3.1 Linear Equations in 2 Variables; The Rectangular Coordinate System

Linear equation in two variables	Solutions of linear equations in two variables
Solutions of linear equations in two variables	

EXAMPLE 2 Deciding Whether Ordered Pairs Are Solutions of an Equation

Decide whether each ordered pair is a solution of the equation $2x + 3y = 12$.

(a) $(3, 2)$ **(b)** $(-2, -7)$

EXAMPLE 3 Completing Ordered Pairs

Complete each ordered pair for the equation $y = 4x + 5$.

(a) $(7, \_\_)$ **(b)** $(\_\_, -3)$

EXAMPLE 4 Completing Tables of Values

Complete the table of values for each equation. Write the results as ordered pairs.

(a) $x - 2y = 8$

x	y
2	
10	
	0
	−2

(b) $x = 5$

x	y
	−2
	6
	3

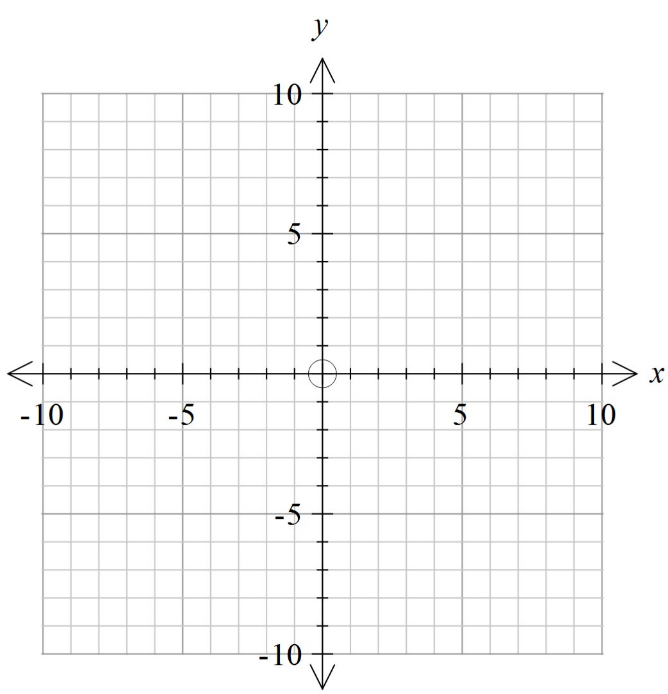
The Cartesian coordinate system	Ordered pairs
Origin	Quadrants

EXAMPLE 5 Plotting Ordered Pairs

Plot the given points in a coordinate system.

(a) $(2, 3)$ **(b)** $(-1, -4)$ **(c)** $(-2, 3)$ **(d)** $(3, -2)$ **(e)** $\left(\frac{3}{2}, 2\right)$

(f) $(4, -3.75)$ **(g)** $(5, 0)$ **(h)** $(0, -3)$ **(i)** $(0, 0)$



3.2 Graphing Linear Equations in Two Variables

OBJECTIVES

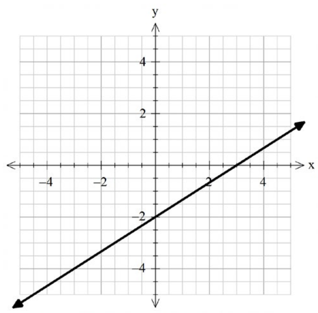
1. Graph linear equations by plotting ordered pairs.
2. Find intercepts.
3. Graph linear equations of the form $Ax + By = 0$.
4. Graph linear equations of the form $y = k$ or $x = k$.
5. Use a linear equation to model data.

Standard form   x-intercept   y-intercept

1) Label the x and y intercepts as coordinates using the graph below:

x-intercept: (,)

y-intercept: (,)



2) Complete the following ordered pair for the line y = -x + 3:

(0 ,)

(, 0)

What do these ordered pairs represent on a graph?

How can these help us graph the line?

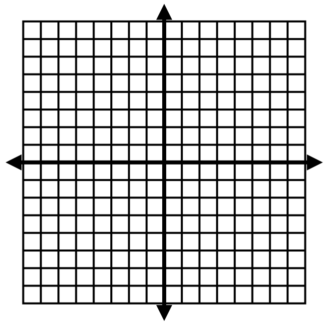
3) What is true about every x-intercept? What is true about every y-intercept?

Graph the following using x and y intercepts:

4) 4x - 5y = 20

x-intercept: (,)

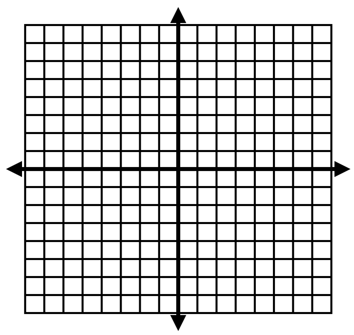
y-intercept: (,)



5) y = -3x + 3

x-intercept: (,)

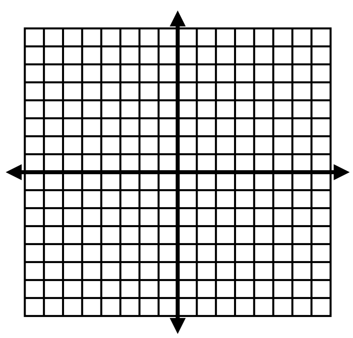
y-intercept: (,)



6) 2x - y = -4

x-intercept: (,)

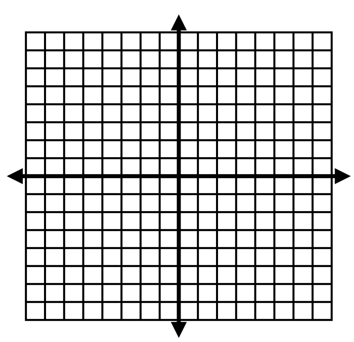
y-intercept: (,)



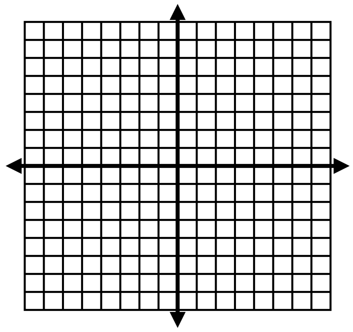
7) $y = \frac{2}{3}x$

x-intercept: (,)

y-intercept: (,)



8) $x - 3y = 0$



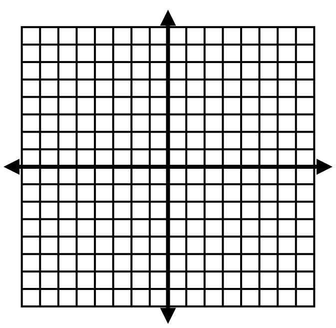
x-intercept: (,   )

y-intercept: (,   )

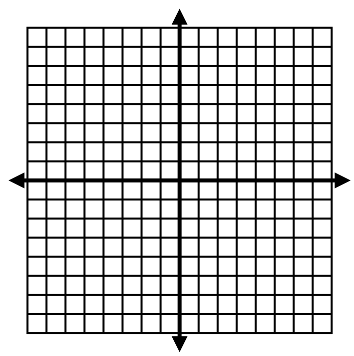
Horizontal and vertical lines

Graph the following:

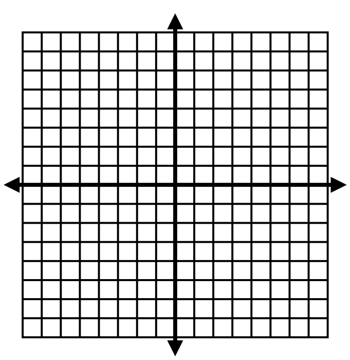
9) $y = 4$



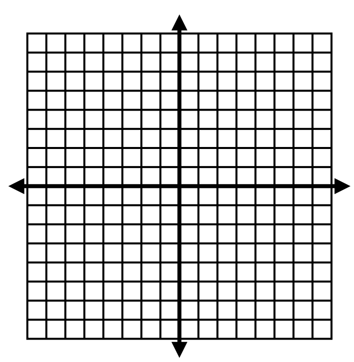
10) $x = 2$



11) $x - 3 = 0$



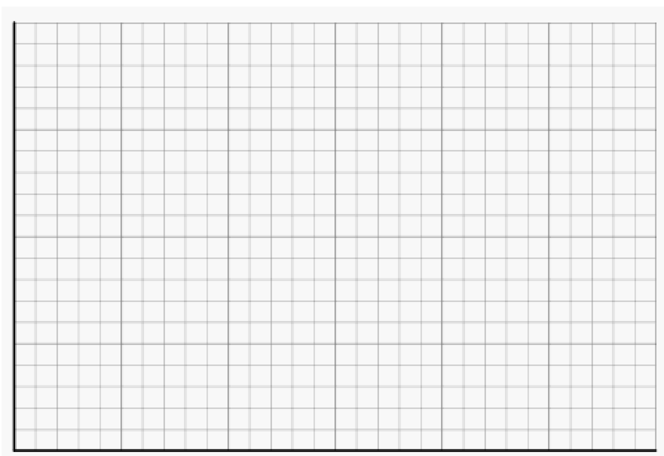
12) $y + 5 = 5$



13) Credit card debt in the United States increased steadily from 2000 through 2008. The amount of debt y in billions of dollars can be modeled by the linear equation $y = 32x + 684$, where $x=0$ represents 2000, $x = 1$ represents 2001, and so on. (source: The Nilson Report)

a) Use the equation to approximate credit card debt in the years 2000, 2004, and 2008.

(b) Write the information from part (a) as three ordered pairs, and use them to graph the given linear equation.



(c) Use the graph and then the equation to approximate credit card debt in 2002.

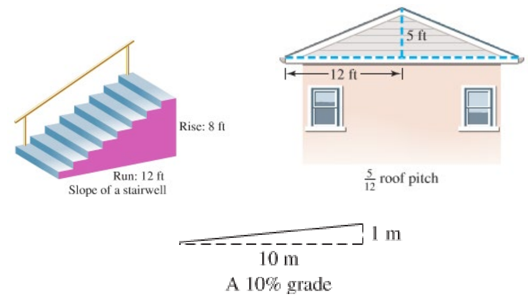
3.3 Slope of a Line

1 Find the slope of a line, given two points.

2 Find the slope from the equation of a line.

3 Use slopes to determine whether two lines are parallel, perpendicular, or neither.

Slope



EXAMPLE 1 Finding the Slope of a Line

Find the slope of the line in **FIGURE 19**.

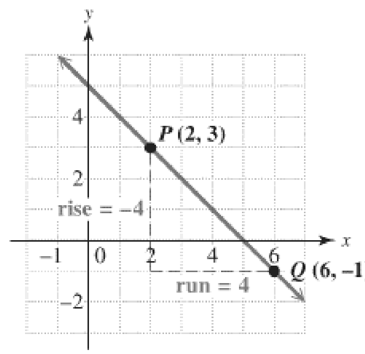
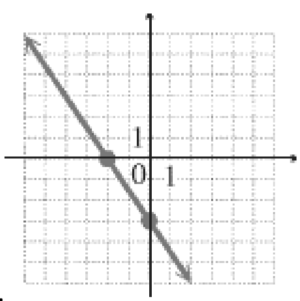
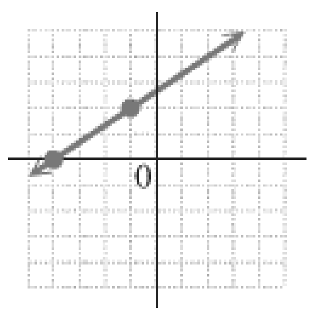


FIGURE 19

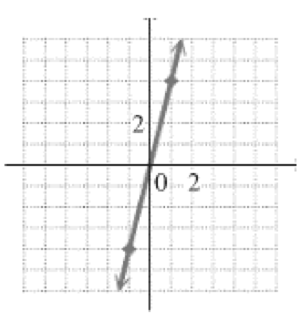
Find the slope of the lines below.



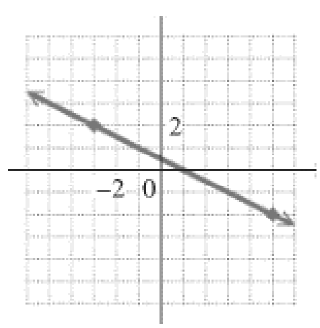
a.



b.



c.



d.

Slope formula

EXAMPLE 2 Finding Slopes of Lines

Find the slope of each line.

(a) The line through $(-4, 7)$ and $(1, -2)$

(b) The line through $(-9, -2)$ and $(12, 5)$

Positive and negative slopes

EXAMPLE 3 Finding the Slope of a Horizontal Line

Find the slope of the line through $(-5, 4)$ and $(2, 4)$.

EXAMPLE 4 Finding the Slope of a Vertical Line

Find the slope of the line through $(6, 2)$ and $(6, -4)$.

Slopes of horizontal and vertical lines

EXAMPLE 5 Finding Slopes from Equations

Find the slope of each line.

(a) $2x - 5y = 4$

(b) $8x + 4y = 1$

Slopes of parallel and perpendicular lines

EXAMPLE 6 Deciding Whether Two Lines Are Parallel or Perpendicular

Decide whether each pair of lines is *parallel, perpendicular,* or *neither.*

(a) $x + 3y = 7$
$-3x + y = 3$

(b) $2x - 3y = 1$
$4x + 6y = 5$

3.4 Writing and Graphing Equations of Lines

OBJECTIVES

1. Use the slope-intercept form of the equation of a line.
2. Graph a line by using its slope and a point on the line.
3. Write an equation of a line by using its slope and any point on the line.
4. Write an equation of a line by using two points on the line.
5. Write an equation of a line that fits a data set.

Slope-intercept form

EXAMPLE 1 Identifying Slopes and y-Intercepts

Identify the slope and y-intercept of the line with each equation.

(a) $y = -4x + 1$

(b) $y = x - 8$ **(c)** $y = 6x$ **(d)** $y = \frac{x}{4} - \frac{3}{4}$

EXAMPLE 2 Writing an Equation of a Line

Write an equation of the line with slope $\frac{2}{3}$ and y-intercept $(0, -1)$.

Example 2A

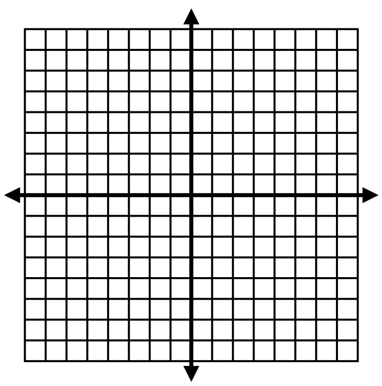
Write an equation of the line with the slope -3 and y-intercept 4.

Graphing a line by using its y-intercept and slope

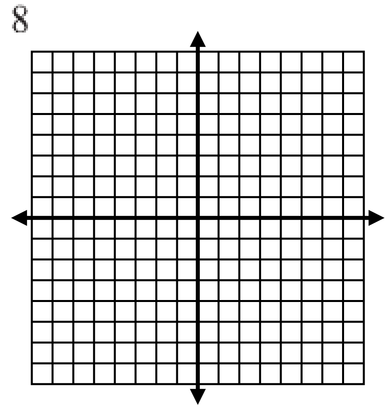
EXAMPLE 3 Graphing Lines by Using Slopes and y-intercepts

Graph the equation of each line by using the slope and y-intercept.

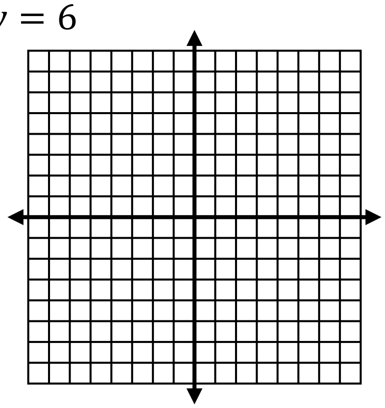
(a) $y = \frac{2}{3}x - 1$



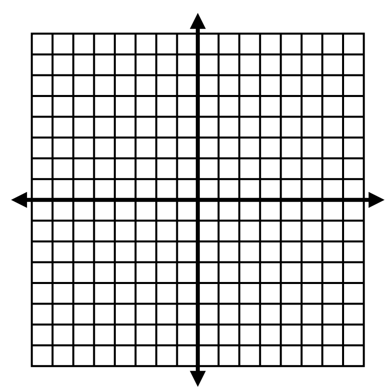
(b) $3x + 4y = 8$



(c) $2x - 3y = 6$

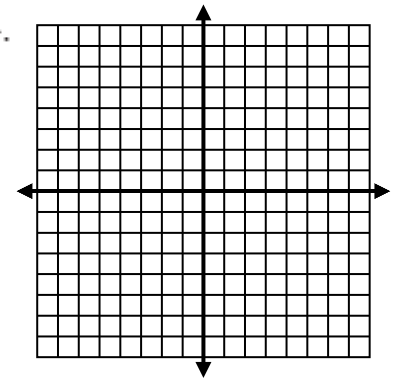


(d) $y = -\frac{5}{4}x$



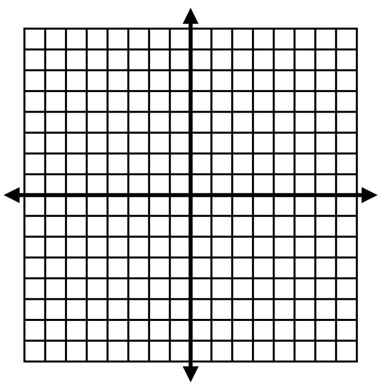
EXAMPLE 4 Graphing a Line by Using the Slope and a Point

Graph the line through $(-2, 3)$ with slope -4.



Example 4A

Graph the line through (2, -1) with slope $\frac{2}{3}$.



Point-slope form

EXAMPLE 5 Using the Slope-Intercept Form to Write an Equation

Write an equation, in slope-intercept form, of the line having slope 4 passing through the point $(2, 5)$.

EXAMPLE 6 Using the Point-Slope Form to Write Equations

Write an equation of each line. Give the final answer in slope-intercept form.

(a) Through $(-2, 4)$, with slope -3

(b) Through $(4, 2)$, with slope $\frac{3}{5}$

(c) Through (-1, -3), with slope 2

(d) Through (0, -4), with slope $-\frac{1}{2}$

Standard Form:

Example 6A

Write the equations in Standard form.

a. $y = 2x - 4$

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

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

Writing equations for horizontal and vertical lines

Horizontal	Vertical

Example 9: Write the equation for the line described:

a. horizontal through (2, -3)

b. vertical through (3, 4)

c. horizontal through (0, 5)

d. vertical through (-6, 7)

e. vertical through (4, 9)

f. horizontal through (-2, 0)

3.5 Graphing Linear Inequalities in Two Variables

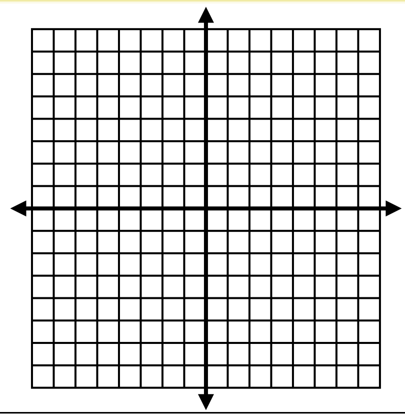
OBJECTIVES

1. Graph linear inequalities in two variables.
2. Graph an inequality with a boundary line through the origin.

Inequality symbols	Shading rules

EXAMPLE 1 Graphing a Linear Inequality

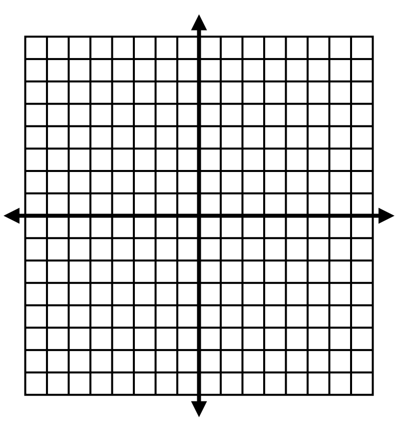
Graph $2x + 3y \leq 6$.

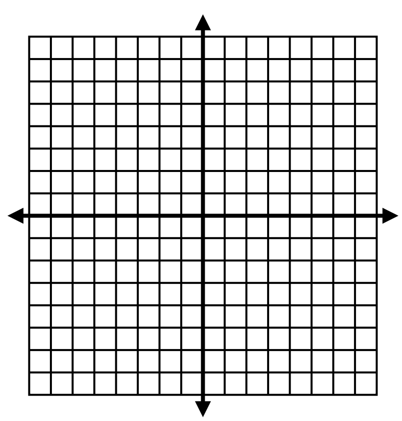


Example 1A

a. Graph $3x + 5y > 15$

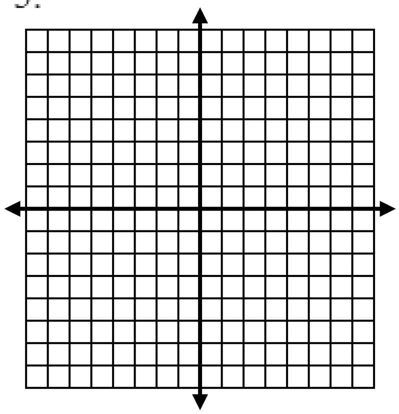
b. Graph $x + 2y < -8$





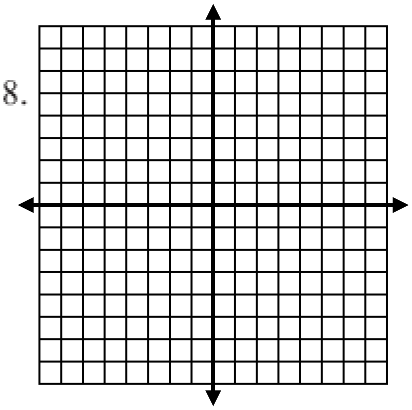
EXAMPLE 2 Graphing a Linear Inequality

Graph $x - y > 5$.



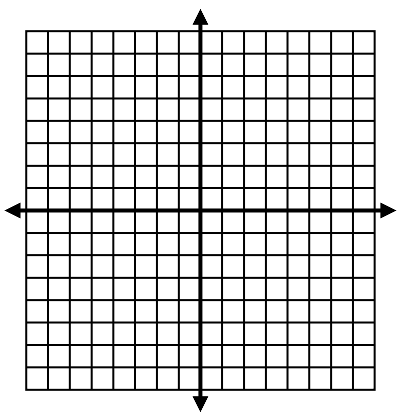
NOW TRY EXERCISE 2

Graph $2x - 4y > 8$.



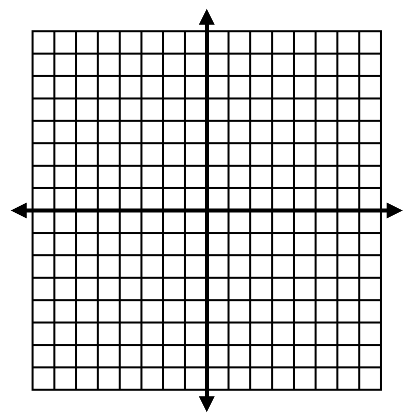
EXAMPLE 3 Graphing a Linear Inequality with a Vertical Boundary Line

Graph $x < 3$.



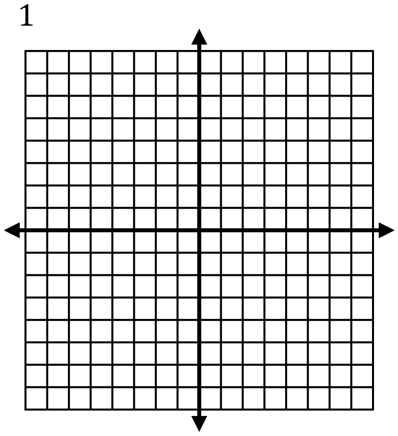
NOW TRY EXERCISE 3

Graph $x > 2$.

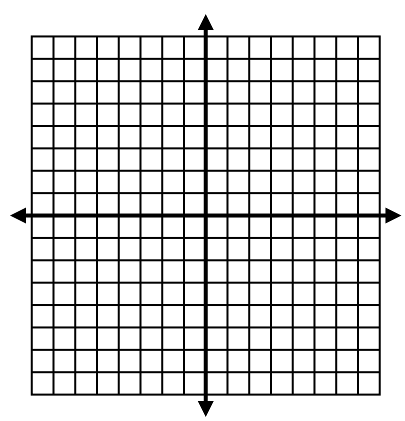


Example 3A

a. Graph $y \leq 1$

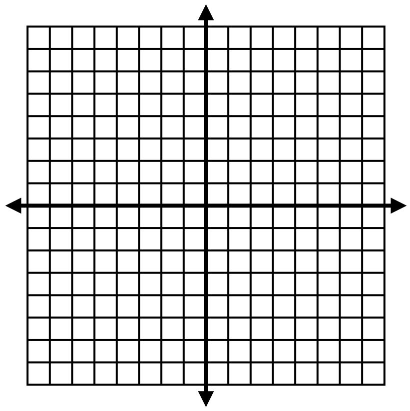


b. Graph $y > -3$

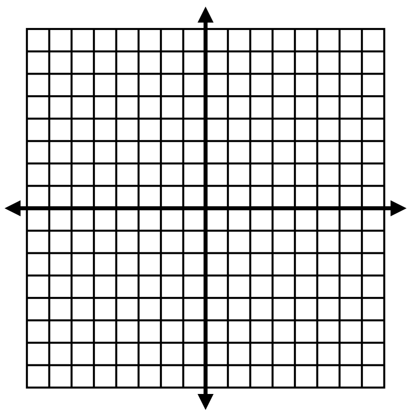


EXAMPLE 4 Graphing a Linear Inequality with a Boundary Line through the Origin

Graph $x \leq 2y$.

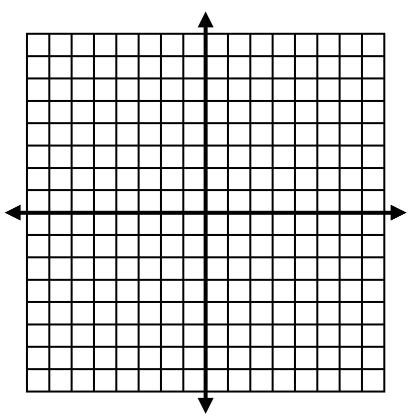


Graph $x > 3y$



NOW TRY EXERCISE 4

Graph $y \leq -2x$.



3.6 Introduction to Functions

OBJECTIVES

1. Understand the definition of a relation.
2. Understand the definition of a function.
3. Decide whether an equation defines a function.
4. Find domains and ranges.
5. Use function notation.
6. Apply the function concept in an application.

Domain	Range
Relation	

EXAMPLE 1 Identifying Domains and Ranges of Relations

Identify the domain and range of each relation.

(a) $\{(0, 1), (2, 5), (3, 8), (4, 2)\}$

b) $\{(3, 5), (3, 6), (3, 7), (3, 8)\}$

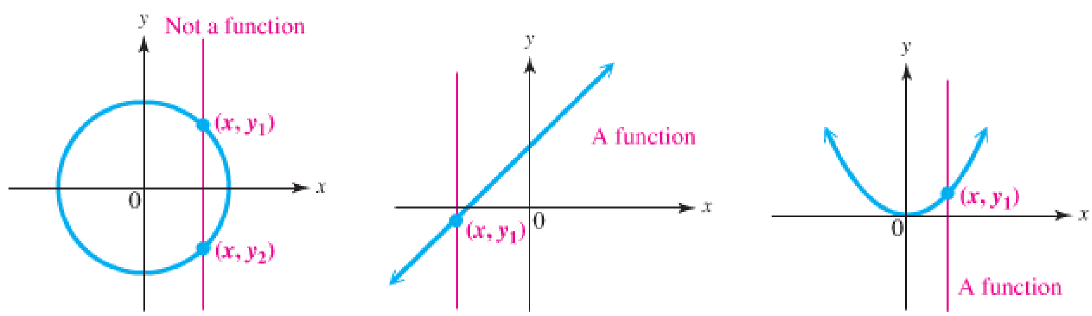
Function

EXAMPLE 2 Determining Whether Relations Are Functions

Determine whether each relation is a function.

(a) $\{(-2, 4), (-1, 1), (0, 0), (1, 1), (2, 4)\}$ **(b)** $\{(9, 3), (9, -3), (4, 2)\}$

Vertical line test

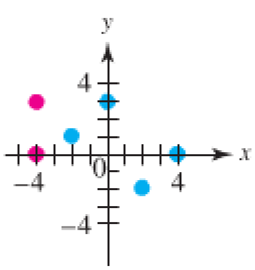


(a) (b) (c)

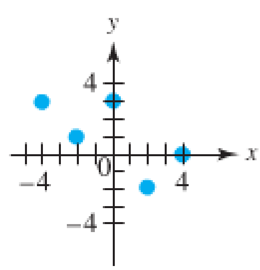
EXAMPLE 3 Determining Whether Relations Define Functions

Determine whether each relation graphed or defined here is a function.

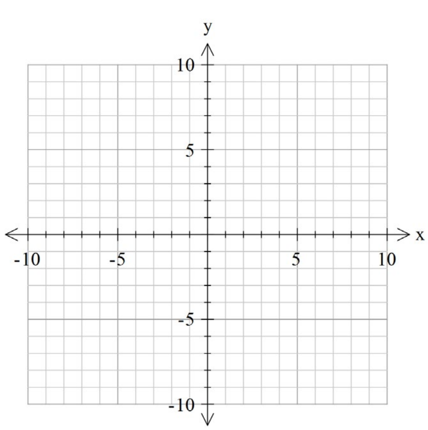
(a)



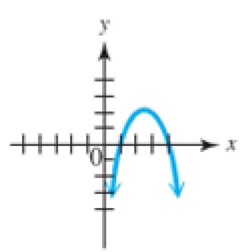
(b)



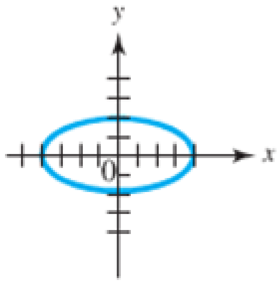
(c) $y = 2x - 9$



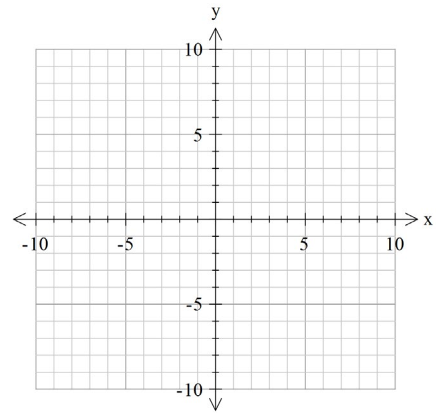
(d)



(e)



(f) $x = 4$



EXAMPLE 4 Finding the Domain and Range of Functions

Find the domain and range of each function.

(a) $y = 2x - 4$

(b) $y = x^2$

NOW TRY EXERCISE 4

Find the domain and range of the function.

$$y = x^2 - 2$$

Function notation

$f(x)$

EXAMPLE 5 Using Function Notation

For the function defined by $f(x) = x^2 - 3$, find the following.

(a) $f(4)$ **(b)** $f(0)$ **(c)** $f(-3)$

EXAMPLE 6 Applying the Function Concept to Population

Asian-American populations (in millions) are shown in the table.

Year	Population (in millions)
1996	9.7
2000	11.2
2004	13.1
2006	14.9

Source: U.S. Census Bureau.

(a) Use the table to write a set of ordered pairs that defines a function f.

(b) What is the domain of f? What is the range?

(c) Find $f(1996)$ and $f(2004)$.

(d) For what x-value does $f(x)$ equal 14.9 million? 11.2 million?