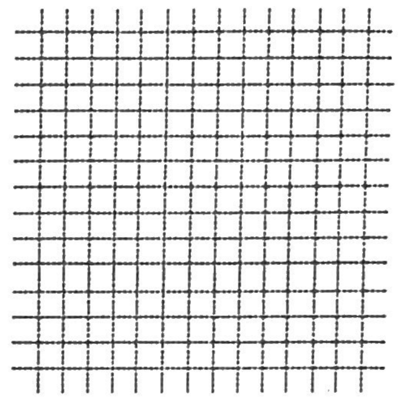
$5x + 6y = 18$



$x + 3y = 0$

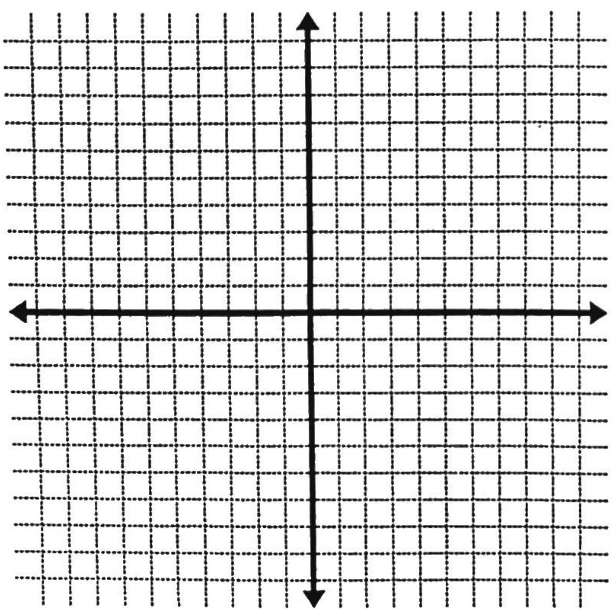


$3x - 4y = {}^{-}16$



Graph each inequality.

$y \geq {}^{-}2x + 4$



$2y - 3x < 6$