

# **Section 1.5**

## **Circles**

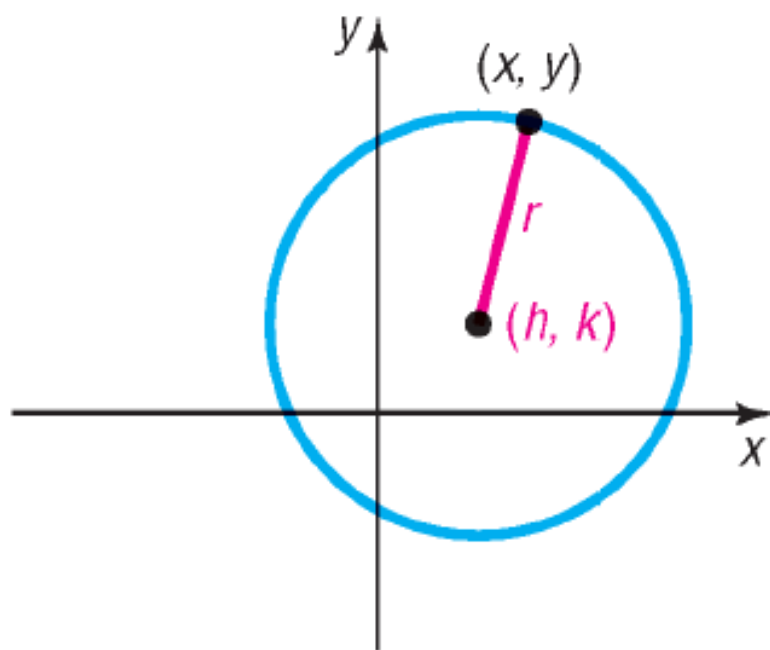
# OBJECTIVE 1

- 1 ✓ Write the Standard Form of the Equation of a Circle

A **circle** is a set of points in the  $xy$ -plane that are a fixed distance  $r$  from a fixed point  $(h, k)$ .

The fixed distance  $r$  is called the **radius**,

and the fixed point  $(h, k)$  is called the **center** of the circle.



The **standard form of an equation of a circle** with radius  $r$  and center  $(h, k)$  is

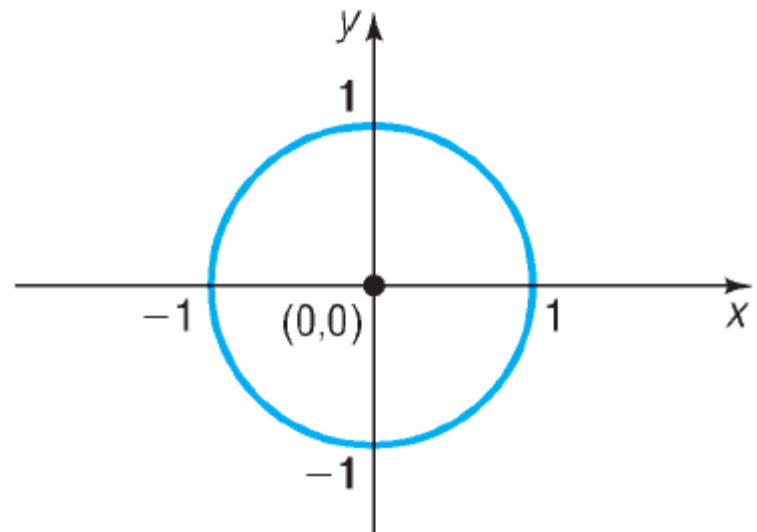
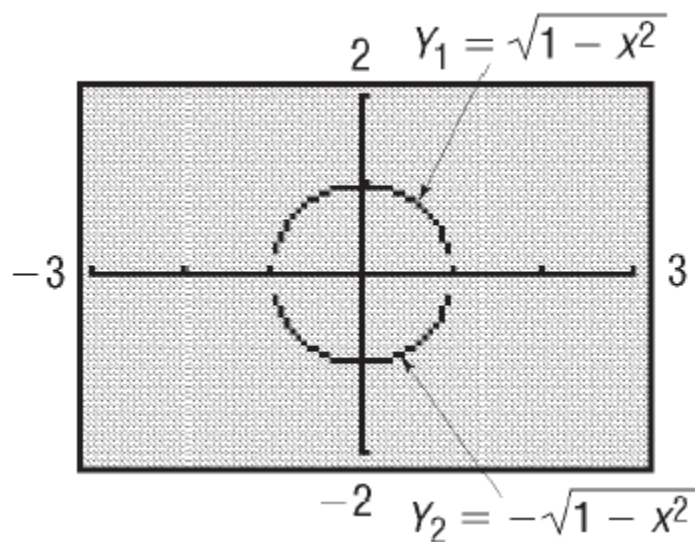
$$(x - h)^2 + (y - k)^2 = r^2$$

The standard form of an equation of a circle of radius  $r$  with center at the origin  $(0, 0)$  is

$$x^2 + y^2 = r^2$$

If the radius  $r = 1$ , the circle whose center is at the origin is called the **unit circle** and has the equation

$$x^2 + y^2 = 1$$



## EXAMPLE

### Writing the Standard Form of the Equation of a Circle

Write the standard form of the equation of the circle with radius 4 and center (2, -4).

**Solution**  $(x - h)^2 + (y - k)^2 = r^2$

$$(x - 2)^2 + (y + 4)^2 = 16$$

# OBJECTIVE 2

**2** Graph a Circle by Hand and by Using a Graphing Utility

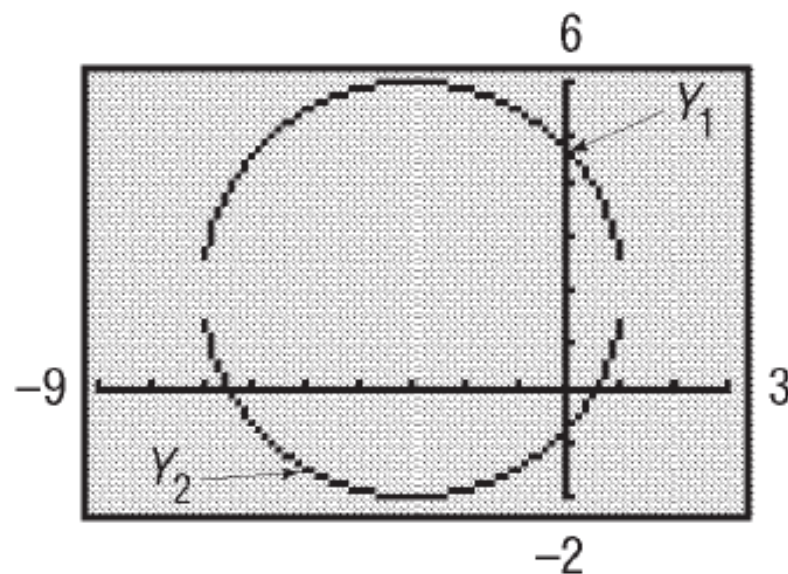
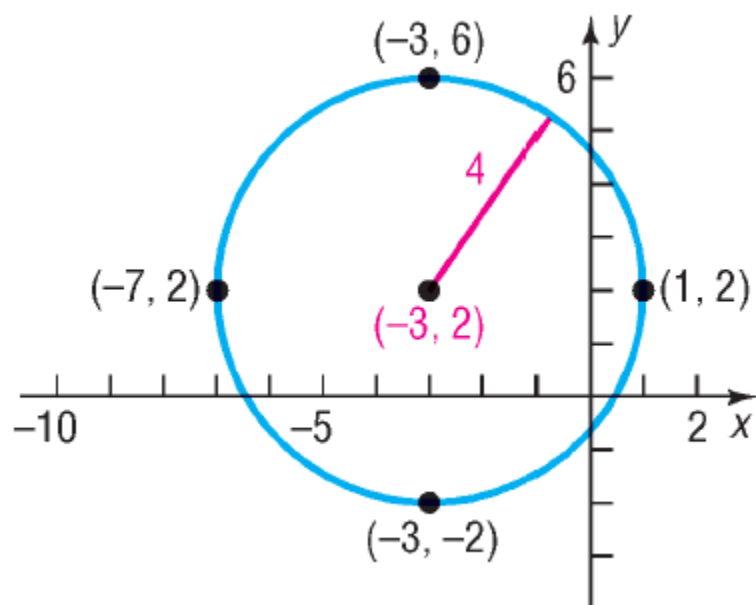
## EXAMPLE

### Graphing a Circle by Hand and by Using a Graphing Utility

Graph the equation:  $(x + 3)^2 + (y - 2)^2 = 16$

### Solution

$$y = 2 \pm \sqrt{16 - (x + 3)^2}$$





## EXAMPLE

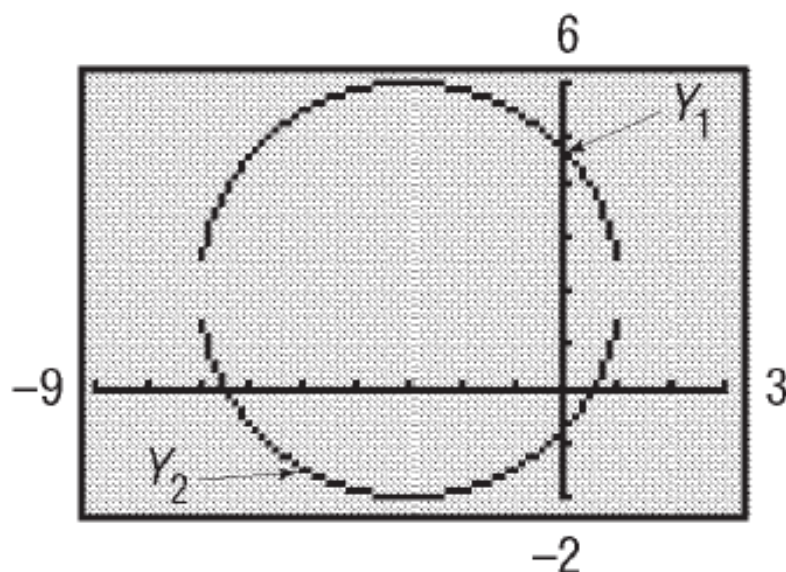
### Finding the Intercepts of a Circle

For the circle  $(x + 3)^2 + (y - 2)^2 = 16$ , find the intercepts, if any,

#### Solution

The  $x$ -intercepts are  $-3 - 2\sqrt{3} \approx -6.46$  and  $-3 + 2\sqrt{3} \approx 0.46$ .

The  $y$ -intercepts are  $2 - \sqrt{7} \approx -0.65$  and  $2 + \sqrt{7} \approx 4.65$ .



# OBJECTIVE 3

**3** Work with the **General Form of the Equation of a Circle**

## General Form of the Equation of a Circle

$$x^2 + y^2 + ax + by + c = 0$$

## EXAMPLE

### Graphing a Circle Whose Equation Is in General Form

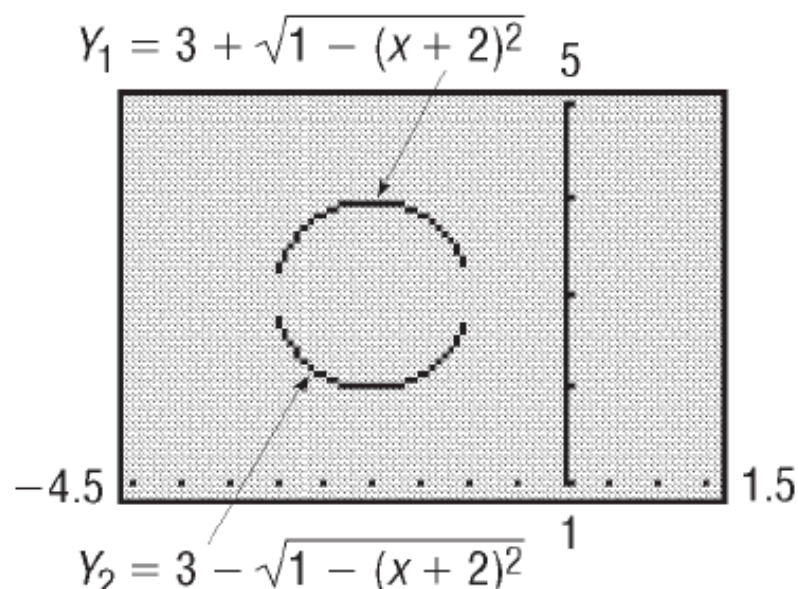
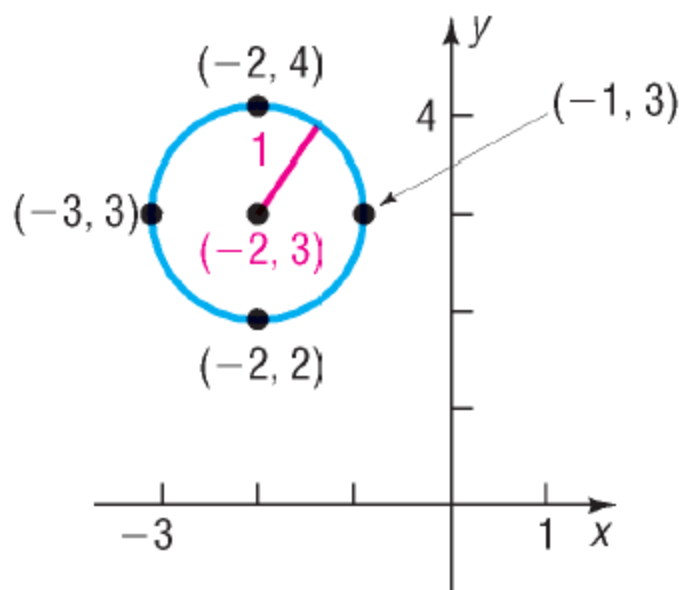
Graph the equation  $x^2 + y^2 + 4x - 6y + 12 = 0$

### Solution

We complete the square in both  $x$  and  $y$  to put the equation in standard form.

$$(x + 2)^2 + (y - 3)^2 = 1$$

$$y = 3 \pm \sqrt{1 - (x + 2)^2}$$



## EXAMPLE

### Finding the General Equation of a Circle

Find the general equation of the circle whose center is  $(-2, 3)$  and whose graph contains the point  $(1, 4)$ .

#### Solution

$$x^2 + y^2 + 4x - 6y + 3 = 0$$

