Solving Equations

4

SECTION 4.8

The Rectangular Coordinate System

Objectives

A Plot ordered pairs on a coordinate system.

B Name the coordinates of a point on the rectangular coordinate system.

C Graph a line given two points.

A The Rectangular Coordinate System

The Rectangular Coordinate System

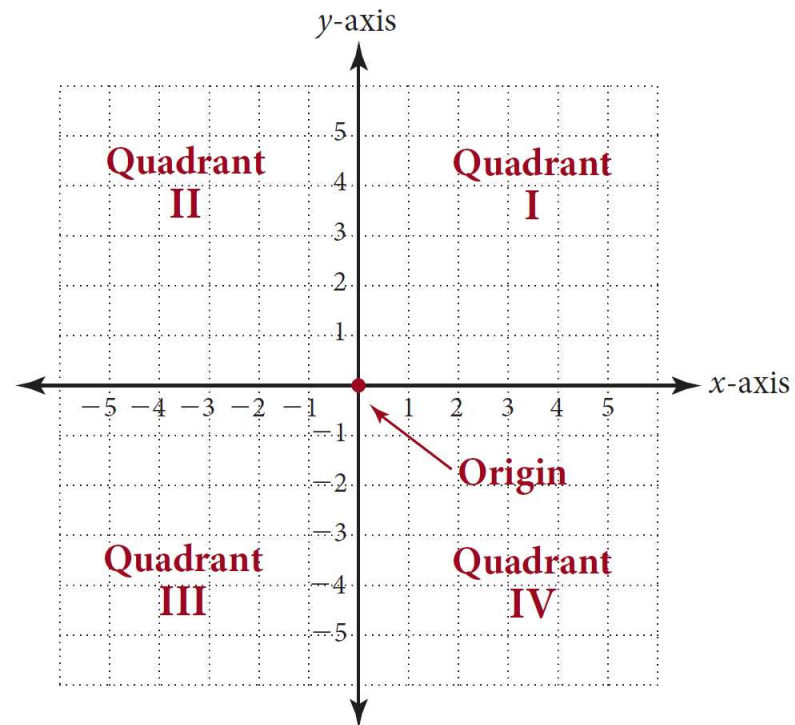The rectangular coordinate system can be used to plot (or graph) pairs of numbers (see Figure 2).

Figure 2

The Rectangular Coordinate System

It consists of two number lines, called *axes*, which intersect at right angles. (We know that a right angle is a 90° angle.)

The point at which the axes intersect is called the *origin*.

The horizontal number line is exactly the same as the real number line and is called the *x-axis*.

The vertical number line is also the same as the real number line with the positive direction up and the negative direction down. It is called the *y-axis*.

The Rectangular Coordinate System

As you can see, the axes divide the plane into four regions, called *quadrants*, which are numbered 1 through IV in a counterclockwise direction.

Because the rectangular coordinate system consists of two number lines, one called the *x*-axis and the other called the *y*-axis, we can plot pairs of numbers such as $x = 2$ and $y = 3$.

As a matter of fact, each point in the rectangular coordinate system is named by exactly one pair of numbers. We call the pair of numbers that name a point the *coordinates* of that point.

The Rectangular Coordinate System

To find the point that is associated with the pair of numbers $x = 2$ and $y = 3$, we start at the origin and move 2 units horizontally to the right and then 3 units vertically up (see Figure 3).
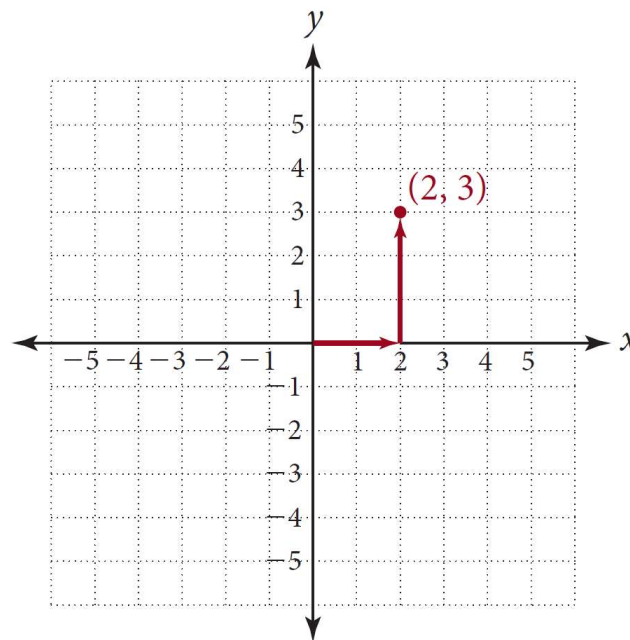

Figure 3

The Rectangular Coordinate System

The place where we end up is the point named by the pair of numbers $x = 2$, $y = 3$, which we write in shorthand form as the ordered pair $(2, 3)$.

In general, to graph an ordered pair (a, b) on the rectangular coordinate system, we start at the origin and move a units right or left (right if a is positive, left if a is negative).

From there we move b units up or down (up if b is positive, down if b is negative). The point where we end up is the graph of the ordered pair (a, b).

9

Example 1

Plot (graph) the ordered pairs (2, 3), (–2, 3), (–2, –3), and (2, –3).

Solution:

To graph the ordered pair (2, 3), we start at the origin and move 2 units to the right, then 3 units up.

We are now at the point whose coordinates are (2, 3).

Example 1 – *Solution*

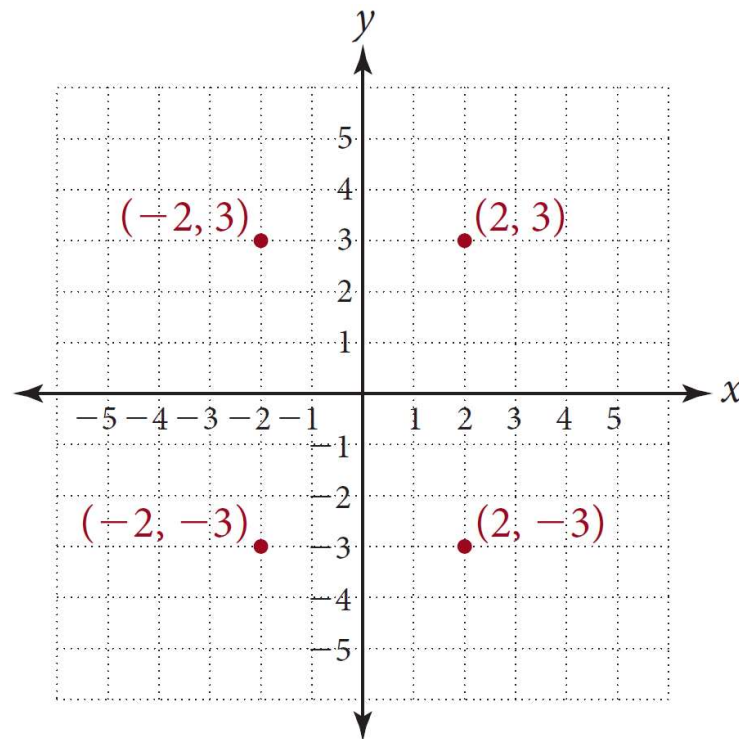We plot the other three ordered pairs in the same manner (Figure 4).

Figure 4

The Rectangular Coordinate System

Looking at Example 1, we see that any point in quadrant I must have positive x- and y-coordinates (+, +).

In quadrant II, x-coordinates are negative and y-coordinates are positive, (−, +).

In quadrant III, both coordinates are negative (−, −).

Finally, in quadrant IV, all ordered pairs must have the form (+, −).

Example 3

Where are all the points that have coordinates of the form $(x, 0)$?

Solution:

Because the y-coordinate is 0, these points must lie on the x-axis.

Remember, the y-coordinate tells us how far up or down we move to find the point in question.

If the y-coordinate is 0, then we don't move up or down at all. Therefore, we must stay on the x-axis.

B Points on a Rectangular
Coordinate System

Points on a Rectangular Coordinate System

Now let's work in the other direction and find the coordinates for given points on a rectangular coordinate system.

Example 4
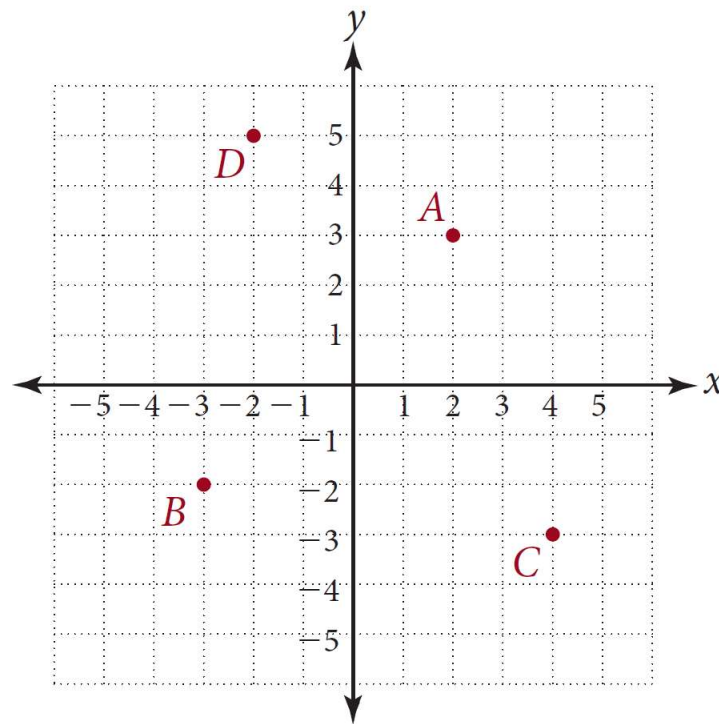
Give the coordinates of each point in Figure 5.

Figure 5

Example 4 – *Solution*

A is named by the ordered pair (2, 3).

B is named by the ordered pair (–3, –2).

C is named by the ordered pair (4, –3).

D is named by the ordered pair (–2, 5).

c   Graphing Lines

Graphing Lines

We can connect two or more points on a graph by drawing a straight line through them.

Then we can determine if any additional points lie on the line. The next example illustrates this.

Example 5

Graph the points (1, 2) and (3, 4), and draw a line through them. Then use your result to answer these questions.

a. Does the graph of (2, 3) lie on this line?

b. Does the graph of (–3, –5) lie on this line?

Example 5 – *Solution*

Figure 6 shows the graphs of (1, 2) and (3, 4) and the line that connects them. The line does not pass through the point (–3, –5) but does pass through (2, 3).
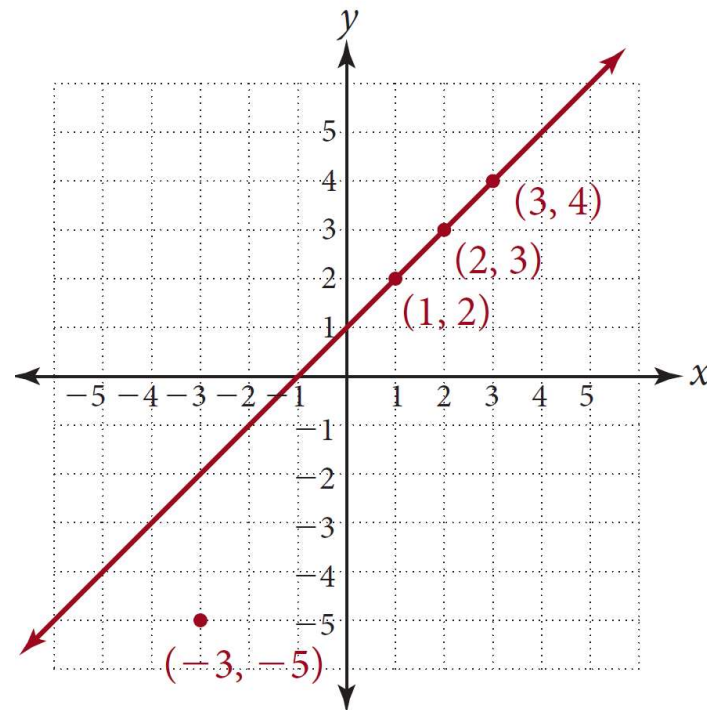

Figure 6